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Computers & ELECTRONICS

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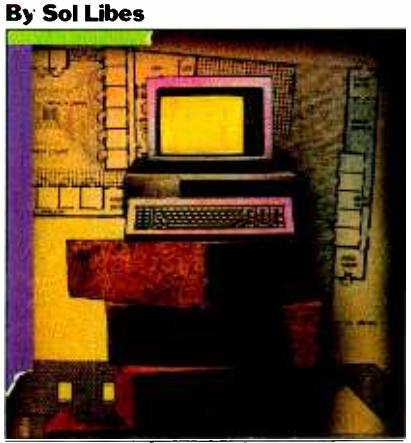
COMPUTER GRAPHICS BY INA SALTZ

Reviews

Columns



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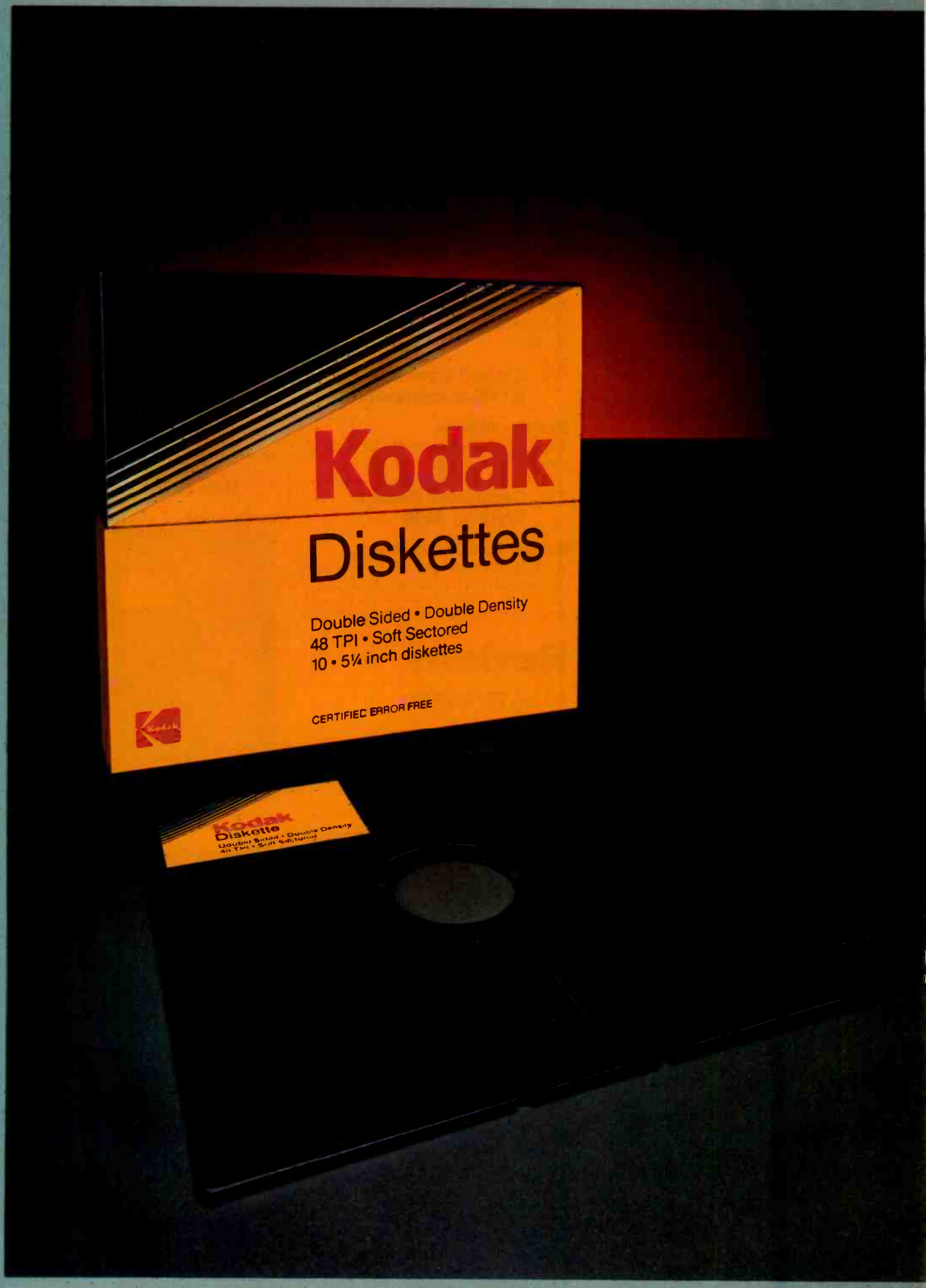
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SETH R. ALPERT

EDITORIAL

ADDICTION

PHOTO BY STEVE BORNS

Do you suffer from the little recognized ailment of computer addiction?

It usually starts in a completely innocuous way. Perhaps you were lured by a flirtation with word processing. Soon you found yourself typing most of your own memos and letters. And you no longer kept those documents in paper files.

The next step down the path toward real addiction began when you got involved with a second major application—electronic spreadsheets, for example. A common symptom at this stage is a feeling of well-being that pervades you when you turn on your machine in the morning. You feel like the master of your own projections, with the power to sort everything out.

Around this time your friends begin to worry about you. They notice that all your phone conversations are punctuated by the clatter of a keyboard in the background and you have become limited to responses like "uh-huh."

In its tertiary phase, the addiction can lead to a third major application, like a database manager. Often at this time a hard disk enters the picture. If you are at this point, you may as well admit it to yourself: You are a full-fledged computer junkie.

Other symptoms to watch for: an inability to talk to anyone until your system has been booted in the morning; decreased ability to communicate verbally; skipping lunch so you can stay glued to your screen; counting floppy disks instead of sheep to put yourself to sleep at night.

Fortunately, it is a socially acceptable addiction, one with many positive aspects. We are all aware of how it can help increase productivity and improve decision making.

But there is a dark side as well: the pain of withdrawal. And because computers are complex electrical and mechanical devices that break, you can find yourself involuntarily going cold turkey. I have experienced it myself. It leaves you feeling dazed, lost, and aimless. Suddenly you realize the extent to which your computer has become a part of the way you work, because you now find it really hard to work at all.

Of course, you should do what you can to avoid the shock of withdrawal. Techniques include making frequent backups, buying a service contract, and having access to a backup machine if yours fails. But inevitably, there will come a time when all such measures fail to protect you.

Therefore, as a public service to the computer junkies among our readers, I offer two simple suggestions for controlling computer addiction and being able to go on coping even if your system crashes. 1. Force yourself to work at your desk for 30 minutes each day with your system powered down. Take phone calls, dictate or hand write letters and memos, read. Whatever you do, *don't* turn on your computer. 2. Practice making decisions without access to a spreadsheet or database. It will be hard at first, but persist. One non-computer based decision per week should keep you in shape.

It won't be easy, but you will be glad you followed my suggestions if your system ever goes down. ◇

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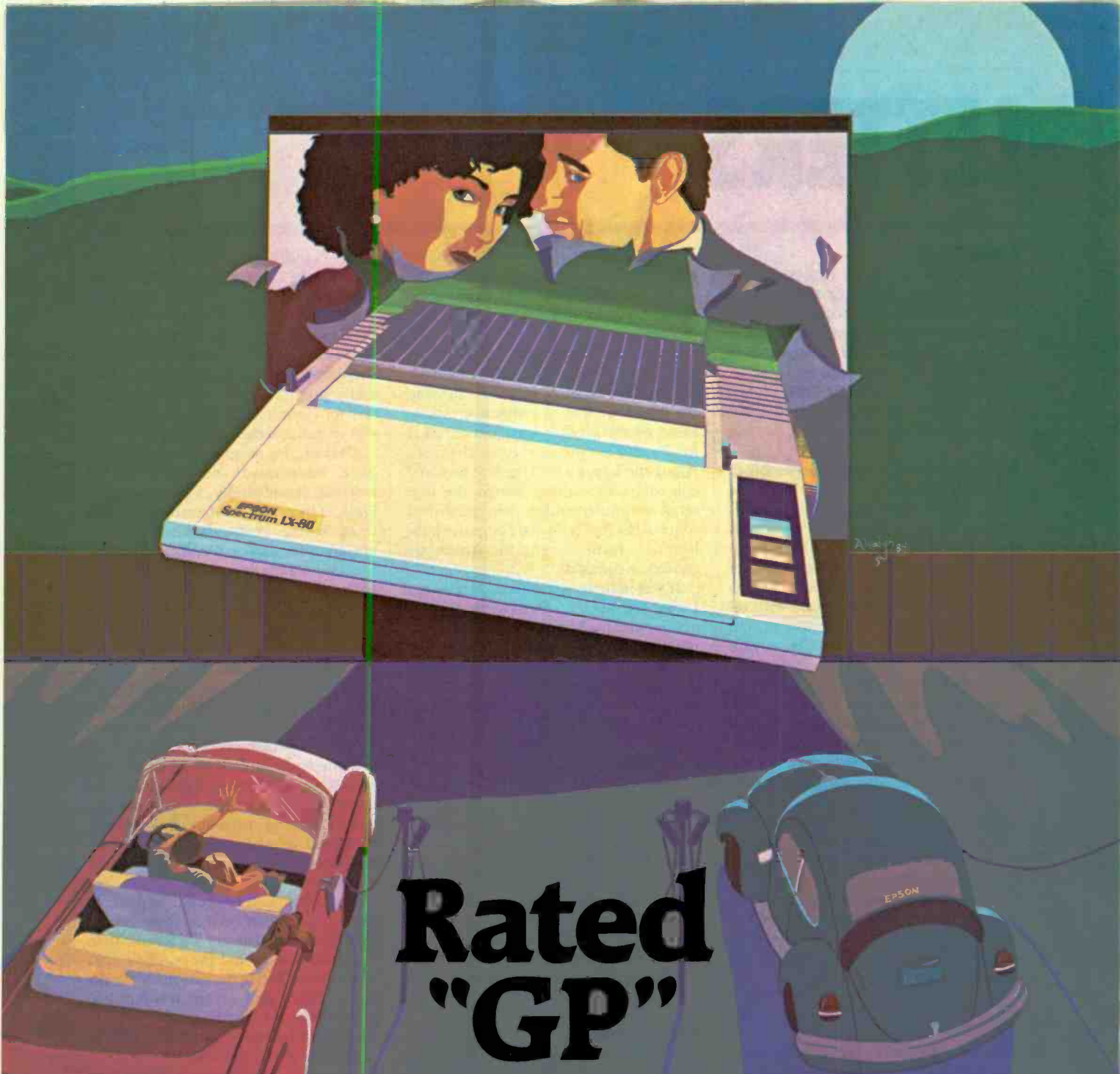

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LETTERS

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Squeezed Data, Lightly Scrambled

Michael McCarthy's article on "Data Compression Techniques" in your December issue contains an erroneous statement in describing what happens to the unsqueezer after some of the data bits have been damaged: "The decoder is now hopelessly desynchronized with respect to the original input. It will, in fact, expand the remainder of the bit stream to gibberish." The author apparently never tried to verify that claim.

Actually, the decoder remains desynchronized as it outputs the next 3 to 10 bytes. After that, chances are very good that it will hit the beginning of a valid code by accident. This is inherent in the very nature of Huffman coding, because 1- and 2-bit sequences predominate.

I have verified the self-healing attribute of the decoder by squeezing SQ.DOC, modifying some of the bits using a byte patching utility, and unsqueezing the results. After 29 of the 14,000 bytes of the squeezed file were modified, only 8 of the 545 lines of the document were scrambled.

—JOE SMITH
Golden, CO

Author McCarthy replies: "The reader's observations are interesting and correct. Evidently, just as programs and designs for programs can have bugs, so can articles about them!"

Toward a Straighter Record

I would like to set the record straight about Forrest M. Mims's article "Setting the Record Straight" in your January issue.

It is absolutely true that I had nothing to do with the product design of the Altair 8800—in fact, at the time, I thought it would never work. It is regretful that one sentence in *Fire in the Valley* would seem to indicate that my participation was at this level. It seems that history is not a perfect science.

For the past 10 years I have been on a virtual crusade to tell people that Ed Roberts is the Father of Personal Computing. Of all the people I have known or worked with in this industry, he is the greatest.

However, "developing" the Altair was much more complicated than designing the actual product. To develop the Altair we had to create a mystique about what it actually was, find a market for it, and create marketing channels. Along the way, we held the first personal computer convention, started the first retail computer stores, and published some of the first personal computer publications. In developing the Altair, we started an industry.

It was in these nontechnical areas that I was very much involved in the Altair's development. While Mr. Mims might not consider this important, I dare say it was much more significant than his authoring of the Altair 8800 operations manual—which, as I recall, was virtually unreadable.

—DAVID BUNNELL
PC World Communications, Inc.
San Francisco, CA

Forrest Mims replies: "I'm glad to know David Bunnell shares my opinion about Ed Roberts's historic role in personal computing. As for the Altair manual, it was about 8080 assembly language. Since David found it unreadable, I suppose that explains why Ed asked me to write it. Anyway, thanks for the opportunity to respond to David's letter. I think we're on the same wavelength."

A Great Sidekick

I read Michael Guttman's review of Sidekick in the January issue with great interest because I find it to be one of the best values available today. I wanted to point out, though, that he apparently missed one of the Calculator's strongest points: its ability to program the displayed value into *any* keyboard key. This "memory" value may then be used anywhere, including within the Calculator. The version I received (1.11) uses 60,816 (59.4K) bytes of memory for the full version, which is less than the author's reported 73K.

I agree with his assessment that there are some minor details that make Sidekick less than perfect. These, for me, include: (1) the Dialer does not use the PGUP, PGDN, HOME, and END keys; (2) the calendar does not display the current time; (3) the CTRL-ALT combination used by the Compaq for hidden screen and key-click functions run into each other; (4) the ENTER key in Notepad "Overwrite mode" is carriage return only (no line feed); (5) the cursor is always on when exiting Sidekick although many programs may use other characters for the cursor or change the cursor size to indicate the current mode.

Overall, the program is useful, complete, inexpensive, and highly recommended. (Incidentally, I purchased the Desk Organizer demonstration disk from Warner Software and was dismayed by its slowness, constant disk access and ability to regularly lock up the computer.)

—JOHN G. RUFF
Wayzata, MN

Mail-Order Interest

The "Guest Column" on buying by mail in the January issue was a good guide to the inconveniences and aggravations of the mail-order business. There is some indication that when interest rates were inordinately high, dealers delayed shipments in order to use their customers' money to make more profit. This practice could be reduced if monetary penalties were required on the seller when there are long delays.

Mail-order houses should be made to pay a high rate of interest from date of order to date of delivery if it is more than a reasonable time and the purchaser has not been notified of the reason for the delay. I suggest that anyone who has had problems in this regard should write to his Congressman suggesting that laws be enacted to charge the interest.

—HARRY G. FEINSTEIN
New Haven, CT

Getting the Byte Right

In "Micro Data Managers Get Mainframe Power" (October), the author states that, "If all records [in a file] are 100 bytes long, then a simple computation shows that the 215th record begins at byte 2151." Unfortunately, I'm afraid he is "off-by-one-bug" and has also slipped a decimal place. Consider where the first record starts: at byte number 1, not 100 + 1. In fact, the kth record will start at $(k - 1) \times 100 + 1$, so the 215th record will start at $(215 - 1) \times 100 + 1 = 21401$.

—RICHARD B. DAEHLER-WILKING
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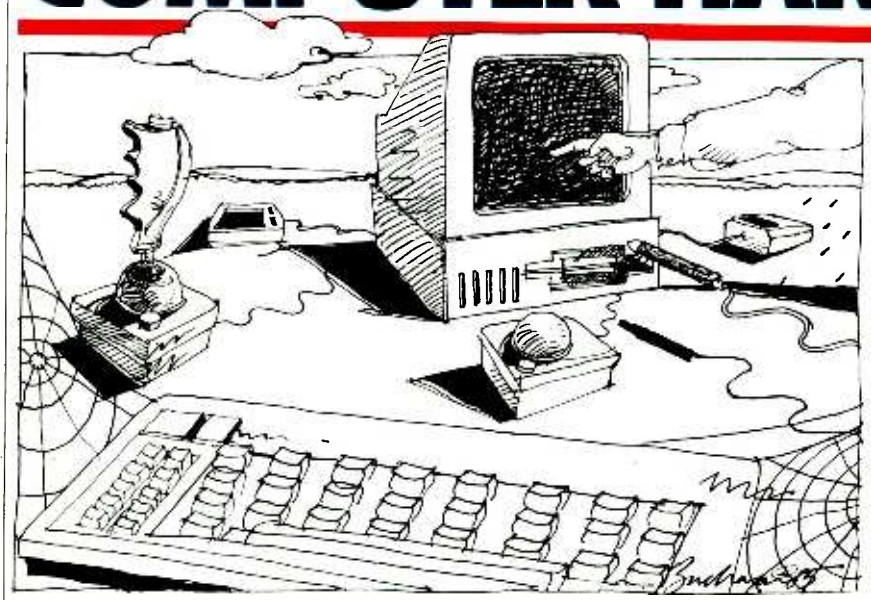


NONKEYBOARD INPUTS

As I observe the increasing numbers of touch screens, light pens and graphics tablets and witness the ubiquitous mouse, I wonder whether the keyboard in a computer system will soon be just another peripheral, relegated to entering alphanumeric data only, that plays almost no role in the *operation* of the computer.

Why this great interest in nonkeyboard input devices?

I believe it came about because the keyboard has become an item of fear for many computer neophytes. They "know" that if they depress the "wrong" key on the keyboard, the computer will either damage itself (for which they will be blamed), or it will cause extensive damage to expensive things connected to the computer (for which they will also be blamed). So they tend to shy away from keyboards.

Keep in mind that all the computer input devices mentioned above and their associated software require nothing more than that the user be able to read and write and have some idea of what he or she wants to do.

In an office, these input devices can reduce operational costs and improve reliability because even relatively untrained people can be rapidly taught to use almost any software in almost any computing system—with almost no errors.

With the introduction of readily available icon software (the reason for the popularity of the Apple Macintosh), it appears that we have finally arrived at the point where "one picture is worth 1000 (or is it 1024) words." In education, icons will allow a computer to be used as a training aid even before a child learns to read. Since icons can be designed to transcend language barriers, "computerese as a second language" will be made much easier.

Nonkeyboard computer entry is relatively common today. For example, realizing that most people have little computer know-how, planners have put touch-screen input computers in shopping and exhibition malls to make it simple to find a particular store or in larger stores to help customers locate an item.

All the user has to do is touch the screen at the box that describes what he or she wants. The computer senses the fingertip position, and the software does the rest.

As simple as this information retrieval appears, the computer and the associated software that reads the touch screen and supplies the request data can be quite complex.

What of the Future?

Special input devices are being developed to aid the handicapped, using eye or limb muscle voltages like joystick inputs for a computer.

There are also data collection services (like inventory control) that require no more than a bar code or optical character recognition reader. Or, what about using a light pen in conjunction with a detailed menu? Neither of these inputs requires any knowledge of programming or computerese.

Voice recognition has come a long way since the Speechlab. As "sound recognition," this technique is ideal for nonkeyboard computer entry for the nonverbal handicapped. A repeatable sound can be used to perform a programmed action. As "voice recognition," it allows data entry via the spoken word. Interestingly, if only one person vocally "trains" the computer, the system will respond only to that one person's voice. This quirk of "training" also ensures a form of protection against illegal verbal entry.

The military has devised a computer-operated, nonkeyboard, nonmanual, data-entry system called "heads up." Depending on what it perceives of the attitude of a subject's head and eyes, the machine responds with particular actions. Although a subject must still wear a special helmet with integrated sensors, future systems may overcome this need.

The way things are going, the next major breakthrough in semiconductor technology may well be something that can be called an "organic chip," a specialized circuit that may allow direct communication between the brain of the user and the computer itself!

Does this mean that signals from the head will be picked up and used as computer inputs, or, will surgery be used to implant a miniconnector in the skull for use as an I/O port? Don't get excited about the last part of that question, I was just thinking aloud. . . . ◇

Personal Note. This is the last of a series of columns and articles that I began 22 years ago in the pages of this magazine's predecessor—*Popular Electronics.* By the time you read this, I will be retired.

For those readers who went through all or part of this period with me, the memories of the exciting electronics we shared will always have a warm spot in the heart.

I want to thank all the authors, PR people, voices on the phone, and people I met at the various shows that came into my life and made it worthwhile. I will miss you.

Shalom.

ILLUSTRATION BY YVONNE BUCHANAN

READ ONLY

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

GRAPHICALLY SPEAKING

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

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

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

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

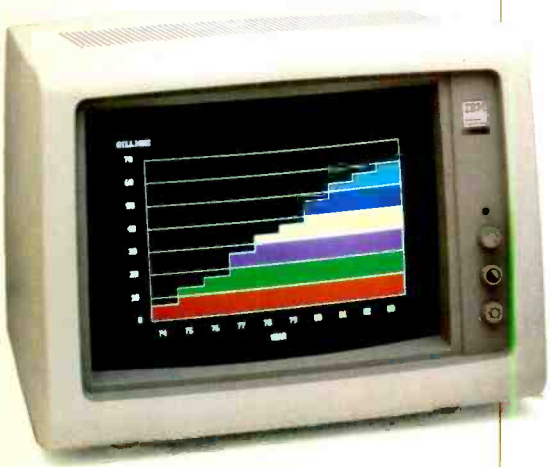
This is possible because the Toolkit contains a constant interface—the Virtual Device Interface—to which all applications can be written. The result is device-independent software.

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

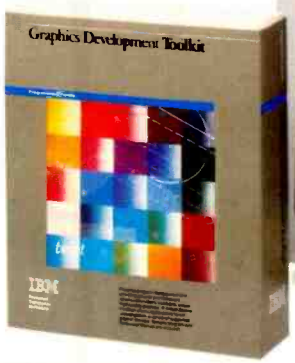
The right tools. Several products from the IBM PC Engineering/Scientific Series also play an important part in the IBM PC graphics programming strategy. All of them incorporate the Virtual Device Interface discussed above.

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

In addition, the IBM Personal Computer Plotting System provides a



IBM Personal Computer Enhanced Color Display



IBM Personal Computer Graphics Development Toolkit

IBM Personal Computer Professional Graphics Display

subroutine library of functions that help make it easy to produce a wide variety of charts and graphs. There's also a Metafile Interpreter available to facilitate retrieving and manipulating graphics images.

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

HARDWARE NEWS

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

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

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

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

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

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

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

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

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

*Developed by Dr. John Henry Martin.

WHAT'S THE PROGRAM?

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

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

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

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

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

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

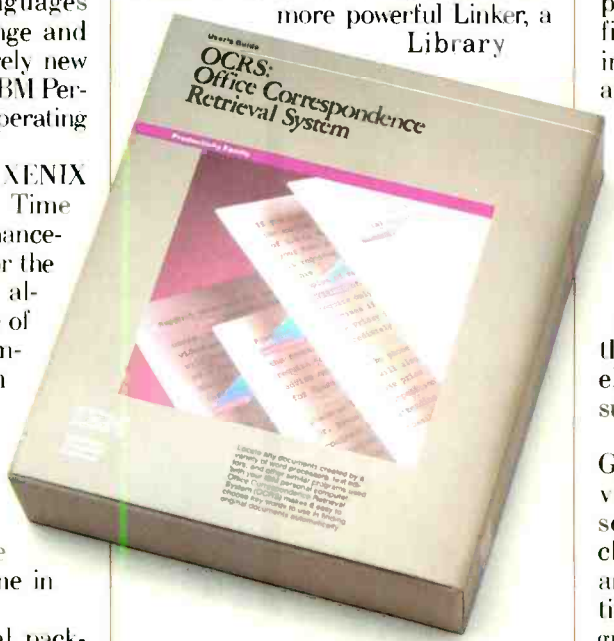
IBM Personal Computer XENIX is derived from the UNIX® Time Sharing System. Several enhancements designed specifically for the IBM Personal Computer AT allow you to take full advantage of its power. IBM Personal Computer XENIX supports both single-user and multi-user configurations. It also enables you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

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

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

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

The recent 2.0 version of the IBM Macro Assembler supports both the 8088 and 80286 processors and the 8087 and 80287 Math Co-processors. Other additions include a new more powerful Linker, a Library Manager, and a Structured Assembler Language Preprocessor. And you can use the IBM Professional Debug Facility to put the finishing touches on your assembler language programs.



Office Correspondence Retrieval System Software from IBM

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

BUDDING USER GROUPS

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

Help is at hand.

Because of the growing interest in PC user groups all across the country, IBM has expanded its efforts to encourage new groups and to support existing ones. There's no charge for this assistance, and all groups—whether they have 10 or 1,000 members—are eligible for the same basic level of support.

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

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

Perhaps the most impressive

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

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

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

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

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

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

HARDCOPY

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

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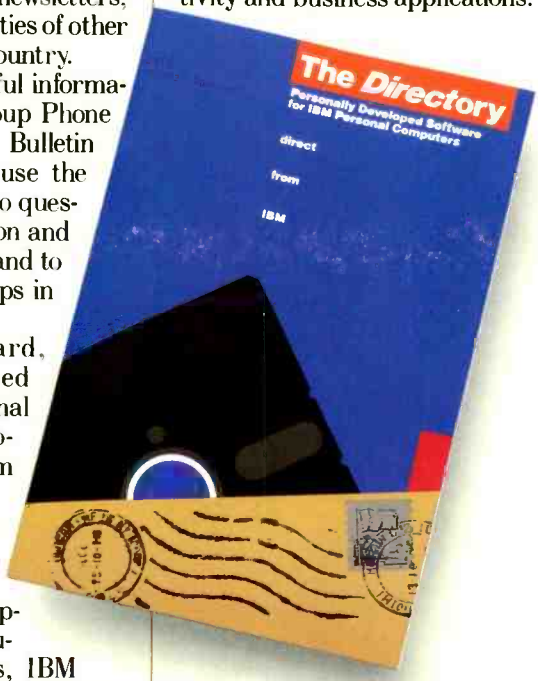

The Directory of Personally Developed Software from IBM

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

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

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TIPS AND TECHNIQUES

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

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

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

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

```
A>debug color.com
File not found (ignore this message)
-rcx
:20
-e 100 2b c0 1e 50 b8 03 00 cd 10 b8
00 06 b9 00 00 ba
-e 110 50 20 b7 ?? cd 10 b4 02 ba 00
00 b7 00 cd 10 cb
-w
writing 20 bytes
-q
```

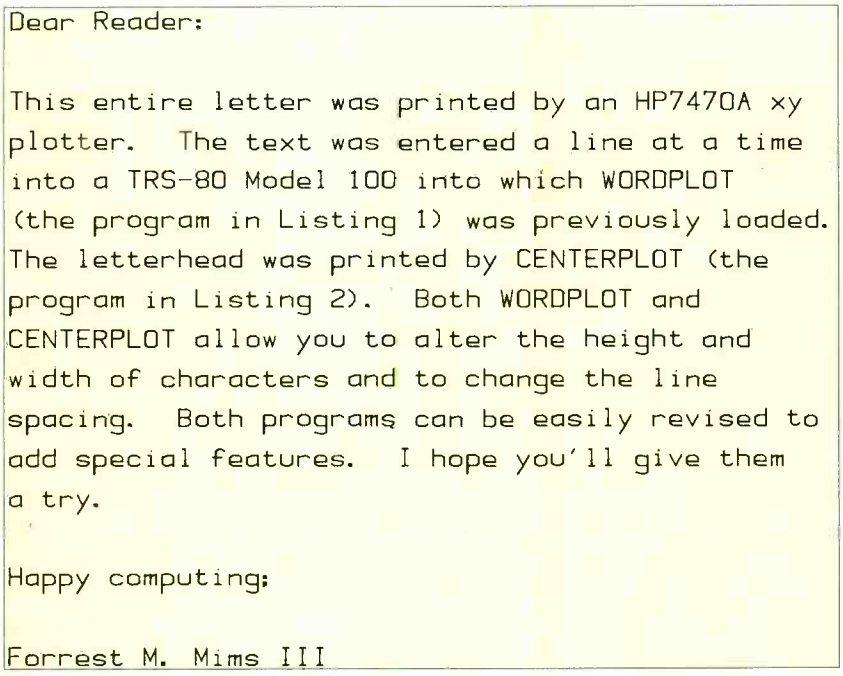
Thereafter, you need only type "color" at the initial DOS prompt after booting your system to change the display from black and white to your preset colors.

For more information about IBM Personal Computer products discussed in this issue of *Read Only*, see your authorized IBM Personal Computer dealer or IBM Product Center. To learn where, call 800-447-4700. In Alaska and Hawaii, 800-447-0890.

FORREST M. MIMS III

THE COMPUTER SCIENTIST

CREATIVE TEXT FORMATTING WITH AN XY-PLOTTER



Dear Reader:

This entire letter was printed by an HP7470A xy plotter. The text was entered a line at a time into a TRS-80 Model 100 into which WORDPLOT (the program in Listing 1) was previously loaded. The letterhead was printed by CENTERPLOT (the program in Listing 2). Both WORDPLOT and CENTERPLOT allow you to alter the height and width of characters and to change the line spacing. Both programs can be easily revised to add special features. I hope you'll give them a try.

Happy computing:

Forrest M. Mims III

Figure 1. A typical plotter-printed letter.

REGULAR readers of this column may recall that I consider the *xy* plotter to be among the most versatile of personal computer peripherals. Indeed, I believe that computer users whose word processing requirements are limited to an occasional letter should give strong consideration to purchasing a plotter before buying a printer.

The *xy* plotter can easily handle simple chores like printing brief notes, letters, labels and signs. It can also be used to make attractive letterheads, form letters and even greeting cards. Of course, the primary nonprinting application for the *xy* plotter is the drawing of publication-quality graphics.

Those who insist that only a standard printer—dot matrix, formed character or otherwise—can be used for printing should have a look at some examples of *xy* plotter printing. When I send plotter-printed notes and letters to relatives, friends and editors, I *always* get results. In fact the recipients often call to comment about the appearance of the letter and to ask how it was printed. In other words, plotter-printed notes and letters are good attention-getters.

In this column I'll describe some of the text formatting programs I use for generating plotter-printed notes, letters, posters and handouts. In a subsequent column, I'll explain how you can create a wide range of special graphic symbols and even your own custom character set using a plotter. First, let's review some of the factors you will want to consider when selecting a computer–plotter combination for text preparation.

Selecting a Computer–Plotter Combination

Since *xy* plotters with serial and parallel interfaces are now available, almost any computer can be used to drive a plotter. For example, I've had excellent results using both a Color Computer and a PC*jr* as plotter drivers.

However, my favorite plotter driver is a TRS-80 Model 100. The compact size of this little machine, which doubles as the word processor into which every installment of this column is typed, makes the Model 100 an ideal plotter driver.

A conventional desktop computer occupies a good deal of valuable space, and adding a plotter worsens the situation. The Model 100 occupies about the same amount of desk real estate as a sheet of typing paper, and it can be placed very close to the plotter. Moreover, the interface connectors on the back of the Model 100 can be easily reached without crawling under the desk or moving bulky computer consoles and monitors.

As for *xy* plotters, more than a dozen companies now make them. I happen to own a Hewlett-Packard HP7470A, a two-pen plotter with an RS-232 interface. Having used this machine extensively, I can give it nothing but praise.

LISTING 1. WORDPLOT, A SIMPLE TEXT FORMATTER FOR AN *XY* PLOTTER.

```
10 CLS
20 PRINT "--------WORDPLOT-------"
30 PRINT " "
40 'COPYRIGHT 1985 BY FORREST M.
   MIMS III
50 'MODEL 100-HP7470 PLOTTER
   PROTOCOL FOLLOWS
60 COM ON: OPEN "COM:48N2E" FOR
   OUTPUT AS 1
70 PRINT #1, "SC0,25,0,20;"
80 INPUT "CHARACTER HEIGHT (IN
   CM)";H
90 INPUT "CHARACTER WIDTH (IN
   CM)";W
100 INPUT "LINE SPACING (IN CM)"; LS
110 CLS
120 CH=W+(W/3):NU=17/CH
130 PRINT "MAXIMUM CHARACTERS
   PER LINE: ";INT(NU)
140 Q=LS+H
150 Q=Q+LS
160 INPUT "TYPE LINE AND PRESS
   ENTER:";X$
170 If X$="QUIT" THEN 220
180 L=LEN(X$):If L > INT(NU) THEN 240
190 PRINT #1,
   "SI";W,H;"DI0,1;SP1;PA"Q,"2;"
200 PRINT #1, "LB"X$;CHR$(3)
210 BEEP:X$="":GOTO 150
220 CLS:PRINT "QUIT. PRESS R TO
   RESTART PROGRAM."
230 IF INKEY$="R" THEN 80 ELSE 230
240 PRINT "THE LINE IS";L-INT(NU):
   "CHARACTERS TOO LONG."
250 PRINT "PLEASE ENTER THE LINE
   AGAIN."
260 GOTO 160
```

Figures 2 and 3. Centerplot is ideal for making posters and signs. (The borders were drawn by using the plotter's front panel controls.)

There is nothing more powerful than an idea whose time has come.

Victor Hugo

It's sturdy, reliable, fast and accurate. Furthermore, it's equipped with HPGL, Hewlett-Packard's powerful and popular graphics language. My only major complaint about this machine is that its high speed makes it noisier than some other plotters.

In short, I prefer the Model 100–HP7470A combination. The two machines can be connected to one another by a ribbon cable equipped with standard RS-232 connectors. A null modem adapter is required. For initial tests the eight status switches on the back panel of the plotter should have these settings:

B1=0	US=1
B2=0	Y=0
B3=1	S1=0
B4=1	S2=0

The programs that follow are written for the Model 100–HP7470A pair. As is the case with most plotter software, the following programs can be modified for other computers, particularly those that use Microsoft BASIC. In most cases, the most important revision will be the computer–plotter communications protocol that must be included in each program. Determining the proper protocol parameters can sometimes be very frustrating, so be prepared to spend some time with the manuals for your plotter and computer. I've found that writing plotter programs is much easier and a lot more fun than figuring out communications protocols.

The programs that follow can also be modified for other plotters, especially those that use HPGL. However, it may be necessary to compare the coordinate system and instruction set of your machine with the HP7470A.

Incidentally, for more information on this subject, see the March 1984 installment of "The Computer Scientist" in this magazine ("Learning to Use an x-y Plotter," page 36). Also see "Inexpensive Plotters," a feature I wrote for the same issue (page 50).

Wordplot

A simple program suitable for preparing brief plotter-printed notes and letters is given in Listing 1. Figure 1 is a typical note formatted and printed with the help of Wordplot.

If you're not familiar with how an *xy* plotter is programmed, several lines in Listing 1 will seem rather cryptic. Those lines contain HPGL plotter instructions. Once you understand them, you'll soon see that the program is very straightforward. Here's how the key parts of the program work:

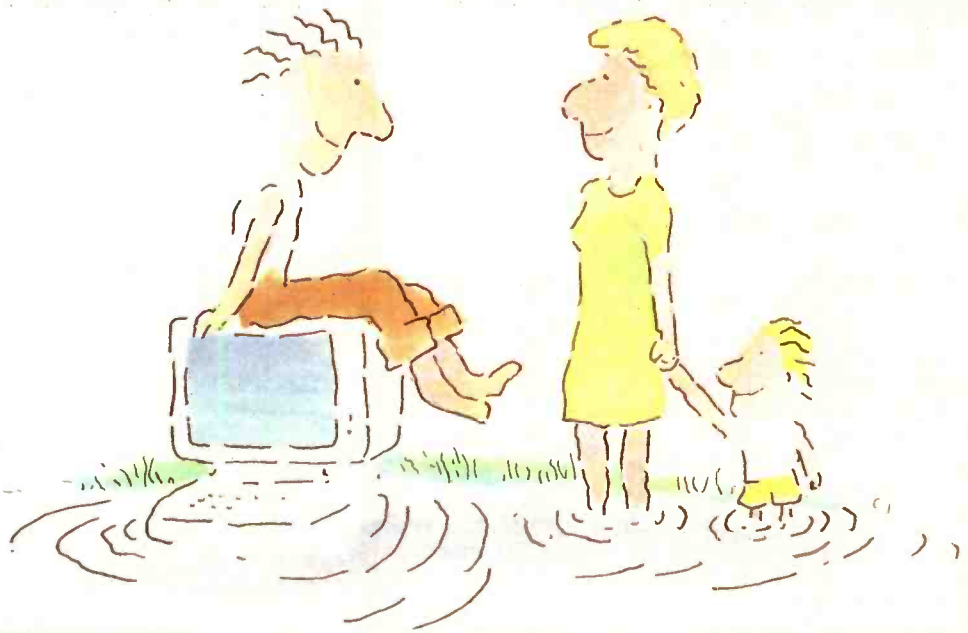
Line 60 establishes the Model 100–HP7470A serial communications protocol and designates the plotter as file #1. All subsequent commands to the plotter are preceded by a PRINT #1 statement.

Line 70, the first HPGL command, establishes the plotting scale (SC). The first coordinate pair (0,25) is the *x*-axis or the long side of the paper, and the second coordinate pair (0,20) is the *y*-axis or the narrow side of the paper.

Lines 80–100 allow the user to establish in centimeters virtually any combination of character dimensions and line spacing. Lines 120–130 calculate the maximum number of characters that can be printed across the page (assuming 17 centimeters of printing space). Lines 140–150 add the character height (H) to the line spacing (LS) to determine where the plotter should move its pen before printing the next line.

Line 160 asks the user to enter a line of text. Line 170 allows the user to stop the program simply by entering QUIT. Line

GET YOUR FEET WET...



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-Brad Baldwin, *InfoWorld* Magazine

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180 counts the number of characters in the line of text and compares it to the maximum allowable number of characters. If the line of text is too long, program control is transferred to lines 240–260. The user is then informed how many characters must be cut and asked to re-enter the line. Program control is then transferred back to line 160.

Line 190 sends a string of HPGL instructions to the plotter. These include character dimensions (SI), direction of printing (DI), pen selection (SP) and pen location (PA). Line 200 sends the line of text to the plotter following an HPGL label (LB) command.

Note that with but one exception each HPGL command sequence is terminated by a semicolon. The exception is line 200, where the label command is terminated by CHR$(3). If this terminator isn't used, the plotter will stay locked in the label mode and begin printing program lines.

Line 210 beeps after the text has been sent to the plotter. This means a second line can be entered while the plotter is still printing the preceding line. Line 210 also clears the text string register and returns program control to line 150 to begin another text entry sequence.

Though this program may seem rather primitive to experienced word processor users, it does the job for which it's intended. I've used it to prepare many of the short notes and letters mentioned earlier. Of course it's possible to develop a more conventional word processing program for a plotter. One approach, which I developed for a conventional printer, could be modified for use with a plotter. This program stores all the text in a file that is then formatted and loaded in ready-to-print format into a second file. The text is then transmitted a line at a time from the second file to the printer.

LISTING 2. CENTERPLOT, A SPECIAL PURPOSE TEXT FORMATTER FOR AN *XY* PLOTTER.

```
10 CLS
20 PRINT "------CENTERPLOT-----"
30 PRINT ""
40 'COPYRIGHT 1985 BY FORREST M.
   MIMS III
50 KEY 1, "Y"+CHR$(13):KEY 2,
   "N"+CHR$(13)
60 'MODEL 100-HP7470 PLOTTER
   PROTOCOL FOLLOWS
70 COM ON: OPEN "COM:48N2E" FOR
   OUTPUT AS 1
80 PRINT #1, "SC0,130,0,100;PA0,53;"
90 PRINT "THIS PROGRAM CENTERS
   TEXT."
100 PRINT "KEY F1 IS Y (YES). KEY F2 IS
   N (NO)."
110 INPUT "LINEFEED (Y OR N)";L$
120 IF L$="Y" THEN 130 ELSE 140
130 PRINT # 1, "CP;":GOTO 110
140 INPUT "SELECT PEN [Y (1) OR N
   (2)]";N$
150 INPUT "DO YOU WANT SLANTED
   CHARACTERS (Y OR N)";S$
160 IF S$="Y" THEN 170 ELSE 180
170 PRINT #1, "SL.5;":GOTO 190
180 PRINT #1, "SL;"
190 INPUT "CHARACTER HEIGHT (IN
   CM)";H
200 INPUT "CHARACTER WIDTH (IN
   CM)";W
210 INPUT "TYPE LINE AND PRESS
   ENTER";A$
220 IF N$="Y" THEN 230 ELSE 250
230 N=1
240 GOTO 260
250 N=2
260 PRINT #1, "SP";N;"SI";W,H;"DI0,1;"
270 PRINT #1, "CP";-LEN(A$)/2;
   "0;LB";A$;CHR$(3)
280 BEEP
290 PRINT #1, "CP;SP;"
300 CLS
310 PRINT A$
320 GOTO 110
```

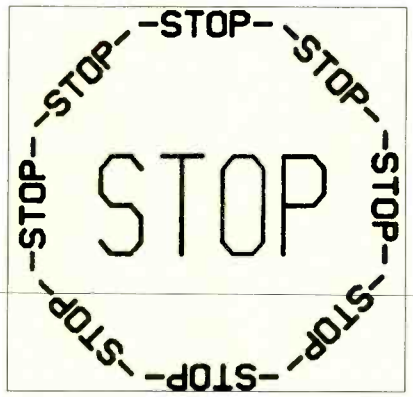

Figure 4. Printing direction can be varied.

Centerplot

The program in Listing 2 centers lines of text on a page. The characters can have any height and width and be slanted or normal. Each line of text can be separated from the preceding line by any specified distance.

Centerplot is a more specialized program than Wordplot, but I use it more often. That's because it's ideally suited for creating custom letterheads, notices and posters. Figures 2 and 3, for example, show several examples of text formatted by Centerplot.

Although Listing 2 is similar to Listing 1 in some ways, there are several important differences between the two. One important difference is that Centerplot asks for new character dimensions and a new line spacing after each line of text has been entered. This permits the plotter to produce a highly customized printout. Here's how the main parts of the program work:

Line 50 assigns the labels "yes" and "no" to the two leftmost function keys of the Model 100, which greatly speeds up user interaction with the computer–plotter combination.

LISTING 3. A DEMONSTRATION OF PRINTING IN DIFFERENT DIRECTIONS.

```
10 CLS
20 PRINT "----------STOP----------"
30 'COPYRIGHT 1985 BY FORREST M.
   MIMS III
40 'MODEL 100-HP7470 PLOTTER
   PROTOCOL FOLLOWS
50 COM ON: OPEN "COM:48N2E" FOR
   OUTPUT AS 1
60 PRINT #1, "SC0,102,0,75,SP1;"
70 PRINT #1, "DI0,1;LB-STOP-"
   CHR$(3)
80 PRINT #1, "DI1,1;LB-STOP-"
   CHR$(3)
90 PRINT #1, "DI1,0;LB-STOP-"
   CHR$(3)
100 PRINT #1, "DI1,-1;LB-STOP-"
   CHR$(3)
110 PRINT #1, "DI0,-1;LB-STOP-"
   CHR$(3)
120 PRINT #1, "DI-1,-1;LB-STOP-"
   CHR$(3)
130 PRINT #1, "DI-1,0;LB-STOP-"
   CHR$(3)
140 PRINT #1, "DI-1,1;LB-STOP-"
   CHR$(3)
150 PRINT #1, "PR11,-2;
   DI0,1;SI.5,1.2;LBSTOP"CHR$(3)
160 PRINT #1, "SP0;"
170 END
```

Line 80 scales the plotter in a way different from the previous program. It also instructs the pen to move (PA or Plot Absolute) to the center of the paper.

Lines 110–200 allow the user to select a linefeed (CP), pen (SP), slanted characters (SL) and character dimensions (SI). Line 210 then asks the user to enter a line of text. The user-selected information is then sent to the plotter by lines 260 and 270. Line 260 sends the selected pen, character dimensions and character slant. Line 270 determines the length of the line of text and divides it by 2. It then moves the plotter pen from its normal position at the center of the page leftward from the center by half the number of character spaces in the line of text. Finally, line 270 prints the line of text perfectly centered on the page.

If line 270 seems complicated, look at it again: PRINT #1, "CP";-LEN(A$)/2; "0;LB";A$;CHR$(3). CP means Character Plot, the HPGL instruction that moves the pen the number of character space widths and heights given in the following pair of numbers. In this case, the first number is -LEN(A$)/2. LEN counts the number of characters, including spaces, in the line of text (A$). Therefore, -LEN(A$)/2 tells the plotter to move the pen toward the left margin (-) half the

(Continued on page 89)

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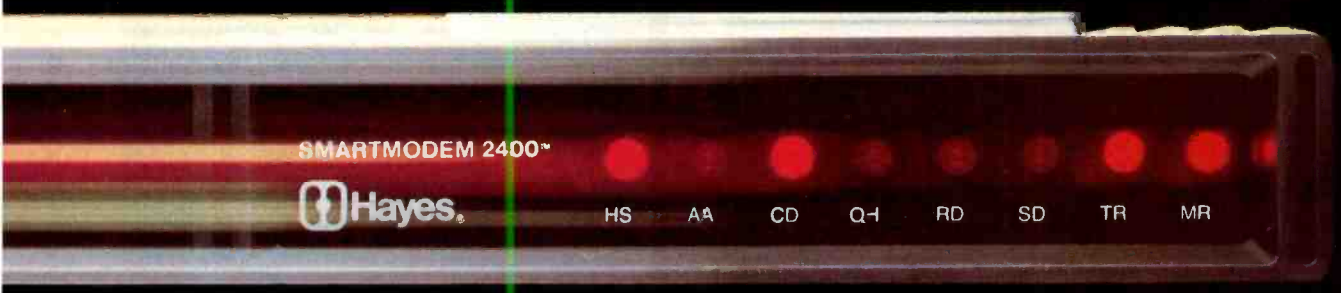

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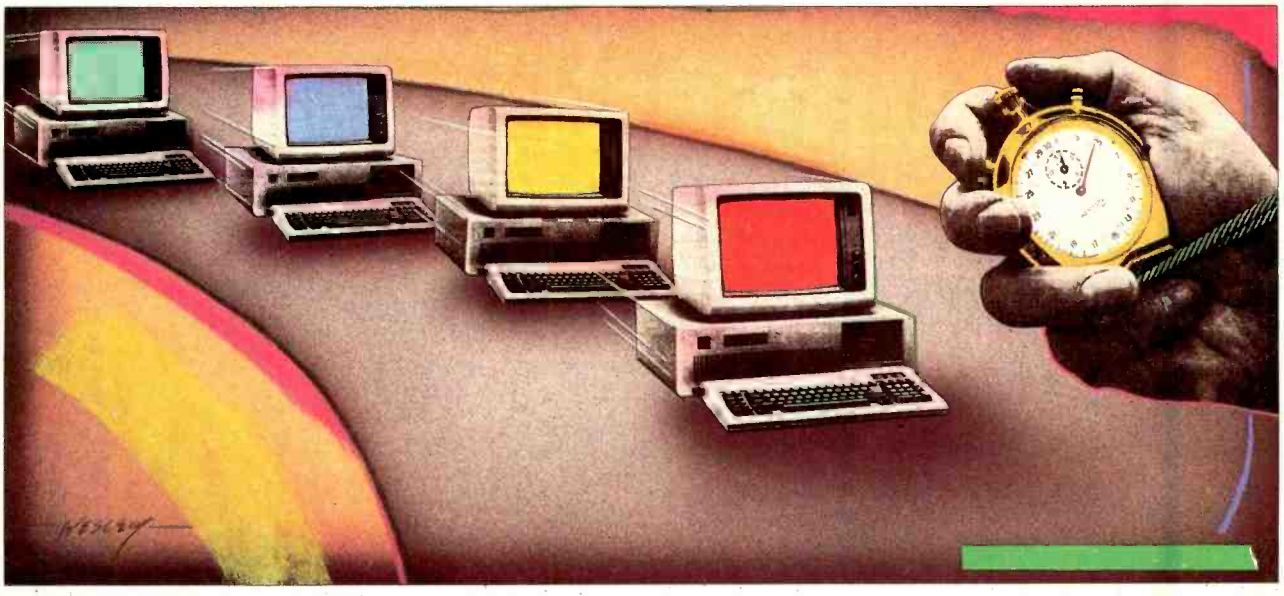


ILLUSTRATIONS BY CARL WESLEY

IBM Doings

▶ It is estimated that personal computers accounted for 14% of IBM's $45 billion business last year (in other words, about $5.4 billion). Five years ago, I never would have believed any one company could do that much business in personal computing!

Last year, IBM is believed to have sold about 40,000 of its new AT systems for about $260 million. This year, it is expected to ship about 250,000 ATs worth $1.5 billion.

It is also believed ready to announce a high-speed version of the AT, with a kit offered to allow current AT owners to upgrade. Since the components that have to be changed are all plug-ins, the change is expected to be easy and inexpensive. Actually some users have already found that merely changing the system clock crystal (a plug-in part) causes the AT to run faster.

Sales of PC, XT, and PC*jr* last year are believed to have totalled about 1.8 million—about three times 1983 levels. These sales are expected to increase substantially this year as IBM introduces new versions of the computers.

Recent tests of the AT have shown that its computing power is two to three times faster than the XT. However, since it uses essentially the same display and I/O interfacing hardware, overall speed is only about 25% to 50% faster. Further, a significant number of the initial users of ATs have reported reliability problems. Nevertheless, sales of the AT are reported to be very strong, and the computers are in short supply.

IBM will shortly release a multi-user version of the Xenix operating system for the AT. Xenix, which sells for about $1100, including software development and text formatter software, is an implementation of Unix. Thus it appears that Xenix is intended for the software developer who wants to write software in C language for Xenix and PC-DOS. It is also interesting that IBM has so far sold less than 4000 copies of PC/IX, a single-user Unix implementation for the XT. IBM's Xenix system is limited to three users. However, I suspect that third-party suppliers will offer enhancements to expand an AT/Xenix system to 16 users.

IBM brought out the AT in Europe only one month after its U.S. introduction. This interval contrasts with the company's wait of a year and a half with the PC. It is believed that the latter delay cost IBM a significant share of the European market. There is no doubt that it allowed European competitors to establish themselves, leaving IBM much less market penetration there than in the U.S. Thus IBM's fast introduction of the AT, at this time, shows that they learned their lesson.

Next month IBM may finally release its long-awaited lapsize portable. See previous issues of this column for its specifications. Also, IBM is expected this summer to introduce its optical disk peripheral, previously mentioned here. Expect the unit to have a write-once capability and to be able to store several gigabytes.

Random Bits

▶ On January 2, Coleco announced that it would withdraw from the home computer market and write off a loss of as much as $110 million. Coleco had promised to ship 500,000 units in 1983 but actually the figure came to only 95,000. It looks like the 1984 figure will be less than 200,000. The Adam, which the company was very late in getting out, was plagued by reliability and production problems early in life.

Sony has disclosed that it is investigating the use of organic materials, such as DNA, for a form of molecular electronics technology. The research involves the use of porphyrin, the active nucleus of chlorophylls and hemoglobin in creating "three-dimensional biochips."

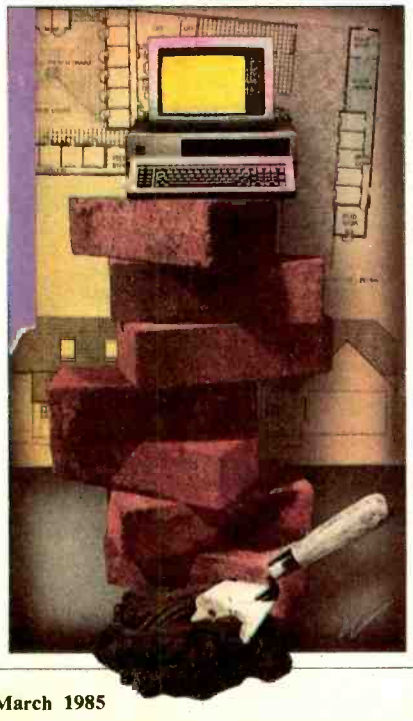
There are reports that copies of many over-$500 software packages from the U.S. are selling in Singapore, Taiwan and Hong Kong for as low as $7.50. . . . Quest International Computer Technology, Camberly, Surrey, England, has put CP/M-68K in a ROM that can be plugged into the new Sinclair QL machine. Quest also has a 10M-byte hard disk for the unit. . . . Siemens Communications Systems, West Lake Village, CA, has introduced a 5¼" hard disk drive storing 306M bytes.

Computer Companies Taking a RISC

▶ IBM, Hewlett-Packard, and Digital Equipment Corp. are all known to be developing RISC (Reduced Instruction Set Computers) machines. The RISC architecture systems promise computers that will operate several times faster than current architecture computers. For example, it takes much less time to execute five simple instructions than three complex instructions. Stanford University has developed a RISC microprocessor that runs some standard benchmarks more than four times faster than the Motorola 68000 16-bit microprocessor. And RISC offers other advantages.

A RISC computer reduces the internal instruction set to a few simple commands, taking less time and circuitry to decode an instruction. Also, a large number of internal registers and instruction pipelining are used to limit time-consuming memory transfers. The simpler architectures also promise reduced hardware cost and greater system flexibility.

Ridge Computers and Pyramid Technology already have RISC-based minicomputers in production. IBM may introduce a RISC version of its Series-1 minicomputer shortly. RISC machines are expected to have their greatest effect in scientific, engineering, and multi-user applications where speed is very important. IC manufacturers (Intel, Motorola, National, TI and Zilog, for example) as yet have not indicated an interest in developing RISC-based microprocessors. However, they may change as they attempt to improve their ICs.



Rumors & Gossip

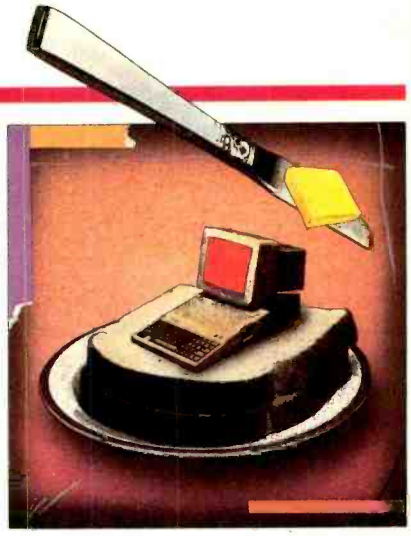
▶ Tandy is expected to drop the price of the Model 1000 to $995 as competition in the IBM PC-compatible marketplace increases. IBM will probably drop the price of the PC*jr* to increase competition pressure in the consumer and educational fields. . . . There are rumors that AT&T is negotiating with Digital Research, producer of CP/M, on a possible acquisition, either total or part. . . . Zenith is believed to be readying a new portable PC compatible with WordStar in ROM while Hewlett-Packard, which has Lotus 1-2-3 in ROM in its slow-selling portable Model 110, is expected to slash the price soon. . . . 4-Systems, Feltham, England, is promising to release Unix to run on the new Sinclair $500 QL computer when equipped with a hard disk. . . . The last few months have seen the cost of add-on hard disk systems drop from $2000 to under $700. That includes the drive, controller card, cables, and software for machines like the IBM PC. The reason is that Hong Kong and Korean drive makers have moved into the market, which was previously dominated by the U.S. and Japan. It appears likely that prices may drop under $600 this year as more Far East suppliers enter the market.

The Market for Unix

▶ Yates Ventures, a respected market research firm, reports that sales of Unix-based systems rose appreciably last year. A total of 197,000 systems were shipped. The leader, with 15% of the market, was Tandy (Radio Shack). Second was Digital Equipment Corp., with 10%, and third was Altos, with 7%. AT&T, which had 2%, and IBM, with less than 1%, are expected to lead this year, with an estimated half-million systems.

Apple Juice

▶ Apple appears firmly committed to the Apple II, which is actually its "bread and butter" system. The company will probably spend over $40 million this year on a print, radio, and TV promotional effort with the slogan "Apple II Forever," stressing that there are over 15,000 program titles for the Apple II. However, it should be remembered that most of those are games and educational programs. Few take advantage of the expanded memory and graphics of the 128K-byte IIe and IIc, and many programs written for the II+/IIe will not run on the IIc.



In the meantime, Apple is rumored to have pushed back the introduction of its flat screen display for the IIc. It had demonstrated a prototype unit to the press last summer and promised introduction in January—look for it midyear now. There are also rumors that Apple may let selected mass merchandisers carry the IIc, which is already being carried by many department stores.

Apple is expected to release shortly a 10M-byte hard disk for the IIe to run under the ProDOS operating system. The company already has a 5M-byte system available. The new drive will probably be available in both stand-alone and intelligent file-server versions and the same unit used in the Lisa. When used in an Apple Bus configuration it should be able to allow interconnection of Apple II, Mac and Lisa machines with nodes that cost less than $100. However, connecting non-Apple systems into the network may be much more expensive.

Apple may also be getting set to unveil Unix for the Lisa. Actually, a Berkeley 4.2 version of Unix for Lisa has been available for almost two years from UniPress, Highland Park, NJ. And, despite a slowdown in Mac sales, Apple is promising to double Mac production by the end of the year to more than 100,000 per month—more than a million a year. ◇

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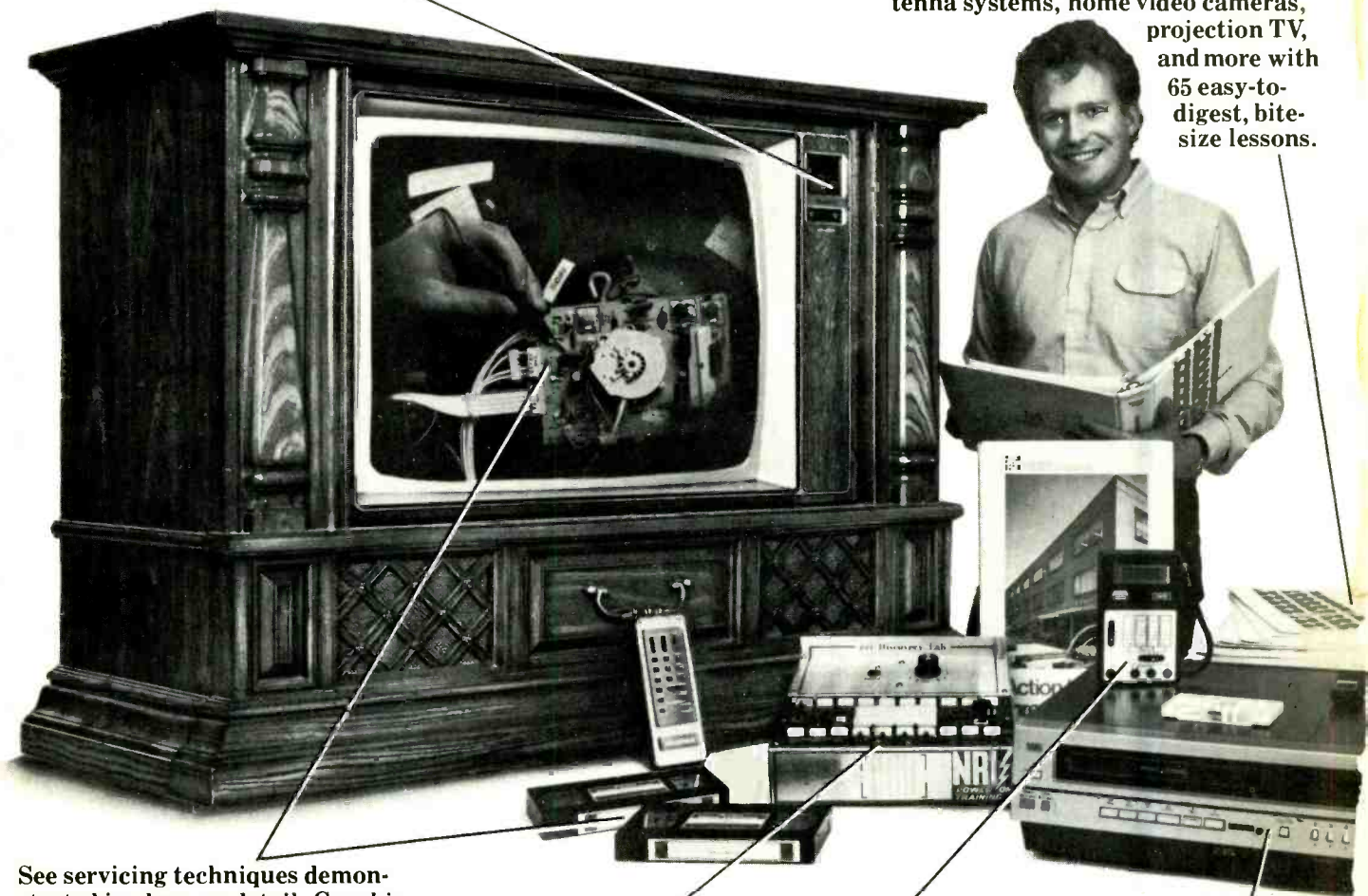

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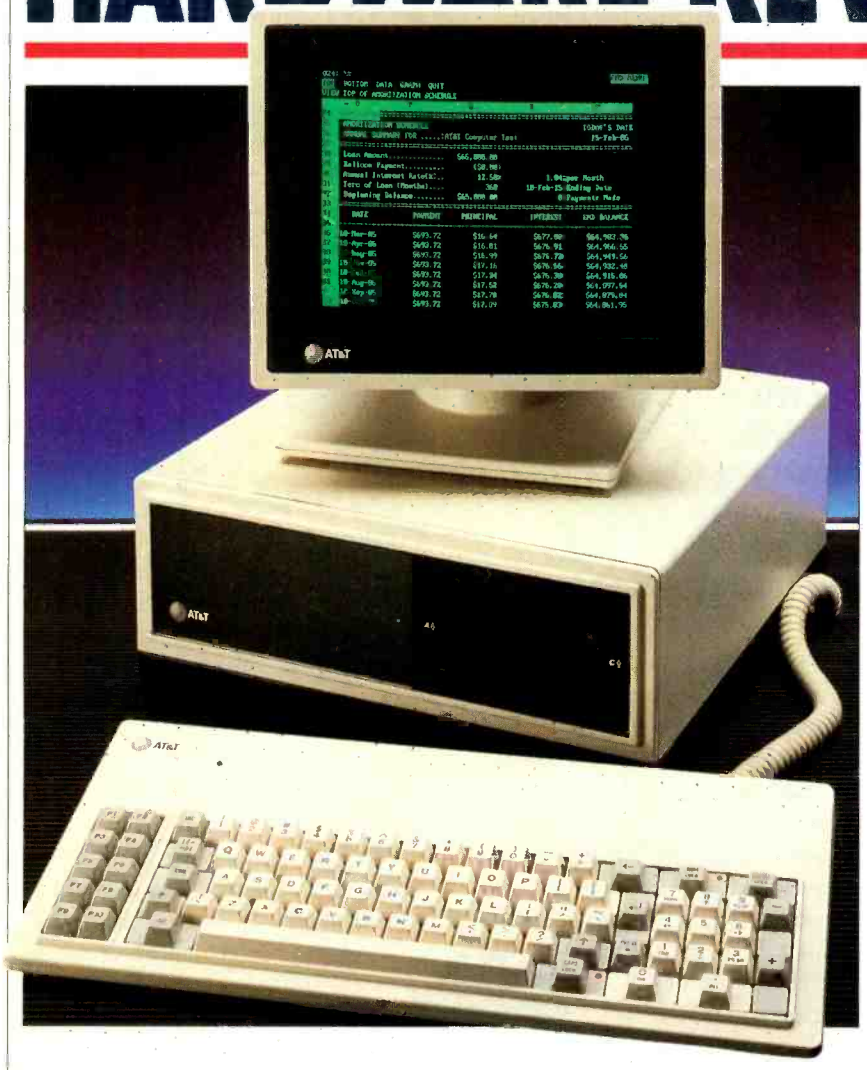
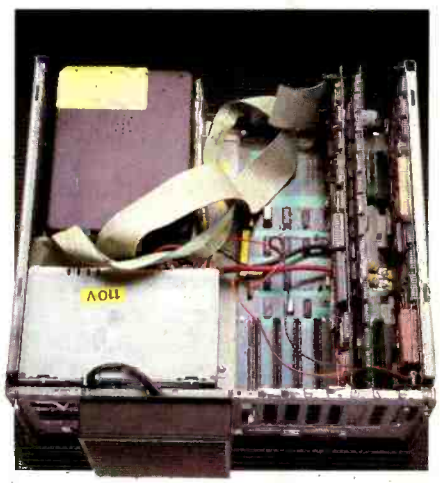
HARDWARE REVIEWS





AT&T 6300

A compact, fast IBM PC clone

BY TOM BADGETT

MICROCOMPUTER manufacturing started as a game anybody could play. All you needed was an interest in hardware and a tinkering spirit. Now the game has turned into high-stake hardball. Only the biggest and toughest dare compete. And even some of those have found the ball too hot to handle. The remaining few, proud and powerful, include AT&T Information Systems, purveyors of the Personal Computer 6300, an IBM PC-compatible with a true 16-bit 8086 CPU running at nearly twice the speed of IBM's 8088.

The communications giant's first micro isn't particularly innovative or exciting, but it is significant: In a market dominated by IBM, AT&T is seen as one of the few viable alternatives to Big Blue. Even after the divestiture of its local operating companies, AT&T is a huge corporation. Now unregulated and free to compete in the open market, it has many of the same advantages that make IBM such a tough competitor: size, a name that is a household word, and a reputation for quality products and service.

But AT&T has an unenviable task in its fight for market share and recognition against its established adversary. AT&T's success was built in a highly regulated, captive marketplace and in a related, but different, technology. IBM has been known for solid, dependable computer products from the beginning. So AT&T first has to produce competitive products, then market them successfully. Only time can prove its marketing abilities, but the industry is carefully scrutinizing this first offering, a version of Olivetti's M24 desktop micro.

This review is based on a technical evaluation done by Belmont Laboratories, an independent testing laboratory.

The Hardware

The 6300's main advantage over the PC is its fast 16-bit CPU. The 8086 in the AT&T runs at 8 MHz, almost twice the speed of the IBM PC's 4.77-MHz 8088. A bus converter board provides seven IBM-compatible expansion sockets and a 4-MHz bus clock for added compatibility. Although the 8088 and the 8086 share the same instruction set and internal architecture, the 8086 talks with the outside world via a 16-bit data path, moving data into and out of the CPU in 16-bit-wide chunks. The 8088 has an external 8-bit data structure, and communicates with memory and I/O devices 8 bits at a time. The accompanying benchmark tests show that in most applications where the CPU is the limiting fac-

PHOTOS BY BOB LORENZ

SOFTWARE FOR THE AT&T 6300

The following are software programs we have confirmed run on the 6300:

VEdit
WordStar 3.3
XYWrite II
Volkswriter Deluxe
Framework 1.0
Sidekick 1.0
Turbo Pascal 1.0
dBASE III 1.0
dBASE II (Version 2.41 runs, but 2.40 is incompatible with MS-DOS version 2.11, which is not to be confused with PC-DOS 2.1)
Lotus 1-2-3 Version 1a
SmartCom 2.0
Crosstalk XVI (Version 3.3 had a problem in that the 6300's 8-MHz clock caused it to time out before a carrier detect on ingoing and outgoing calls. Obviously, Microstuff was using software timing loops. This problem was corrected in Crosstalk Version 3.5, which now uses the system's hardware for timing.)
PC-DOS 2.1 and 3.0
Harvard Project Manager
GW-BASIC games programs (Of approximately 40 different games tested, only Pac Mac didn't run.)

tor, the AT&T 6300 is significantly faster than the IBM PC—by about 40% on the average.

The hardware design is noticeably different from IBM's. AT&T puts nearly everything on the system motherboard. The 6300 comes standard with 128K RAM (with sockets for another 128K), one serial port, one parallel port, video board, battery-backed-up clock/calendar, and disk controller, all on the motherboard. This system board is mounted component side down in the base of the machine to give easy access for memory additions or other changes. Expansion sockets are on the foil side of the board. Two of the seven expansion sockets will take 16-bit boards and there's room to add the necessary 32-pin sockets to the other expansion slots.

Double-sided, 360K, half-height floppies are standard, but the unit we tested came with one floppy, a 10M-byte hard disk, and 512K of RAM, divided equally between the system board and a 16-bit expansion board. It should be possible to free up this 16-bit slot by replacing one bank (128K) of system-board memory with 256K chips, but units that are factory configured with a hard disk have soldered-in memory, making the task unrealistic for most users.

The 6300's display adapter may be an improvement over IBM's, or it may not, depending on your application. The AT&T will support color or monochrome text and graphics with its motherboard-resident display adapter. Characters are displayed using a very readable 8 × 16 matrix. Standard text formats of 40 × 25 lines and 80 × 25 lines are available, as well as monochrome graphics of 640 × 400 pixels. IBM-style, four-color graphics of 320 × 200 pixels is also supported. You don't need separate monochrome and color boards as you do with IBM, but because of the integral construction, you can't add third-party video boards without fairly extensive hardware and software changes. AT&T has a 16-color, 640 × 400-pixel enhanced graphics board that uses one of the 16-bit expansion slots. A video capture board to permit computer imaging with standard video sources, a NAPLAPS interface, and "a very low cost" async adapter are among planned offerings from AT&T.

The 6300 keyboard uses an IBM-like layout and has a pleasant "touch." Welcome additions include LEDs for CAPS-LOCK and NUM-LOCK condition, and a mouse connector. We are told a two-button mouse, available for $150.00, includes a Microsoft-compatible software driver to permit its use with most programs that use Microsoft's mouse. We noticed one small problem with the keyboard: After about two months' use two of the keys lost what little tactile feedback they once had, inducing missed keys and some "bounce." The switches are made with conductive rubber contacts, and some users say the keyboard has a mushy feel because of it. The keyboard is considerably lighter than the

(Continued on page 85)

Specifications

Product: AT&T Personal Computer 6300
Mfr: AT&T Information Systems, 111 Westwood Pl., Suite 300 Brentwood, TN 37027 800-247-1212
Price: System with two floppy drives, 128K RAM, keyboard, and monochrome monitor: $2495
System with one floppy drive, 10M-byte hard disk, 256K RAM, keyboard, and monochrome monitor: $4420
Keyboard: $150
Monochrome monitor: $295
Color monitor: $795
DOS: $60
Dimensions: 15" × 14 ½" × 6 ⅓"
Weight: 31 lb (system unit), 20 lb (display), 6 lb (keyboard)
Operating System: MS-DOS 2.11

BENCHMARK TESTS COMPARING AT&T 6300 WITH IBM XT AND AT

Benchmark tests were made to compare the AT&T 6300 with the IBM AT and IBM XT in speed of operation. (All figures are in seconds.)

- Read/write tests were performed by writing/reading 100 records of the indicated byte length to a data file 10 times, for a total of 1000 records.
- A WordStar test timed how long it took to reach the end of a 50K document file.
- A dBase sort was done of 100 records.
- A BASICA test was a brute-force search for all primes from 0 to 50.

A note on the AT times: The AT was running DOS 3.0, and the AT&T and XT were running MS-DOS 2.1 and PC-DOS 2.1, respectively. DOS 3.0 on the AT uses a much less I/O efficient disk management scheme. On all machines, tests were run with buffers set to 2. By increasing buffers the AT times on the read/write tests can be decreased by a factor of 5.

	IBM XT	ATT 6300	IBM AT
128-byte write test	11	11	17
128-byte read test	6.5	6	14
512-byte write test	44	39	64
512-byte read test	23	22	44
WordStar: time to end of 50K file	9	5	14
dBase II sort	28	14	19
BASICA primes	61	39	24
Lotus 1-2-3 sort	110	59	44

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Controller Card by ComX	$ 110	$ 49
T80, Half Ht., Double, 326K	$ 449	$ 329
Controller Card by Teac	$ 85	$ 59
RANA, Elite I, 163K, 40 Track	$ 379	$ 199
Elite II, 326K, 80 Track	$ 649	$ 369
Elite Controller	$ 145	$ 89
VIDEO TECH, Half Ht. Drive	$ 225	$ 149

HARD DISKS

Quark, QC10 for IIc/IIe/III/MAC	$1995	$1595

OTHER HARDWARE

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CPS/Eastside, Wild Card II(copier, +/e)	$ 140	$ 99
ComX, 80 col. +64K RAM Card (IIe)	$ 199	$ 99
16K RAM Card (II+), 1 yr. ltd. wty.	$ 179	$ 39
Digital Research, CPM Gold Card(w/64K)	$ 350	$ 250
64K to 128K Gold Card Expansion	$ 295	$ 215
Hayes, Mach II Joystick (+/e)	$ 45	$ 29
Kensington, System Saver Fan	$ 90	$ 65
Key Tronic, KB200 Keyboard	$ 298	$ 188
Koala, Muppet Keys	$ 80	$ 49
Touch Tablet w/Micro Illustrator	$ 125	$ 75
Kraft, Joystick (II/II+)	$ 65	$ 49
Game Paddles (II/II+)	$ 50	$ 39
M&R, Sup R fan (II+)	$ 50	$ 30
Microsoft, 16K RAM Card (II+)	$ 100	$ 69
Z80 Softcard (+/e)	$ 345	$ 235
Z80 Softcard Premium (e)	$ 395	$ 275
Orange Micro, Grappler Plus (+/e)	$ 149	$ 99
16K Buffer Board for Grappler Plus	$ 175	$ 99
Buffered Grappler Plus, 16K	$ 239	$ 159
2 Chip Set for Buffered Grappler	$ 28	$ 12
Paymar, Lower Case Chip, Rev. 7 (+)	$ 50	$ 19
PCPI, Applicard 6 MHz, 14 features	$ 375	$ 275
RH Electronics, Super Fan II	$ 75	$ 59

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Other RAM Cards & Software IN STOCK		CALL
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VideoTerm 80 col. card (+/e)	$ 279	$ 175
PSIO I/F Card	$ 229	$ 145

MACINTOSH

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Creative Solutions, MacForth Level I	$ 149	$ 95
Dow Jones, Market Manager	$ 249	$ 159
Haba, Habadex	$ 199	CALL
Hayden, Sargon III	$ 50	$ 33
Human Edge, Sales or Mgmt. Edge, ea.	$ 250	$ 159
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Surge Suppressor	$ 50	$ 35
Living Videotext, Think Tank	$ 145	$ 85
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Main Street, Filer or Writer, ea.	$ 199	$ 125
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Monogram, Dollars & $ense	$ 150	$ 95
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Penguin, Graphics Magician	$ 50	$ 32
Prometheus, ProModem 1200w/cabl & softw	$ 495	$ 350
ProVue, OverVue	$ 295	$ 195
Scarborough, Mastertype	$ 35	$ 19
Simon & Schuster, Typing Tutor III	$ 50	$ 33
Softw. Pub., PFS:File or PFS:Report, ea	$ 125	$ 79
PFS: File & Report Combo	$ 195	$ 125
Stoneware, DB Master	$ 195	$ 125
Telos, File Vision	$ 195	$ 125
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Jane w/o Mouse (IIc)	$ 179	$ 119
Artaci, Magic Window II	$ 150	$ 100
Ashton-Tate, dBase II (Req CP/M 80)	$ 495	$ 269
BPI, Job Cost	$ 595	$ 375
AR,AP,PR or INV,each	$ 395	$ 249
Broderbund, Print Shop	$ 50	$ 34
Print Shop Graphics Library	$ 25	$ 18
Bank St. Writer or Speller, ea (spec +/e/c)	$ 70	$ 45
Bank St. Combo (Writer & Speller)	$ 140	$ 85
Continental, GL,AR,AP or PR, each	$ 250	$ 165
CDEX, for Visicalc, Multiplan, Apple IIe,ea	$ 60	$ 40
Dow Jones, Market Manager	$ 300	$ 189
Market Analyzer or Microscope, ea.	$ 350	$ 219
Hayden, Pie Writer (v 2.2)	$ 150	$ 89
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Hayes, Terminal Prog. for Smartmodem	$ 100	$ 65
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Graphics Magician	$ 60	$ 40
Phoenix, Zoom Grafix	$ 40	$ 34
Quality, Bag of Tricks	$ 40	$ 29
United SWI, ASCII Express-The Pro	$ 130	$ 87
Utilico, Essential Data Duplicator III	$ 80	$ 49

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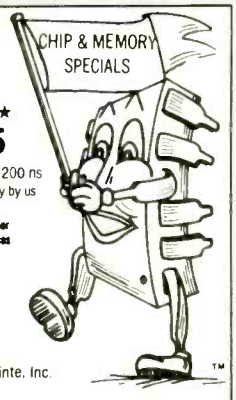

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HARD DISK DRIVES FOR MACINTOSH

More storage and speed for the Mac

BY JOSEPH DESPOSITO

ONE of the more desirable upgrades for a business microcomputer system is a hard disk. It provides a vastly increased storage capacity and significantly faster operations. These attributes are just what the doctor ordered for Apple's Macintosh computer, so we tested three hard disks available for it: Tecmar's MacDrive, Corvus's OmniDrive, and Davong's Mac Disk.

Hardware Appearance and Setup

All three drives are physically imposing compared to the diminutive Mac. Each has a larger footprint, the Tecmar unit barely. The Tecmar and Davong drives, at 22 lb apiece, outweigh the Mac by 6 lb. The Corvus drive, however, weighs just 11 lb.

The Tecmar drive that we tested is a 5M-byte removable cartridge hard disk. It includes two serial ports, ac socket (for plugging the Mac into the drive), and power switch at the rear. In front are the opening for the removable disk and an indicator LED. The Corvus drive is a 16M-byte unit with an Omninet connector, an eight-position "address" DIP switch, and power switch at the rear. In front are three indicator LEDs for FAULT, BUSY and READY. The Davong is a 10M-byte drive with a serial port and ac power switch at the rear, and four indicator LEDs for CHK, COM, R/W and PWR on the front. All three manufacturers offer configurations other than the ones we tested.

Setting up any of the hard drives is mostly a matter of connecting a cable between the modem serial port on the Macintosh and the drive. With the Corvus drive, however, you must also check that the DIP switch settings are correct. Then you just plug in the drive and you're ready to begin.

Software

Each hard drive comes with an accompanying floppy disk that's needed to boot the system. You start up the Mac by inserting this disk (or preferably a backup copy) into the micro floppy drive. All the hard disks come preformatted and ready to use. Transferring applications and files from a standard disk to the hard disk is done by simply dragging their icons to the hard disk window.

At the time of this writing, there was a significant difference between the software for the Corvus drive and the software for the other two. The Corvus disk is preconfigured into volumes, which means that the disk has been partitioned into sections. Each volume is treated by the software as a separate entity similar to a Macintosh floppy disk. Using a utility called the Volume Manager, you can vary the volume sizes from 400K bytes to 3200K bytes. Though you may have many of these volumes on one hard disk, only two can be used at a time (one if there's a disk in the internal floppy drive). A utility called the Mount Man-

PHOTO BY BOB LORENZ

ager moves volumes on and off the Mac desktop. Other utilities that Corvus includes are for backing up volumes to floppy disks and verifying the Omnidrive/Macintosh connection and the drive interface.

Since the Mac operating system (version 1.1 of the Finder) doesn't recognize hard disks, each manufacturer has been forced to provide its own version of the Finder. All work well for a limited number of files but encounter problems as the number increases. This is due to limitations inherent in the Apple Finder itself. For example, a simple operation such as cleaning up a desktop that contains 100 files can take 5 or 10 minutes, which essentially makes this function unusable. Also there's a tendency for files to disappear when there's a large number of them, which makes it very difficult to take advantage of the storage capacity of the hard disk. You may have used just half the room on a 10M-byte hard disk, but if you have 125 files or so, you're near the limit that the operating system can handle.

Performance

The nicest feature of using a hard disk with the Macintosh is the increase in the speed of operations, especially after disks have been removed from the internal and external floppy drives. We timed two operations for each of the hard disks: 1) opening a MacWrite document and 2) closing the document and opening MacPaint.

The times were compared to those we got when performing the same operations on a Mac with an external drive. In general, we found that the Mac with a hard drive was about twice as fast (see table above).

One way the performance of your system will be degraded when a hard drive is connected to the Mac's modem port is that your ability to connect to the phone lines is restricted—you have to disconnect the drive whenever you want to use your modem.

Specifications

Product: Mac Disk
Mfr: Davong Systems, Inc.
217 Humboldt Ct.
Sunnyvale, CA 94089
Dimensions: 15½"W × 12⅛"D × 4¼"H
Weight: 22 lb
Price: $1950
Features: 10M-byte storage capacity
Other configurations: 21M bytes ($2795), 32M bytes ($3395), 43M bytes ($3995)

FLOPPY VS HARD DISK PERFORMANCE (times in seconds)

Operations	Two Floppy Drives	Tecmar MacDrive (removable)	Corvus OmniDrive	Davong Mac Disk
Load a MacWrite Document	24.8	14.7	11.0	11.4
Close MacWrite/ Begin MacPaint	41.5	21.2	15.3	19.4

Comments

The major drawbacks to using a hard disk with the Macintosh are the current state of the system software and the limitations to speed imposed by the serial port. The software problems are under attack both by Apple and the hard disk manufacturers. Apple plans to include hard disk support in its next version of the Finder, which, hopefully, will substantially increase the number of files that it can handle. In the meantime, both Tecmar and Davong will allow you to partition the disk in future software.

The speed limitations imposed by the serial port are here to stay, however. At about 700K bits/sec, it is a great improvement over Mac's floppy drives. But it's not comparable to what you could get with a built-in hard disk using a standard disk controller. A further limitation of using the serial port is that the Mac is unable to boot from the hard disk.

For the problem of modem communications, each of the manufacturers has a long-range solution. Corvus expects to have available a networking arrangement for the Macintosh called Omninet by the time this is printed. It eliminates the problem, since the hard disk will just be part of the network, as will a modem. Davong, it appears, hopes to solve the problem in a similar way by having its disk hook into the Applebus network when that becomes available. Tecmar is approaching the problem from a different angle. The new version of the software will allow you to connect the disk to the printer port and a printer to the disk in a "daisy chain" fashion. The disk will then act as a 150K buffer for print spooling.

Specifications

Product: Omnidrive
Mfr: Corvus Systems, Inc.
2100 Corvus Dr.
San Jose, CA 95124
Dimensions: 9½"H × 13⅝"D × 5½"H
Weight: 11 lb
Price: $3195
Features: 16-M byte storage capacity, Omninet connector
Other configurations: 5.5M bytes ($1795), 11M bytes ($2495), 45M bytes ($4995), 126M bytes ($5495)

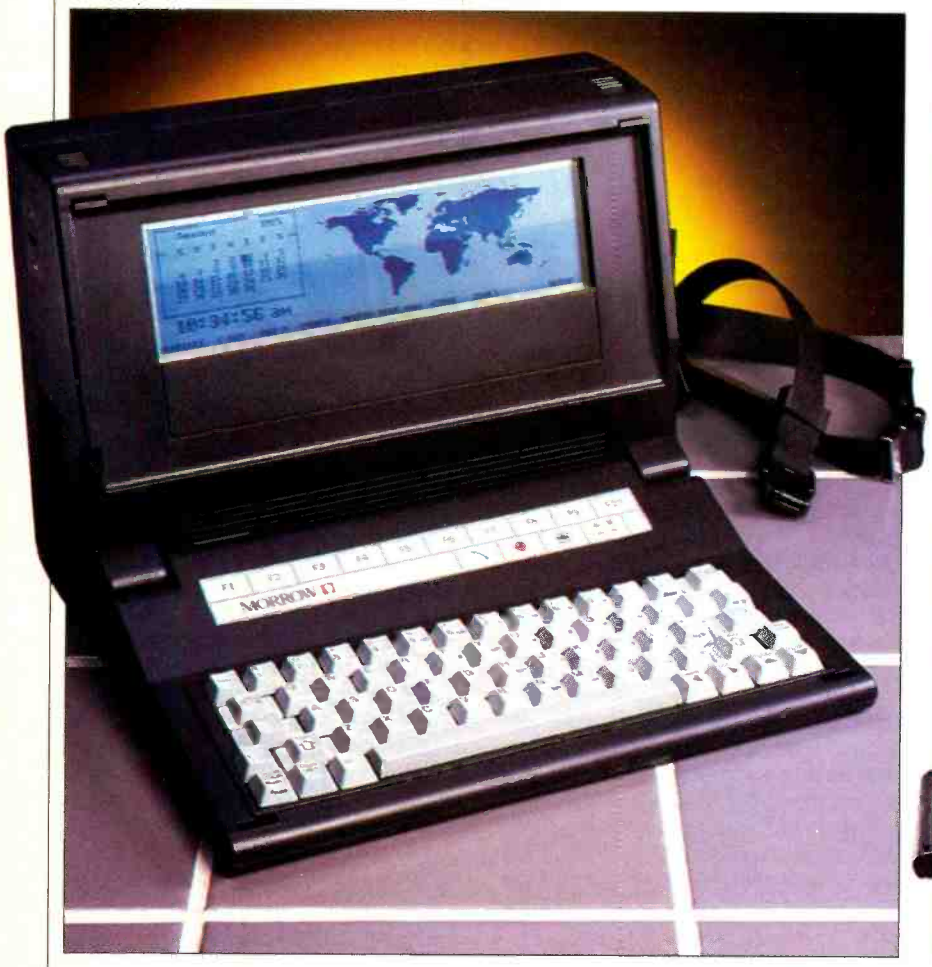
Conclusions

Although there are problems and annoyances that you may encounter when using these hard disks, I thought all of them performed well. It may be irritating to spend more than $2000 on a product and then experience any problems, but all can be dealt with to some degree. For example, instead of creating a lot of small files it's better to make your files as large as possible. If you write 1- or 2-page letters, you might try running them together in a MacWrite document. If your modem communications are hampered, you might try using software such as "PC to Mac and Back" that will run from the printer port.

Deciding which of the hard disks to purchase depends on a number of factors, such as cost, speed, capacity, integration into a network, fixed or removable media, and current state of the manufacturer's software. I think any of these hard disks is a significant enhancement to the Macintosh. But if you aren't willing to "rough it" to an extent, you're probably better off waiting for the software improvements to materialize. ◇

Specifications

Product: MacDrive
Mfr: Tecmar, Inc.
6225 Cochran Rd.
Solon, Ohio 44139-3377
Dimensions: 10¼"W × 10⅝"D × 5½"H
Weight: 22 lb
Price: $1995
Features: 5M-byte storage capacity on a removable hard disk, two serial ports
Other configurations: 10M byte fixed ($1995), 10M bytes fixed plus 5M bytes removable ($3290), 5M bytes removable plus 5M bytes removable ($3290)



MORROW PIVOT

IBM-compatible portable uses 5¼" drives.

BY MICHAEL K. GUTTMAN & MICHAEL KIRKLAND

IF there has been a true portable computer that runs IBM PC software "out of the box," it has been a well-kept secret. Now, however, Morrow has done it with a 10-lb, battery-operated, MS-DOS computer that uses 5¼" floppy disks. Named the Pivot, it comes standard with one disk drive and 128K of RAM for $1995. The evaluation unit had two disk drives and 512K RAM and lists for $2895. At this price, the Pivot should offer stiff competition, not only to other MS-DOS portables, but also to fully featured units.

The Pivot Package

The Pivot is housed in a sleek black case measuring 9.5"H × 13"W × 5.6"D when closed. The case is made of a very tough plastic that will withstand a fairly strong impact. Ours remained unharmed after a healthy swing (accidental) into the end of a car door.

Morrow provides a padded shoulder strap that hooks onto the sides for easy carrying. There is no handle, so it isn't possible to carry the Pivot like a briefcase. There aren't any storage slots for disks, manuals, or notes, either. However, for about $60 Morrow will provide a carrying case that should amply remedy these deficiencies.

The Keyboard

The keyboard folds down from the front of the case, swinging on a pivot from which, we surmise, the unit gets its name. The keyboard has standard-size typewriter-style keys and spacing, and the keys have a solid feel when pressed. To conserve space the numeric pad shares keys on the right side of the keyboard and is, as usual, activated by the NUM LOCK key. The arrow keys are placed in a row at the bottom right hand corner.

Along the top of the keyboard are the standard ten function keys, as well as four special function keys that Morrow refers to as icons. These icons, labeled by meaningful pictures, are used to select the ROM software and to boot or return to MS-DOS. The function keys are of the touch type, similar to those found on microwave ovens. Fortunately, their use is limited enough that they present no problem.

The Disk Drives

The Pivot we reviewed had two internal doubled-sided, double-density, one-third-height floppy disk drives. They are mounted in such a way that the disks are inserted vertically through the right side of the unit. Like most third-height drives, these have access times that are noticeably slow. In particular, changing from one drive to the other (which happens several times while a disk is copied), takes some time. It is also accompanied by a sharp buzzing sound, which could present a problem if you expect to use the Pivot during a meeting or lecture or in a library.

Otherwise, the drives functioned

(Continued on page 86)

PHOTOS BY BOB LORENZ

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SOFTWARE REVIEWS

WORDSTAR 2000

Has Micropro developed the ultimate word processor?

BY CHARLES A. MILLER

WHEN MicroPro talks, will everyone listen? That's something the company worried very little about in the past. Beginning in 1979, when it introduced WordStar, the company built a huge audience for its word processing program. Eventually, MicroPro claims, over 1.25 million satisfied—more or less—buyers (and untold numbers of pirates) were listening.

WordStar, which was born in an 8-bit world, has always had its detractors, of course, but only recently has its popularity begun to slip, due in part to the appearance of new programs like MultiMate, WordPerfect, Microsoft Word, and others, loaded with features. Although MicroPro had a few good years (sales in fiscal year 1984 were $66.9 million, a 53% gain over the previous period), the company knew it had to produce another winner if it was to thrive in coming times.

In response, MicroPro has introduced a completely new product, WordStar 2000, which bears little resemblance to the original or its many incarnations. The only striking similarity to the original product is the user interface (for lack of a better term), or at least its basic conception. With WordStar 2000, you still use a two-key sequence to initiate a command (such as CTRL QS—Quit & Save—to save a file), just as you did with the original product, except that now the commands are more mnemonic. The only familiar keyboard commands are the cursor controls, which resemble the WordStar keyboard "diamond"—CTRL S, for instance, moves the cursor one space to the left—a holdover from the days when few personal computers had dedicated cursor keys. In fact, some of the commands that used to require a single CTRL/keystroke combination require more keystrokes. For example, CTRL T (delete right word in the original version) now becomes a more mnemonic CTRL RW.

Users of the original WordStar can anticipate a new learning experience with version 2000. True, they can forego the frustration of non-mnemonic commands and arcane documentation, but they will also need to relearn all the old command sequences. Novices, however, will have it easy. Learning WordStar 2000 will probably be a breeze compared with learning WordStar 3.3. For one thing, there are no more dot commands. If you want to format a file, you do it from the keyboard.

Running WordStar 2000

To run the program, you must first install it, and if you have a two-drive system, you're in for a real challenge. The installation procedure is almost perplexing—novices may get through it, but not by trying to follow the documentation. To begin with, the program comes on six disks, the Plus version on seven. Much of the installation is automated with batch files, but there is a lot of disk swapping on a floppy-based system. If you have a hard disk, the installation goes much more smoothly.

You may make up to three copies of the program (a counter decrements after each installation), but you can uninstall a copy anytime, forcing the counter back up by one.

The first thing users of the original WordStar will notice about WS2000 is that the menus are a lot cleaner. In fact, they're downright sparse. And, of course, once you learn the program, you can fix things so the menus don't show at all.

The help screens are a bit more context-sensitive than those of the original WordStar. For general information, you can scroll to the screen you want either by pressing the spacebar or, more quickly, by pressing the command you want to know more about, then entering CTRL G. For detailed information, however, you must refer to the documentation. The help screens do little more than jog your memory.

To select a file to open, you first call up a list of the files on the disk with an E

Specifications

Product: WordStar 2000; WordStar 2000 Plus
Mfg: MicroPro International Corp.
33 San Pablo Ave.
San Rafael, CA 94903
415-499-1200
Price: WordStar 2000: $495; WordStar 2000 Plus, $595
Requirements: IBM PC, XT, AT or compatible, PC DOS 2.x, 3.0; 256K RAM (320K for DOS 3.0 and IBM AT); two floppy disk drives (hard disk recommended). Copy protected—three copies are permitted at any given time and the program can be booted from a hard disk. The program is written in the C programming language, and MicroPro intends to port it to other formats later this year.

PHOTOS BY STEVE BORNS

command (the mnemonic device, of course, for Edit) from the main menu. If the file already exists, you move a highlight (the filename in inverse video) to the file name and press ENTER. One minor problem is that the highlight doesn't wrap vertically: When you get to the bottom of one column you have to move it to the top of the next; it doesn't jump there automatically. And the PG UP and PG DN keys won't scroll you through the file list, a minor inconvenience when you are working with a long list. You can, however, use the directory features of DOS—that is, retrieve (or save) documents in any directory you wish.

New Possibilities

One handy feature of the program may not turn out to be so handy. The typewriter mode, which should let you use your computer/printer combination as a regular, albeit expensive, typewriter—for addressing envelopes or dashing off quick notes—works fine, except when your printer has a buffer that you can't turn off. With a buffer, typed characters won't print until you hit the return key, whereupon the entire line prints. You don't see each character at the printer as you type it, which seemed to make it a nonfeature feature to me, especially since so many printers have buffers.

One thing I like about the program—and something that has become almost standard with word processors—is the flying reformatting of text. When you insert a word or change the margins, the text is reformatted automatically (and quickly), including any centered lines. There are no more CTRL B's (the original WordStar reformatting commands) to issue. And when the text is reformatted, "soft" hyphens—for word breaks at the ends of lines—appear and disappear (as necessary) automatically. You can set margins line by line, that is, so that each new line has a new margin, and you can use multiple ruler lines to keep track of each new setting. With this feature, it's easy to create hanging indents.

This brings us to a tradeoff that seems, to me, a bit frustrating. Under some conditions, what you see on display is not what you get. For example, line spacing (and justification, as well) does not show on the screen. If you want to change line spacing, you can do so easily by designing a proper Format file or by typing a Print Height

(Continued on page 90)

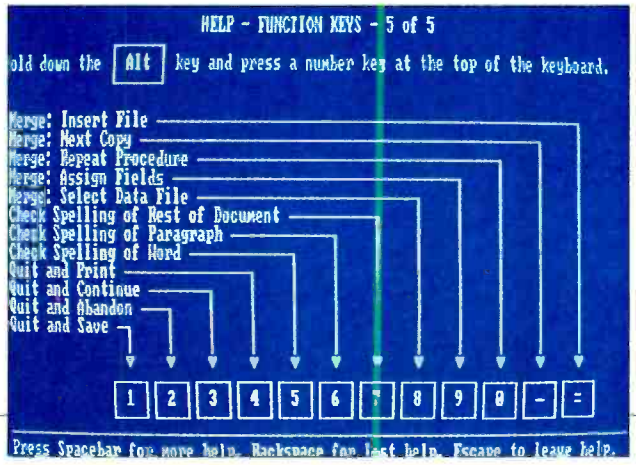
SELECTED COMMANDS IN WORDSTAR AND WORDSTAR 2000

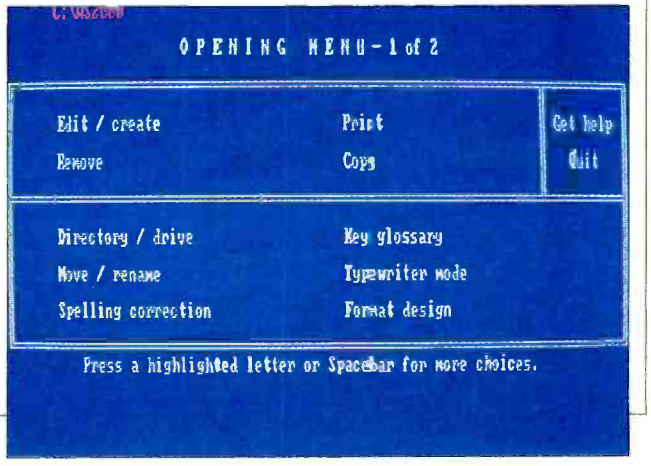
Command	WordStar	WordStar 2000
Right one character	CTRL D or r. arrow	CTRL D or r. arrow
Left one character	CTRL S or l. arrow	CTRL S or l. arrow
Up one line	CTRL E or up arrow	CTRL E or up arrow
Down one line	CTRL X or d. arrow	CTRL X or d. arrow
Top of screen	CTRL QE or HOME	CTRL CH or HOME
Bottom of screen	CTRL QX or END	CTRL CX or END
Beginning of file	CTRL QR	CTRL CB
End of file	CTRL QC	CTRL CE
Beginning of block	CTRL QB	CTRL CA
End of block	CTRL QK	CTRL CZ
Set left margin	CTRL OL	CTRL TL
Set right margin	CTRL OR	CTRL TR
Ruler on/off	CTRL OT	always on (formatted file)
Delete right word	CTRL T	CTRL RW
Insert carriage return	CTRL N	CTRL CI
Save and resume edit	CTRL KS	CTRL OS
Delete block	CTRL KY	CTRL BR
Print double strike	CTRL PD	CTRL PE
Print underline	CTRL PS	CTRL PU
Conditional page	.CP (dot command)	CTRL OK
New page	.PA (dot command)	CTRL OP

WORDSTAR 2000 COMMANDS NOT IN WORDSTAR

Command	WordStar 2000
Cursor to window	CTRL CW
Remove sentence	CTRL RS
Undo last removed text	CTRL U
Quit and print	CTRL QP
Block arithmetic	CTRL BA
Block sort	CTRL BS
Select print font	CTRL PF

WordStar 2000 help menus (below left) are context sensitve. Other menus (right) are clean and direct.





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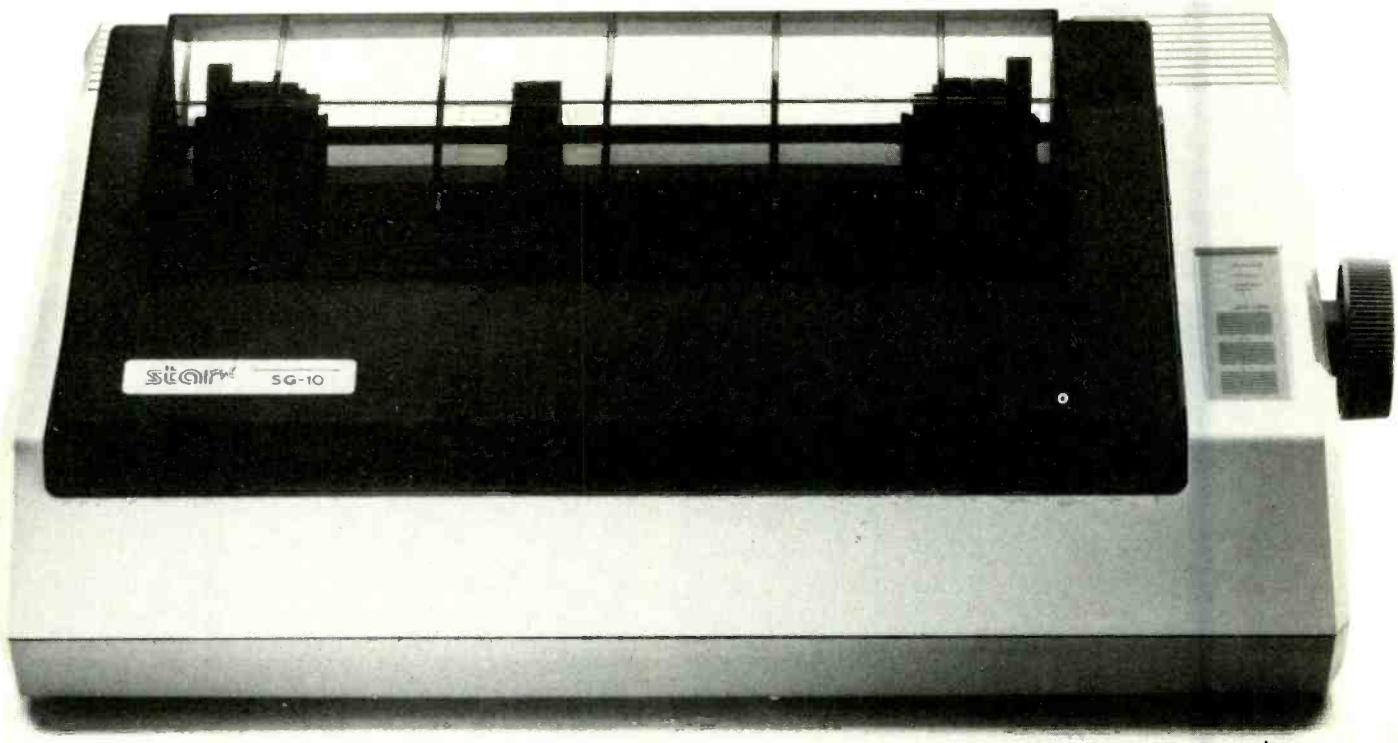

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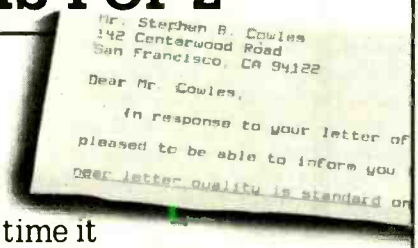

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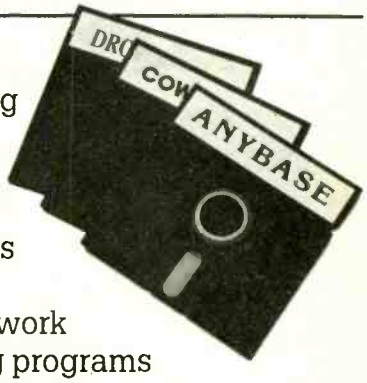

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HABADEX AND MACPHONE

Two telephone management systems for Macintosh.

BY BRAD HESSEL & REDMOND SIMONSEN

ALTHOUGH the image of the personal computer as an "electronic desktop" predates Apple's Macintosh, it has become a cardinal article of faith with the Mac.

Now two products claim to extend the electronic desk metaphor further: Habadex, by Haba Systems, and MacPhone, by Intermatrix. They would have you forget your calendar, your desk clock, your rolodex, and your programmable phone. They promise to integrate every aspect of your desk-life.

How ambitious is this promise? Well, consider the fact that while your Mac is running Habadex or MacPhone, it cannot do anything else. To replace $250 worth of desk paraphenalia with a $2000+ computer, such a program has to be awfully good.

Habadex

Of the two products, Habadex has the greater aspirations. It can:

- Act as phone/address book
- Dial phone calls
- Keep track of daily appointments
- Produce labels using data in the address book
- Produce form letters using the address book

Habadex consists of the master disk, a 48-page manual, and the HabaDialer, which connects your phone and phone line to the Mac. The master disk, which can be copied, is not needed to run the program or store data; it is needed only for an "ID check" to start the program each time. The HabaDialer is a snap to install—one end plugs into the Mac's sound port and the other connects to the phone line. The phone is then plugged into this dialer.

The sight that greets the Habadex user is a picture of two of the items that, presumably, will no longer be needed on your desk: a directory book indexed from A to Z and an appointment book indexed from January to December. On the cover of the appointment book is the current date and time and listings of your next two appointments (if you have any more today) and the next two "things to do" (if you've listed any of up to 21 such possible "things"). The screen is functional: selecting, with the mouse, the letter C opens a window with directory book entries starting with C, for example. Selecting Jan calls up the January page of a 1985 calendar.

To make an entry in the directory, you select the "New Entry" tab on the directory, which brings up a "New Record Entry" screen. This screen looks impressive. It consists of 19 predefined fields ranging from "First Name" through "Misc. #1" and "Misc. #2" to "Account Code." Habadex can sort your directory by any one of eight of these fields, including zip code, category, first name (handy if you forget someone's last name), account code, company, and the two miscellaneous fields, in addition to last name. The fact that you cannot redefine fields or add or delete them is a drawback—how serious it is depends upon your needs.

A serious inconvenience is that you also cannot alter the size of each field. The first two company names I wanted to enter—Ares Development Corporation and Health Insurance Plan of Greater New York—would not fit. The titles of my first two entries—Executive Vice President and Coordinator of Regulatory Affairs—were also too long. So much for using a Habadex label to make a good impression on a title-conscious associate or a new contact.

The documentation does not discuss any limitation on the number of phone/address book entries.

The next major facet of Habadex is the automatic dialer. It is quite rudimentary. Probably the crudest aspect is that Habadex does not recognize your own area code. Thus, when you enter phone numbers, you must omit the area code for local numbers, or else Habadex will blindly use it and botch the call. If, like me, you happen to work in one area code and live in another, forget about taking Habadex home with you to use on your own Mac: You'd have to change all the area codes! You would have the same problem if you moved.

The second most inconvenient feature of the dialer is that Habadex recognizes only one long distance service. If you happen to use more than one. . . . well you get to dial the access number and your authorization code yourself. And presumably since Habadex does not appreciate the difference between a local and a long distance call, there is no "automatic" long distance service option—you have to specify long distance from the dialer menu for each call you want it to apply to.

Another annoyance is that it will not automatically dial "1" for AT&T long distance. You have to input that along with every individual phone number. On balance, assuming you're calling from the right area code, Habadex is more convenient than dialing yourself, but less convenient than using a programmable phone.

Probably the strongest component of Habadex is the label generator. The program gives you tremendous flexibility in designing the appearance and selecting

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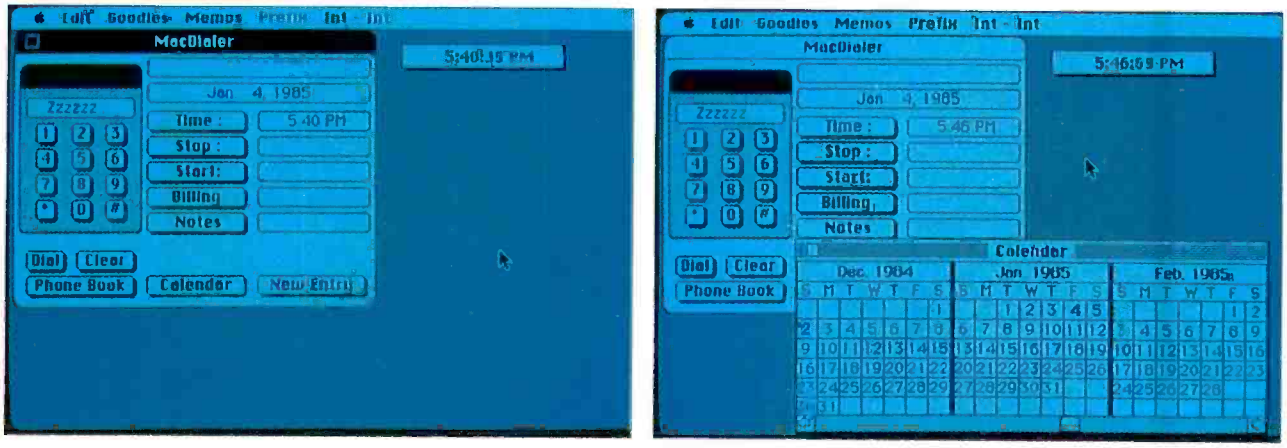
Habadex and MacPhone



MacPhone's opening screen is shown on the left. Selecting "calendar" brings up the screen shown on the right. Selecting any date brings up a window that contains notes for that date.

the information content. You can control font and style. You can also print across one, two, or three labels. The main drawback is that you have to position the label icons on the screen to get the spacing right on paper, and, as the manual euphemistically understates, Habadex "is a little sensitive about where you put the labels on the screen."

Considerably less useful is the form letter option. While you can send one-page letters to any subset of the names in the directory, you really need tractor-fed letterhead to do so efficiently. Blank paper won't do since there is no way to head the letter with your return address. You also have to be willing to start your letter, "Dear. . . ." There is no way to change or eliminate the salutation.

Finally there is the appointments feature. You're allowed up to 14 a day, and Habadex beeps you whenever it's just past time for one (for some reason, Habadex uses its own clock, rather than the one built into the Mac, and it runs slightly slow). The main drawback here is that you can only schedule appointments up to 31 December 1985. Possibly Haba Systems anticipates that by then most people will have given up on Habadex.

MacPhone

MacPhone is the less presuming of the two programs, but generally what it does, it does very well. Its main functions are to:

- Act as a personal phone directory
- Dial calls
- Maintain a phone log of outgoing calls
- Track daily appointments

The MacPhone package consists of the master disk, a 52-page manual, an $8\frac{1}{2}" \times 7\frac{1}{2}" \times 2"$ base unit which attaches to the side of your Macintosh, and an inexpensive hand-set telephone. The master disk is copy-protected, and you are expected to trust your data to it. You can get a second master disk for $20 from the manufacturer, but the documentation indicates no way to back up your data from one to the other. The base unit is connected between the Mac's sound port and the phone line; the MacPhone phone (or more likely, your own phone) plugs into the base unit.

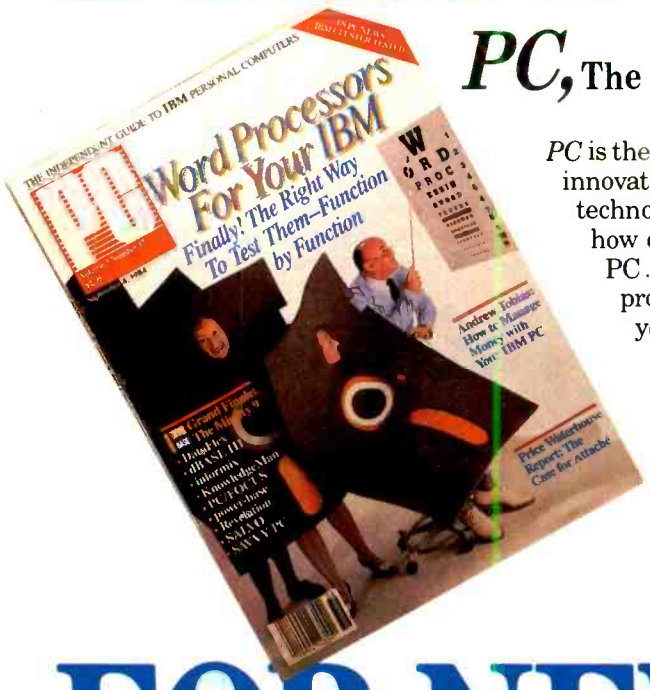
Starting the program summons the "control panel" to appear in the upper left-hand quarter of the screen. From the control panel you can call up the Phone Book, Calendar, New Entry, or Phone Notes windows, or initiate a call.

The phone directory is limited to 200 numbers sorted alphabetically. Up to 80 of these can also be inscribed in convenient pull-down menus (and until you accrue more than 80, all your numbers automatically appear there). These numbers can be called without using the Phone Book window.

(Continued on page 85)

Habadex users are greeted with a picture of directory and appointment books as shown on the right. Selecting "Mar" brings up the screen shown on the right. Selecting any date will show the appointments for it.

FIRST CHOICE



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THREE STATISTICS PACKAGES

Now you can get much of the power of mainframe stat packages on your micro.

BY MARK LERNER

THERE is an increasing probability, experts say, that you will be doing statistics on your micro very soon. Several new statistical packages for micros have become available, among them SPSS/PC, StatPro, and Trajectories.

These three programs, in most respects, live up to their billings—each does analysis of variance, cross tabulations, and regression analysis. Specialized routines are also available, such as time-series analysis or regression model building. The programs are similar only insofar as they all accept raw input data, compute statistics, and report the results. They vary in how they acquire raw data, whether they work from a menu or a command language, in what statistics they compute, and *how* they display results. Of the three, SPSS/PC provides the most detailed and flexible statistical routines. StatPro is the easiest to use, and is quite powerful. Trajectories needs a minimum of hardware and provides source code to all routines.

SPSS/PC

The most versatile program is SPSS/PC. This package is largely compatible with the SPSS found on mainframe computers; the PC/XT version uses a command language that I found quite flexible. The language can be used interactively, and sequences of commands can be written with an editor for subsequent processing.

SPSS/PC processes both alphabetic and numeric data read in fixed-field or variable-field format. It's not limited to one record per line of input; rather, it allows both multiple inputs per record and multiple records per input. Data can be saved, and later restored, with portable system files.

Because several language statements support record selection, SPSS/PC can be instructed to process part of the database, based upon complex logical expressions. In addition, particular values can be designated as logically deleted, or "missing." Data manipulation features include a RECODE statement, along with computational and logical abilities that are better than many programming languages. Recoding consists of assigning specific values to a range of inputs.

One-pass Transformations

The program can do computations with built-in algebraic and transcendental functions as well as other functions and LAG statements to reference the value of a previous case. All transformations are executed in one pass over the data.

In addition, the command called VALUE LABELS, can be used to add descriptive information to each variable, even months after it is created.

The gem of this package is its statistics, which consists of various routines that ultimately provide more flexibility than the other two packages. With SPSS/PC, you specify the name of a procedure, the variables to be used, the options, and requests for additional statistics. One command, REGRESSION, has powerful model-building features. These include 6 methods of using variables, 7 criteria for selecting variables, 17 statistical operations (analysis of variables, sweep matrix tolerance, etc.), and 11 "descriptives," (mean, mode, median, etc.). Output can be manipulated by a flexible report writer, which can do aggregation and computation, column/row labels, and other formatting functions.

The program makes it easy to share data with other PCs or mainframes. It comes with a communication program (called Kermit, which was developed at Columbia University Center for Computing Activities) to transfer data and programs between a mainframe and a PC. In addition, the system file format is compatible with mainframe files; a mainframe SPSS-X utility can translate jobs for the PC.

(Continued on page 88)

Specifications

Product: Trajectories
Mfg: DBi Software Products
One Energy Place
5805 E. Pickard Rd.
Mt. Pleasant, MI 48858
517-772-5055
Price: $395
Requirements: IBM PC or compatible, BASIC, 64K RAM, and one floppy drive

Specifications

Product: StatPro
Mfr: Wadsworth Professional Software
Statler Office Bldg., Suite 1435
20 Park Plaza
Boston, MA 02116
617-423-0420
Price: $795
Requirements: IBM PC/XT or compatible, Apple II series or III, UCSD P-System (included), 128K RAM

Specifications

Product: SPSS/PC
Mfr: SPSS, Inc.
444 N. Michigan Ave.
Chicago, IL 60611
312-329-2400
Price: $795
Requirements: IBM PC/XT or compatible, DEC Pro 350, 320K RAM, hard disk

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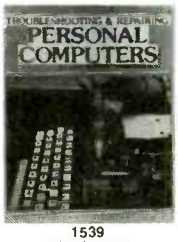

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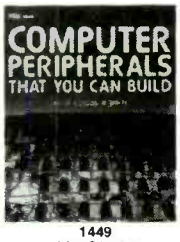

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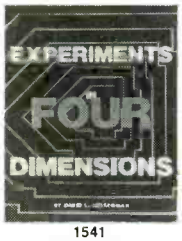

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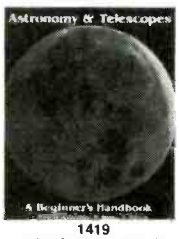

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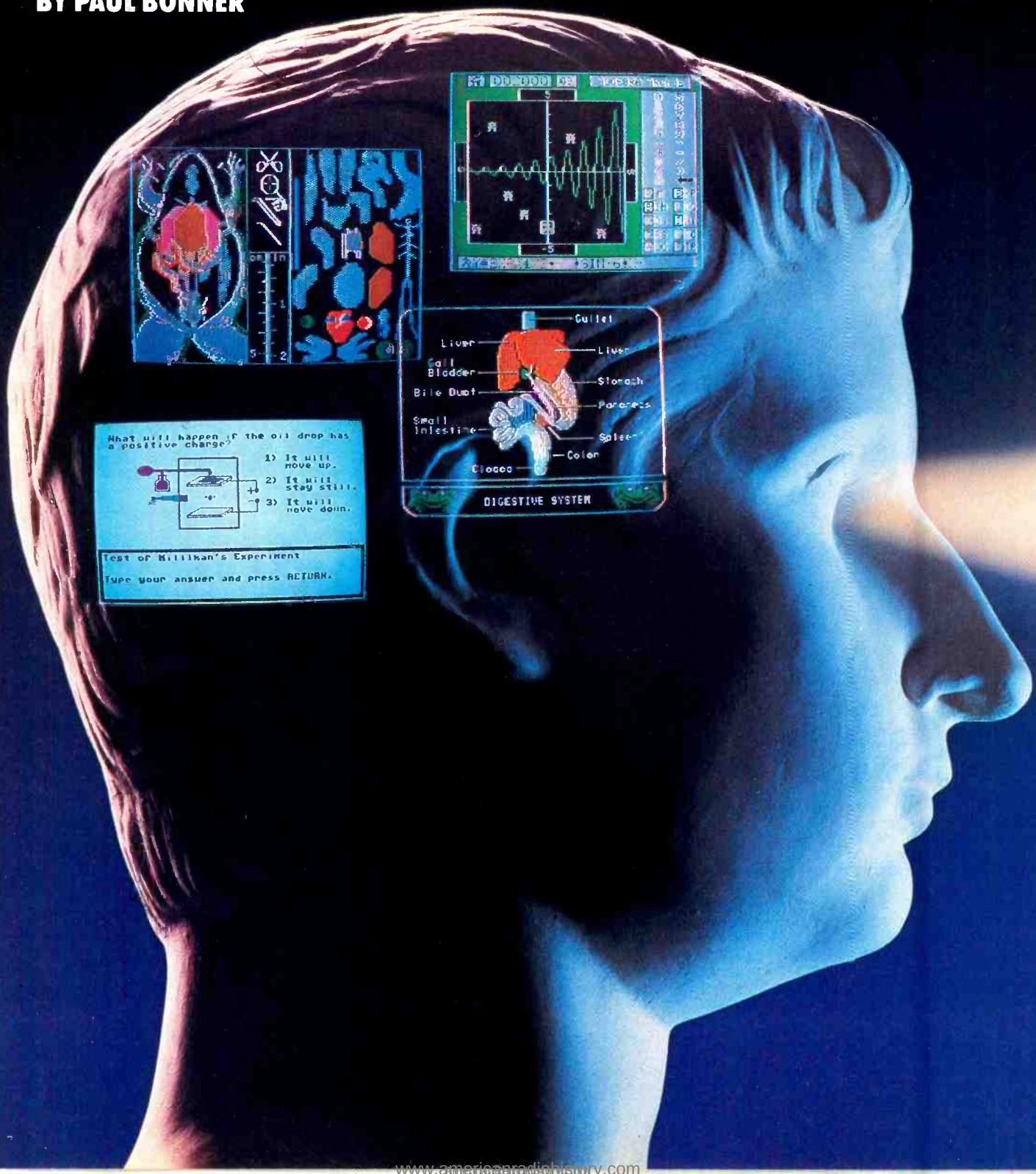
DOES COMPUTER-ASSISTED INSTRUCTION WORK?

Educational software has captured the public's imagination. But is it better than traditional teaching methods?

BY PAUL BONNER



IN schools and homes across America, students are using personal computers to help them learn algebra, master the intricacies of Mendelian genetics and balance complex chemical equations. But despite the publicity about advances in education made possible by micros, some educators and critics claim that only one in ten educational software programs is worth buying.

"Only a small percentage of the educational software out there is really interesting," said Jay Sivin, coordinator of microcourseware evaluations for EPIE (Education Product Information Exchange). Based in Watermill, NY, EPIE is a nonprofit organization that examines each of the 125 or so new educational programs released each month and selects from those the most promising 5 for in-depth (30-40-hour) evaluations. Sivin notes that out of all the packages EPIE examines each month, usually "only one or two comes out smelling like a rose."

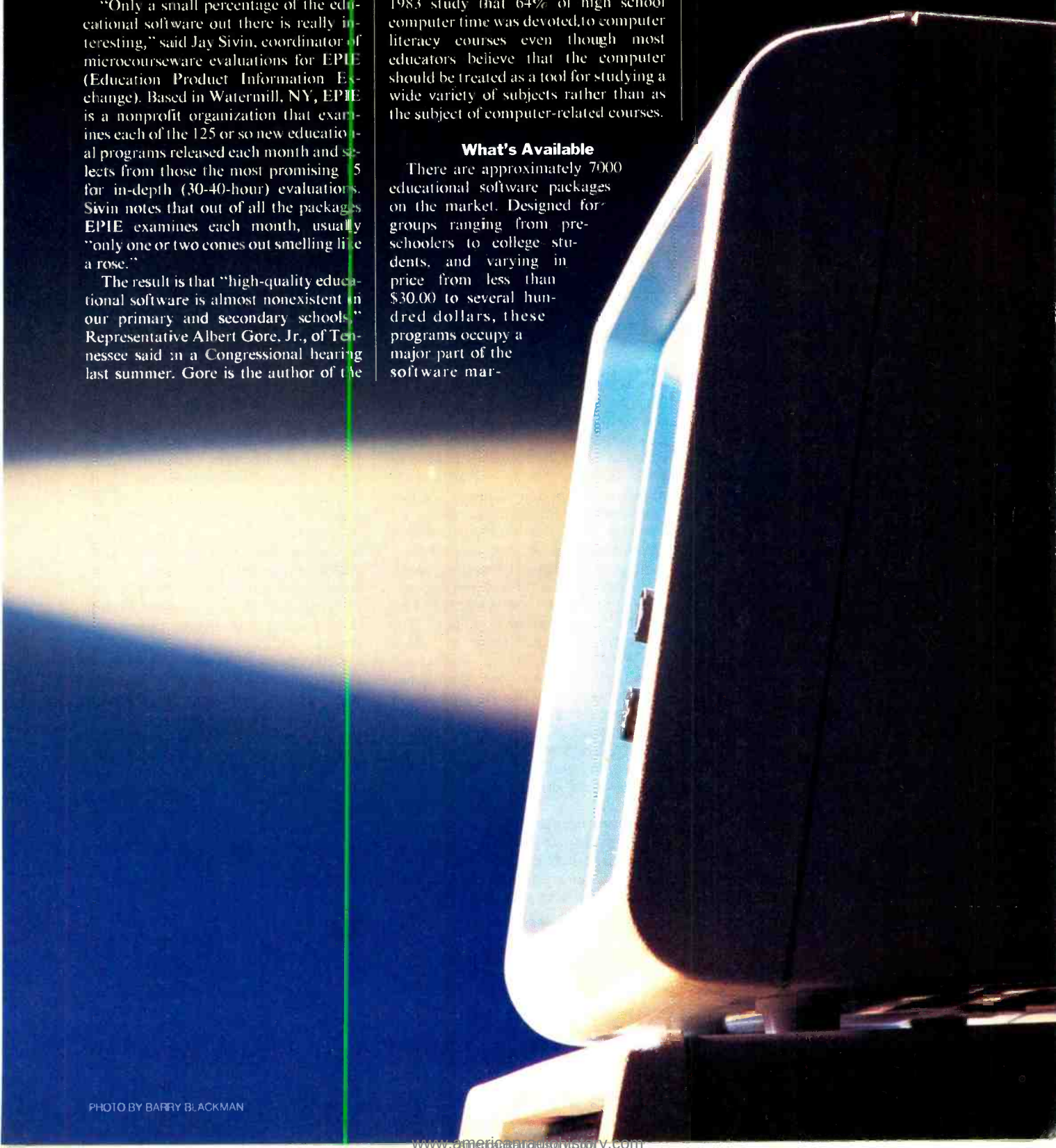
The result is that "high-quality educational software is almost nonexistent in our primary and secondary schools," Representative Albert Gore, Jr., of Tennessee said in a Congressional hearing last summer. Gore is the author of the National Educational Software Act of 1984, which would create a National Educational Software Corporation to fund R&D for educational software.

In the absence of good courseware, students spend most of their time at computers acquiring computer literacy rather than learning about anything else. The Center for Social Organization at Johns Hopkins University found in a 1983 study that 64% of high school computer time was devoted to computer literacy courses even though most educators believe that the computer should be treated as a tool for studying a wide variety of subjects rather than as the subject of computer-related courses.

What's Available

There are approximately 7000 educational software packages on the market. Designed for groups ranging from preschoolers to college students, and varying in price from less than $30.00 to several hundred dollars, these programs occupy a major part of the software market. Sales of educational software exceeded $130 million in 1983. Of that amount, $20 million was spent by schools, which form a rapidly growing market. (The number of computers in public schools, doubling in each of the last three years, has reached about

Paul Bonner is a technical editor of COMPUTERS & ELECTRONICS.



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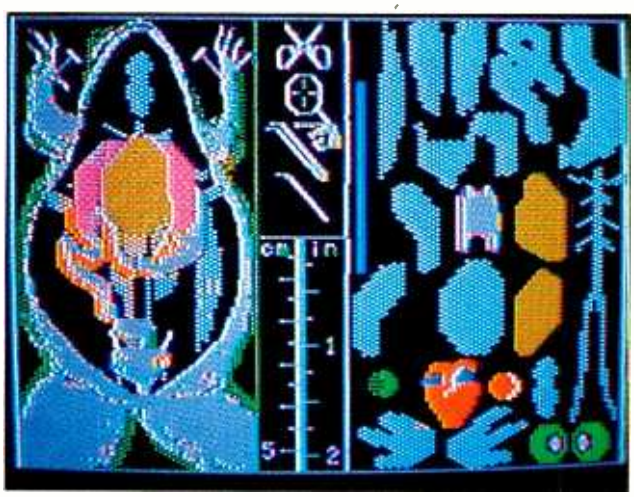
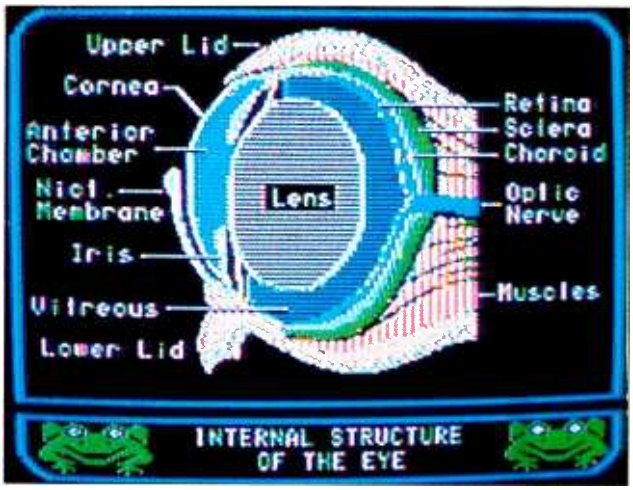
Computer-Assisted Instruction





Operation Frog recreates the high school biology class experience of dissecting a frog and supplies information about each of the frog's organs, including, at right, the frog's eye.

600,000, and is expected to double again in each of the next four years.)

The most common way educational programs instruct is through drill-and-practice. Generally, a drill-and-practice program resembles an electronic workbook. The computer presents the student with a few pages of information, then presents a quiz. Programs of this type were among the earliest examples of educational software. Dave Weaver, who coordinates courseware evaluations for the Northwest Regional Education Laboratory's MicroSIFT Clearinghouse, explained that "When computers were first introduced into schools you saw a lot of computerization of activities that teachers already do: drill-and-practice, workbooks on computers, those types of things. I call them direct instruction packages. They computerized something that was already taking place."

In the better examples of drill-and-practice software the computer adds something that could not be obtained from a workbook. Jay Sivin stated that in examining drill-and-practice software, EPIE's evaluators "look for an element that adds something that you can't get from a workbook. For instance, feedback or what the computer shows you or tells you after you respond. We look for graphic demonstration of the answer or how you would get the answer. We look for explanations of solutions. We would also look for the producer to explain why your answer wasn't right. In that kind of delivery system the computer is almost acting like a human tutor in addressing the specific problems that a student has." Using a computer in this way, a software author can make even something as unappetizing as an algebra drill "a much more enjoyable and motivating experience," says Sivin.

Weaver agrees with Sivin's criteria, but finds that drill-and-practice is overused. "Getting immediate feedback is one of the only advantages of direct instruction packages on the computer. That's why people still use it, and why there will always be a place for it in education." However, he added, many educators feel that the situations in which drill-and-practice software is appropriate are too few to justify the fact that 60-80% of the educational software available today falls into the drill-and-practice category. According to Weaver, "The general public is becoming much more critical of drill-and-practice and tutorial packages." and is tending to reject the "computerized workbook" type of program: "People began to realize that while the computer can do that and do it fairly well, there are other things that the computer can do that workbooks and textbooks really can't do." As a result, he says, MicroSIFT's evaluators have begun to give much higher ratings to programs that are exploratory, that do something that another medium doesn't do.

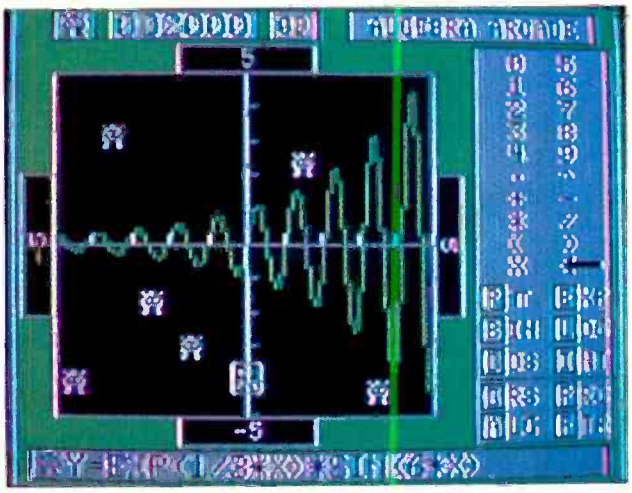
Not only does drill-and-practice software seem to underutilize the computer's special capabilities, but, as Sivin noted, "Drill-and-practice doesn't suit itself terribly well to a lot of high school fields, where the idea isn't so much simple memorization as interconnecting ideas and developing the ability to apply ideas. . . . High school social studies teachers will not be satisfied by having the student memorize a certain body of facts."

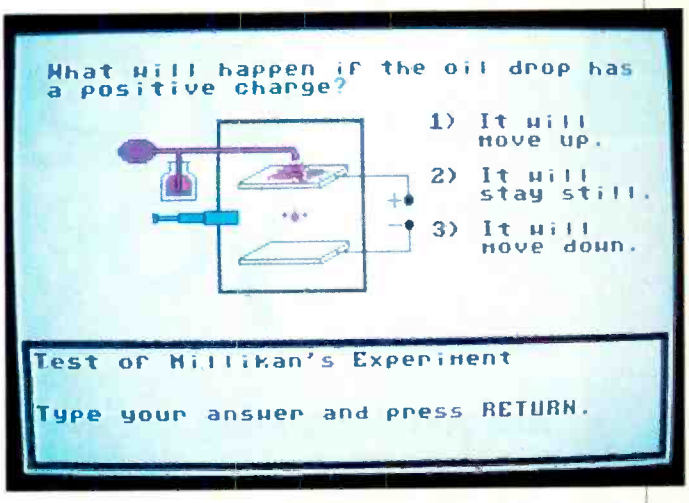
Fortunately, a second kind of educational software is beginning to emerge—software that simulates real-world events and gives students educational experiences otherwise unavailable. Although this genre of software to date comprises only about one out of 20 educational packages, examples of it dominate anybody's list of the most talked about and highly rated items.

One of the most popular simulations on the high school and college level is Catlab from Conduit. Catlab illustrates genetic theory by simulating cat breeding. Students can determine about six characteristics of the markings of a pair of cats whose offspring will be shown on the screen. They can form hypotheses about the dominance or recessiveness of certain markings and then test their theories over the course of dozens of generations in a matter of minutes rather than years.

Catlab doesn't intend to give students the detailed information a textbook would or to replace the textbook. Rather it tries to provide an experience that no textbook, in fact no other educational medium, can provide. Molly Hepler, a product manager at Conduit explained, "Certainly Catlab won't teach you everything about genetics. There are things that are better left to textbooks. But the thing about Catlab is the easy way that students can design experiments and replicate them. They can do many more experiments using the program than they could without it. Certainly at most universities you're not going to allow your introductory level genetics students to house cats, or any animal for that matter."

Thus, the point of simulations, as Sivin noted, is that some kinds of activities and problems will be out of reach to the student in a high school classroom without the computer at this time; "for





Algebra Arcade (left) asks you to enter an equation which, when plotted, will hit each "algebroid." The Arrakis Advantage (right) presents science concepts with interactive text and graphics.

instance, there are a couple of simulations of presidential campaigns. It's very difficult to have students experience what it's like to be in a real presidential campaign, but if you've got a good computer simulation, you can get the emotions and thinking flowing."

Selecting the Best

There are educational software programs that can, in Sivin's words, "really turn around an educational experience." On the other hand, there are also a great number of programs that are entirely mediocre, and finding the good ones can be a trying endeavor.

One thing that makes selecting the most effective programs difficult is that no one really knows how to tell if a program "works" or not. The research necessary to say that one approach is superior to another just hasn't been done. As Dr. Gary G. Bitter, coordinator of the Arizona State University Microcomputer Research Clinic, explained, "I can't give you direct evidence that this piece of software is effective or this one isn't. . . . It's too early to say that we're helping the algebra student learn math with

(Continued on page 92)

THE DARTMOUTH EXPERIENCE

Not everyone is gloomy about the educational benefits of computers. Students at Dartmouth have been using computers for more than 20 years, plenty of time to discover whether computers are the educational flops some critics suggest. In fact, the role of computers continues to grow at Dartmouth accompanied by the applause of students and faculty.

Dartmouth's uniquely long history of widespread educational use of computers began in 1964, when the university established a policy of free access to its time-sharing computers for all its students. In that year, Dartmouth also became the birthplace of the BASIC programming language.

Today, Dartmouth still leads in using computers for education. In 1984 an ambitious plan to tie every dormitory room into the school's high-speed information network was completed, giving each on-campus student access to the school's mainframe computers from his or her dormitory room. And to help the students use the network, Dartmouth has taken advantage of its membership in Apple's University Consortium to offer its students computers and software at discounted prices.

Their long experience with computers has given educators at Dartmouth an unusual perspective. For example, although educators elsewhere decry what they see as a shortage of educational software, William Arms, vice provost for computing and planning at Dartmouth, said that "by and large, specialized courseware is only a minor part of computing on most university campuses."

Arms finds no fault with using specialized courseware when appropriate. In fact, he said, Dartmouth has embarked on an "energetic program" to encourage the faculty to develop courseware. With funds from the Sloan Foundation, faculty members design courseware that they turn over to outside programmers to implement on the Macintosh. Among the areas in which courseware is currently under development are music, languages, chemistry, the social sciences, statistics, and logic. Software developed under this program will be shared with other colleges and universities through the Sloan Foundation and the Apple University Consortium.

In general, however, Arms believes the most interesting work being done with computers on campus is with general applications software: "Clearly there will be more courseware in the future, but I don't think that's the most important area." While most educational courseware seems to be in math and science, Walls said the humanities are probably the most active area in computing. However, he added, the degree to which computers are being used in the humanities is hidden because computers aren't being used to run courseware so much as they are being used, for example, in text processing, laser printers, and text sorting.

Dartmouth business students are also using computers heavily—for standard spreadsheet and database programs. Once again, the level of computer usage cannot be measured by the amount of courseware available in it. "Computers are general purpose tools," Arms notes. "Often they are best used with general purpose software." ◇

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A+ covers what you need to expand your Macintosh or Apple II series...current advances in telecommunications and networking...new ways to augment memory...how to

ary Disk—It's new, it's hot and word processing a snap.

Modem Magic—Reach out and access an information service.

access a wider variety of peripherals with greater ease ...what debugging aids *really* work...how to expand your RAM...ink-jet printers or dot-matrix printers...and the hardware you'll need to accomplish the jobs in your business and home!

You'll get this and so much more in each monthly issue of A+! Regular columns and features covering Graphics, Programming, Education, Games and Entertainment make A+ the source for new applications and ideas...and Rescue Squad, Thoughtware and Product News round out all the facts you need for your Apple!

A+ is the complete guide for Apple computing, *the* magazine you can't do without!

CRITICAL JUDGMENTS ABOUT EDUCATIONAL SOFTWARE

A noted educator argues for careful thought before we computerize our schools.

BY DOUGLAS SLOAN

EXTOLLING the computer as a boon to critical thinking, educators have been conspicuously uncritical about it. Scrambling to lead the computer-communications revolution in education, American educators have made no concerted effort to ask at what level, for what purposes, and in what ways the computer is educationally appropriate and inappropriate, in what ways and to whom we can count on its being beneficial or harmful. The overall picture has been one, instead, of educators vying to outdo one another in thinking of new ways to use the computer in all manners and at every level of education possible. As a result they have been almost totally remiss in their professional responsibility.

Why have American educators so persistently avoided the critical questions? Several possible answers come readily to mind. There are the obvious, not so flattering ones: Pushing computers is where the money is; it is better to be on the bandwagon than running to catch up, or standing in front of it; no one wants to be labeled a neo-Luddite, an antitechnologist, a nongrowth person, a mathophobe or computer-anxious one, the kind of person who would also have opposed Gutenberg and Copernicus—all the epithets even the mildest computer critic often is saddled with. Moreover, at a time when the nation's schools are widely perceived to be in trouble, the computer seems for many people to have come on the scene as a veritable *deus ex machina* to put all things right, and to relieve parents and teachers and all our sundry officials of any necessity for fundamental reexamination of self and society.

At the same time, the prevalence of the computer in the adult world tempts parents and teachers to have children enter that world, that is, to turn children into little adults, as soon as possible. The fear then quickly arises—and is often fanned by the computer and educational industries themselves—that children who are not introduced to the computer the moment they drop from the womb will have their life chances spoiled forever. Such anxiety, however, is a poor basis from which to think clearly about what is really best for the child and the child's own growth in learning. One consequence is that even the most obvious, critical questions about who stands to profit from the computer revolution go unasked. After all, it ought not to take a flaming Bolshevik, nor even a benighted neo-Luddite, to wonder whether all those computer companies, and their related textbook publishers, that are mounting media campaigns for computer literacy and supplying hundreds of thousands of computers to schools and colleges really have the interests of children and young people as their primary concern. But even more important are the educational questions that go unasked.

And here, perhaps, we see the main reason for the failure of educators to shape a critical perspective on the computer. Very little in the literature on computers indicates any sense of conflict between the dominantly accepted goals of modern education and the use of the computer. Increasingly, there appears a growing convergence of outlook among educators, parents, and the larger public that the chief goal of education is to develop the problem-solving skills of technical reason. And it is precisely these technical, utilitarian, logical skills that the computer is seen as best able to foster.

In all of this, however, it is forgotten that knowing involves a rationality of imagination and intuition much deeper and more embracing than technical reason alone. It is forgotten that the development of strong logic, and technical reason itself, may not best be served by the hot-house forcing of analytical and abstract thinking in children at an ever earlier age. It is forgotten that what may be appropriate for high school students and adults may be inappropriate and outright harmful for small and school-age children. In such a climate, therefore, to call for a critical look at the computer in education will be immediately seen by many as antitechnology and antitechnical reasoning. But it is none of these, and such a reaction simply misses what is really at stake. The central question is not whether one is for or against computers in education, but how to define the human educational criteria and priorities that can make a truly human use of the computer possible.

Crucial to any education worthy of the name is recognition of the central part played by the emotional-feeling life in all cognition. The main cognitive activity of the emotions is twofold. The emotions guide and empower logical reason, setting its goals and providing its energy. And, more important, feelings themselves, when properly developed and educated, work as our most penetrating and indispensable organs of cognition. It is only through a deep, feeling awareness that we can come to know the

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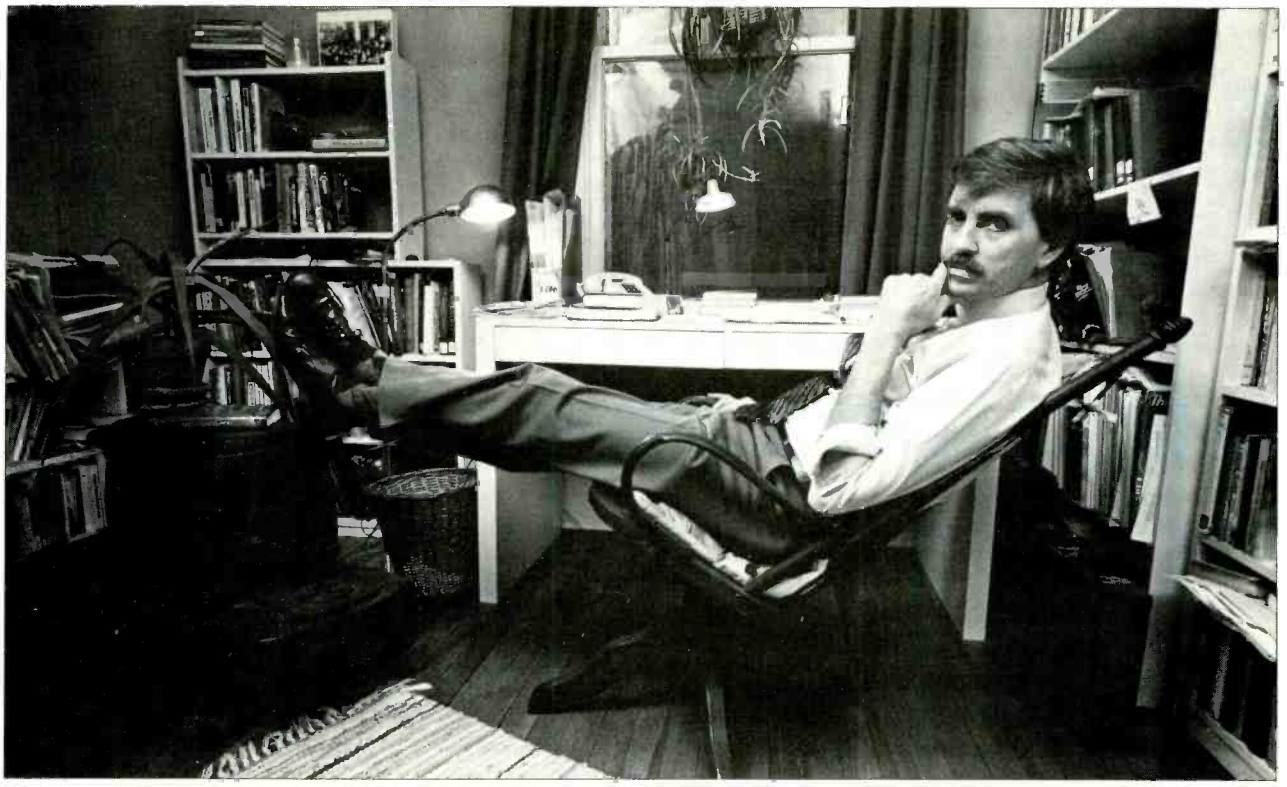
PHOTOS BY STEVE BORNS



qualitative dimension of life—in nature, in other persons, in ourselves. It is in this larger matrix of qualitative reality that all reason, including the logical and calculative, ultimately finds its ground. Qualitative knowing—the only kind capable of grasping living and personal reality, the only kind capable of giving value and purpose to quantitative knowing—requires a rich, vital emotional life.

Merely having feelings, however, is not enough (some "get-'em-all-out" schools of popular therapy to the contrary notwithstanding). Just as we can have false reasons, we can have false emotions. For the feelings to serve as organs of cognition requires that they be nourished and educated—inner discipline, energetic attentiveness, and discrimination are essential.

Modern education often seems, however, to have lost all sense of the cognitive significance of the feeling-emotional life. To be sure, a few educational psychologists champion the importance of "affective education," but almost always set it off against "cognitive education," and as a result probably do more harm than good. Otherwise, in most modern educational settings the feelings seem to be regarded mainly as problems—if they cannot be held in check, perhaps they can be channeled off, as in athletics—or are seen as opportunities for exploitation—"capture their interest," "make learning fun."

It is in this latter connection that the computer is frequently recommended as educationally important for children in that "it motivates them." Motivation by itself, however, it should be noted, is not an educationally sufficient argument *for* anything. When motivation is lacking in education, we may be sure there is a problem. Where motivation is present there may also be a problem; there will certainly remain a problematical situation. Children can be motivated by many things—ice cream, sex, cash, for examples. In the hands of an enterprising behavioral psychologist each of these could no doubt yield some interesting classroom procedures, but we should presumably like to know more before introducing them *carte blanche* into the nation's schools. Stirring up and snaring the feelings of children is not the same as nourishing and educating the feelings.

By relegating feelings to the realm of the peripheral in education, we not only weaken and short-circuit thinking, we leave individuals and society aswim in feelings that are unformed, maudlin, and brutish. A people whose feeling sensibilities are more and more dulled and coarsened will quickly lose the capacity to recognize that the health of society can never be gained through the gross national product, a new election, technological advance, or bigger defense spending. The atrophy of feeling-perception and feeling-intellect will have cut this people off from communion with the essential qualities of life.

What then does an education of feeling-intellect, of emotional rationality demand? A first, absolutely essential, requirement is the nourishment and development of a rich life of the senses. For the healthy development of growing children especially, the importance of an environment rich in sensory experience—color, sound, smell, movement, texture, a direct acquaintance with nature, and so forth—cannot be too strongly emphasized. And that fine sensitivity in discrimination which is the heart of emotional rationality arises in working and playing with the materials of the senses—through storytelling, drama, movement, music, painting, handwork, encounters with responsive, involved other human beings. What is demanded is clearly an artistic education in which the senses are nourished and sensibility and sensitivity developed. The lack of such an education can produce only a society that, whatever its cleverness and power, becomes increasingly philistine, insensitive to life, and uncaring, because incapable of truly knowing. And it becomes more and more a menace to itself and others.

One crucial form of question, then, is: What is the nature and quality of the sensory life and experience encouraged by the compuer? At what points and in what ways can the computer in education serve a vital, qualitatively rich life of feeling and feeling for life? At what points and in what ways will the computer in education only further impoverish and stunt the sensory experience so

(Continued on page 79)

BUYER'S GUIDE TO SCIENCE AND MATH EDUCATIONAL SOFTWARE

In the past few years, the widespread use of computers in schools has created a demand for quality educational software, and manufacturers are responding with a wide array of products.

Although educational software is available in almost every subject, many of the most innovative products are appearing in science and math education, where developers are taking advantage of the computer's capacity for graphics, animation and individualized instruction and offering software to supplement and enhance classroom learning.

Educational science and math software comes in many forms. Some developers take a traditional approach, providing drill-and-practice programs designed to reinforce knowledge in a specific area. A second approach couches educational concepts in game format. Perhaps the most interesting genre of science and math software, and the one currently receiving the greatest attention from educators, is simulation software. Simulations take advantage of the computer's capacity for animation and graphics to illustrate mathematical concepts and physical laws and properties and to allow students to carry out experiments impractical (or impossible) in the average classroom.

The chart on the following pages lists a sampling of math and science software for grades seven and up. Although software is available at primary levels, the seventh grade is generally regarded as the starting point for study of specific branches of math and the sciences, which our categories (biology, chemistry, etc.) follow.

Because of the phenomenal growth of the educational software industry, we could only select representative products. The following buyer's guide is by no means complete. Rather, we seek to give the reader some idea of the range of software products available for science and math education. Listings include price, compatibility, grade level, and a description of the product. For more information, contact the manufacturers listed below. ◇

EDUCATIONAL SOFTWARE PUBLISHERS

American Educational Computer
2450 Embarcadero Way
Palo Alto, CA 94303
415-494-2021

Avant-Garde, Inc.
PO Box 30160
Eugene, OR 97403
503-345-3043

Cambridge Development Laboratory
100 Fifth Ave.
Waltham, MA 02154
617-890-8076

CBS Software
1 Fawcett Pl.
Greenwich, CT 06836
203-622-2500

COMpress
PO Box 102
Wentworth, NH 03282
603-764-5831

Conduit
University of Iowa
Oakdale Campus
Iowa City, IA 52242
319-353-5789

EME (Educational Materials and Equipment Co.)
PO Box 17
Pelham, NY 10803
914-576-1121

Encyclopaedia Britannica Educational Corp.
425 N. Michigan Ave.
Chicago, IL 60611
800-554-9862

Focus Media
839 Stewart Ave.
Garden City, NY 11530
800-645-8989

J&S Software
14 Vanderventer Ave.
Port Washington, NY 11050
516-944-9304

Krell Software Corp.
1320 Stony Brook Rd.
Stony Brook, NY 11790
516-751-5139

Merlan Scientific Ltd.
247 Armstrong Ave.
Georgetown, Ontario
Canada L7G 4X6
416-877-0171

MECC
3490 Lexington Ave. N.
St. Paul, MN 55112
612-481-3500

Microcomputer Workshops Corp.
225 Westchester Ave.
Port Chester, NY 10573
914-937-5440

Micro Power & Light Co.
12820 Hillcrest Rd. #219
Dallas, TX 75230
214-239-6620

Prentice-Hall
General Publishing Division
PO Box 819
Englewood Cliffs, NJ 07632
201-592-2611

Scholastic Software
730 Broadway
New York, NY 10003
212-503-3000

Sunburst Communications Microcomputer Courseware Div.
39 Washington Ave.
Pleasantville, NY 10570
800-431-1934

WEPCO
10 Davis Dr.
Belmont, CA 94002
415-595-2350

BUYER'S GUIDE TO SCIENCE AND MATH EDUCATIONAL SOFTWARE

Program/Company	Price	Computer	Grades	Graphics	Description
BIOLOGY					
Biology: Genetics Encyclopaedia Britannica	$125.00	Apl	7-12	Y	Tutorials on Mendelian inheritance, sex determination, and chromosomal abnormality.
Biology: Energy and Life Encyclopaedia Britannica	$125.00	Apl	7-12	Y	Covers molecules, reactions, energy storage and transfer. Includes glossary and drill disk.
Biology: The Cell Encyclopaedia Britannica	$125.00	Apl	7-12		Lessons on cell theory, size and structure with glossary and quizzes.
Biology/Physics 1 MECC	$45.00	Apl	7-12	N	Simulations of scientific models including Millikan oil drop experiment and whale migration.
Biology/Physics 2 MECC	$49.00	Apl	7-12	Y	Science simulations designed to teach exploration through trial and error.
Biology Programs J&S Software	$250.00 (set) $28.00 (each) $225.00 (set) $27.00 (each)	Apl TRS	7-12	Y	Fifteen programs feature lessons on cell structure, plant and animal reproduction, genetics.
Catlab Conduit	$75.00	Apl	7 and up	Y	Genetics simulation allows students to breed cats and produce genetically valid litters.
Heart Simulator Focus Media	$55.00	Apl	7-12	Y	Graphic simulation of human heart with definitions and timing exercises.
Introductory Genetics EME	$85.00 $87.00	Apl TRS	7-12	Y	Five-part overview of principles of heredity. Simulations of breeding experiments.
Mark & Recapture Conduit	$50.00	Apl	7-12	Y	Simulations to introduce three techniques for estimating field populations.
Match Maker Biology Facts American Educational Computer	$39.95	Apl IBM	7-12	N	Drill-and-practice program and option to create new lessons. Based on SAT.
Microbiology Techniques EME	$55.00	Apl	10 and up	Y	Lessons and simulations covering experimentation methods.
Mendelian Genetics Merlan	$45.00	Apl Com	9-12	Y	Introduction to experiments and findings of Mendel.
Operation Frog Scholastic	$39.95	Apl	7-12	Y	Interactive simulation of frog dissection with explanations of internal organs.
Predation Conduit	$50.00	Apl	7 and up	Y	Simulation of predator-prey interaction.
PHYSICS					
Air Track Simulator Cambridge Development	$60.00	Apl	7-12	Y	Tutorial and simulation covering principles of collision. Student can set collision parameters.
Introductory Mechanics Conduit	$55.00	Apl	9 and up	Y	Simulations of physical laws of motion with animated graphics.
Mass Spring Cambridge Development	$60.00	Apl	7-12	Y	Simulates displacement of objects over time.
Periodic Waves Merlan	$36.00	Apl	9-12	Y	Tutorials and demos on waves and vibrations.
Physics Programs J&S Software	$195.00 (set) $28.00 (each)	Apl	7-12	Y	Twelve programs. Lessons on waves, sound, circular and uniform motion and scientific laws.
Standing Waves Conduit	$75.00	Apl	7-12	Y	Simulations designed to teach definitions and physical properties of waves.
Vectors and Linear Motion Focus Media	$99.00	Apl	9-12	Y	Lessons and problems on vector addition, equilibrium and acceleration.
Yellow Light Cambridge Development	$60.00	Apl	7-12	Y	Traffic simulation allows students to study factors affecting motion of a car at an intersection.
CHEMISTRY					
Arrakis Advantage Chemistry Prentice-Hall	$39.95	IBM	7-12	Y	Interactive tutorial with simulations covers basic principles and models of atomic theory.
Chemistry Democomp Series Focus Media	$119.00	Apl	9-12	Y	Simulations of kinetic theory, radioactive decay, scattering, and use of a mass spectrometer.
Chemistry Programs J&S Software	$250.00 (set) $28.00 (each)	Apl	9-12	Y	Fifteen programs. Molecular structure, periodic table, chemical equations, and organic chemistry.

Program/Company	Price	Computer	Grades	Graphics	Description
CHEMISTRY					
Chemistry: Acids and Bases Encyclopaedia Britannica	$59.00	Apl	9-12	Y	Covers acid/base equilibria; equilibrium of water. Features interactive graphic simulations of titration.
Chemistry: Stoichiometry Encyclopaedia Britannica	$59.00	Apl	9-12	N	Tutorials on understanding formulas, balancing equations, mole computation. Includes drills.
Element Hunt COMpress	$40.00	Apl	7-12	N	Game to reinforce knowledge of periodic table.
Writing Chemical Formulas Microcomputer Workshops	$29.95	Apl	7-12	N	Exercises and drills in writing chemical formulas.
MATHEMATICS					
Algebra Arcade WEPCO	$49.95	Apl IBM	7-12	Y	Arcade-style game in which user zaps "algebroids" by typing quadratic equations.
Algebra Word Problems 1 Microcomputer Workshops	$39.95	Apl	8-11	Y	Designed to help students solve motion problems by deriving and solving equations.
Arrakis Advantage Algebra 1 Prentice-Hall	$39.95	IBM	7-12	Y	Interactive tutorial with simulations covers number uses, numerical values, integers, and fractions.
Arrakis Advantage Geometry 1 Prentice-Hall	$39.95	IBM	7-12	Y	Interactive tutorial with simulations covers 39 geometry topics.
Challenge Math Sunburst	$55.00	Apl	7-12	Y	Three programs in game format designed to sharpen arithmetic skills.
Descartes' Delight Krell	$79.95	Apl	9-12	Y	Coordinate-geometry program for creating and animating Cartesian graphs.
Discovery Learning in Trigonometry Conduit	$75.00	Apl	9 and up	Y	Lessons and problems to encourage students to discover trigonometric principles through examples.
Intermediate Algebra Avant-Garde	$34.95	Apl	8-12	Y	Math problems to reinforce skills with distributive law, binomials, trinomials, and quadrinomials.
Introductory Algebra Avant-Garde	$34.95	Apl	8-12	Y	Four levels of algebra problems to solve. Lessons are automatically timed and scored.
Logic Workout Avant-Garde	$34.95	Apl Com	8-12	Y	Logic problems designed to develop thinking and problem-solving skills.
Math Man Scholastic	$39.95	Apl	7-12	Y	Arcade-style game designed to reinforce arithmetic skills at 12 levels of difficulty.
Math Skills—Junior High Encyclopaedia Britannica	$59.00	Apl	7-9	Y	Covers ratio and proportion, percentages, measurements, estimations, and graphing.
Mathematics for Science: Basic Math Techniques Merlan	$83.00	Apl Com	7-12	Y	Tutorials on significant digits, rounding off, and arithmetic applied to science.
Measurement Focus Media	$59.00	Apl Com	7-12	Y	Lessons and problems in measuring lengths, masses, and volumes.
On The Average Micro Power & Light Co.	$19.95	Apl	7-12	Y	Covers mean, mode, median, scores and variables, and frequency tables and curves.
Order of Operations Microcomputer Workshops	$29.95 $25.95	Apl, TRS Com	7-10	N	Designed to teach simplification of expressions through order of math operations.
Problem Solving in Algebra Encyclopaedia Britannica	$299.00	Apl TRS	9-12	Y	Five disks contain tutorials to help students translate word problems into equations.
Puzzle Tanks Sunburst	$55.00	Apl TRS	7-12	Y	Math problems to develop thinking and math skills.
Pythagoras and the Dragon Krell	$39.95	Apl TRS	7-12	Y	Adventure game in which students must answer math questions in order to proceed.
Solving Equations and Inequalities Sunburst	$55.00	Apl	7-12	Y	Uses graphics to illustrate algebraic problem-solving. Includes exercises.
Success with Math: Linear Equations CBS Software	$24.95	Apl Com	7-11	N	Drill-and-practice in solving linear equations.
Success with Math: Quadratic Equations CBS Software	$24.95	Apl Com	7-11	N	Drill-and-practice in solving quadratic equations.
Surface Conduit	$65.00	Apl	7 and up	Y	Allows students to display graphs of functions of two variables. Includes sample graphs.
Survival Math Sunburst	$55.00	Apl, TRS Com, Acn	7-12	N	Four simulations of real-life situations to reinforce problem-solving and basic math skills.

EVALUATING MACINTOSH

AFTER THE FIRST YEAR

Computer graphic created by Joseph Priebor with MacPaint based on a digitized image from I.O. Video, Cambridge, Ma.

Mac was widely acclaimed at its introduction last year, but very little software was available. How does it stack up now?

BY BRAD HESSEL & REDMOND SIMONSEN

If any one word best described the response to Apple's Macintosh at its introduction, it was excitement. The diminutive 68000-based fruit from Apple's orchard was powerful, attractive, and so-o-o-o easy to use. It had windows, pull-down menus, and even a mouse.

Upon its small rounded shoulders the Macintosh carried an awesome weight: the future existence of Apple Computer, Inc., and the last hope for a viable alternative to the implacable IBM PC. It's a tribute to the boldness of the basic Mac design that anyone would take seriously the competition between a 640K, mature, conservative micro from a $40 billion company and a 128K, unsupported, radically new, mighty-mite from a company less than one-twentieth the size. But Apple itself encouraged this comparison by proclaiming the new machine a powerful *business* computer "for the rest of us."

And just what software were the rest of us to run? When Mac made its debut, all that was available was MacWrite and MacPaint. Apple thoughtfully bundled these two packages with the machine—they knew you had to have them since there was nothing else.

Multiplan from Microsoft hit the market shortly after, but unfortunately the early version had some disturbing bugs. The only languages available in the first months were BASIC, also from Microsoft, and MacForth from Creative Solutions.

In the showrooms, some would-be drivers kicked the tires, looked under the hood and said, "Only one drive? Why is it so slow? Only 128K? No workable hard disk? No daisywheel printer? No built-in language, integrated software, or expandability? The numeric keypad is optional? No video port? No parallel port or bus connection? I *have* to buy an Imagewriter? No mainframe connection? No color? I *have* to use this mouse? Where are the slots? Where is third-party software? Is this really a business computer?"

So how has the Macintosh changed in the year or so since its birth? Let's first examine how the hardware—the Mac itself and the availabilty of peripherals—has changed, and then let's take a close look at the software.

Mac Hardware at Age One

Macintosh Memory. In September '84, Apple announced the availability of the "Fat Mac," a Macintosh with 512K RAM. Concurrently, it announced that owners of the 128K Mac could upgrade its memory for $995, which caused some grumbling among the Mac pioneers. The immediate benefit of the increased memory size was that users of MacWrite and Multiplan could create larger documents. Also, MacPaint users found that some parts of the program ran faster since an entire picture could be stored in memory. However, the long-range benefit of increased memory size will be that more powerful programs can run on the Mac. For example, Lotus Development Corporation has announced Jazz, an integrated software product that will run on a 512K Mac with dual disk drives.

Disk Drives. The Macintosh has an integral 3½" floppy disk drive, which was the only mass storage device available at introduction. Now, you can add a second floppy drive (available from Apple and other suppliers) or choose from a selection of hard disks. Tecmar, Corvus, and Davong, among others, offer add-on hard disks with capacities from 5M bytes on up. A hard disk greatly increases storage capacity and speed of operation, but some bugs surfaced in the early releases of the accompanying software. (See the hardware section for reviews of three hard disks.)

One outfit, the General Computer Company, sells a 10M-byte hard disk, the Hyperdrive, mounted *inside* the Macintosh. It also supplies a disk controller board piggybacked onto the Mac's digital board. This configuration allows a 5M-bits/s transfer rate of data to and from the hard disk. Normally, with outboard hard disks, connected to the Mac's serial port, the transfer rate is limited to about 700K bits/s.

Printers. One of the most annoying limitations of the Macintosh at its introduction was that it supported just one printer, Apple's Imagewriter dot-matrix printer. This condition has been alleviated somewhat by products that supply printer drivers or hardware interfaces for other printer models. For example, SoftStyle sells a printer driver called Epstart that will let you use an FX-80 or JX-80 dot-matrix printer with the Mac. For daisywheel printers, products like Creighton Development's ProPrint provide the drivers necessary to let you hook your Mac to most of the popular models. Some printers, such as Okidata's ML 92 and 93, are factory configured to interface with the Macintosh.

Although no formal announcement has been made at the time of this writing, Apple is expected to market a laser printer for the Macintosh this year. It will make it feasible for the Mac to function as a low-end typesetting system.

Modems. Like the printers at the Mac's introduction, standard modems couldn't be used with the Macintosh due to a lack of communications software. Even Apple didn't support communications back then. Now Apple's MacTerminal, as well as other packages, enables the Mac to communicate over the phone lines with modems like the Apple modem, Hayes Smartmodem, and Novation Smart-Cat Plus.

Specialized Hardware. The Mac's excellent graphics has attracted specialized hardware, such as the the ThunderScan by Thunderware. It's an optical scanning device that attaches to the Imagewriter printer and digitizes any printed image so that it can be used as a MacPaint document.

Mac Software at One

Even though the "Fat Mac" has been available for some time, just about the only "serious" software you can use with it is Multiplan. After a whole year of Maclife, the only word processor for the Mac is the original MacWrite (Microsoft Word, at this writing, is still a victim of repeated development delays); there is no integrated software, no really powerful database manager, no alternative spreadsheets, in short, no "power" software to enable the Mac to compete successfully as a business computer.

However, strong efforts are being made to produce software for the Mac.

Brad Hessel and Redmond Simonsen have been writing about and designing software for microcomputers since 1980. The two are presently partners in the NY-based software design firm, Redmond Simonsen Associates.

PHOTO BY DAVID ARKY

The release of several significant packages in the near future appears all but certain. The following products illustrate the trends of current and forthcoming software support for the Mac. (Products not yet commercially available are marked with asterisks.)

Applications Languages

MacForth is a full implementation of Forth with hundreds of additional commands to control the Mac ROM-ware. With a workspace of 50K in the 128K Mac, MacForth is the most useful applications language available. . . unless you want to sell your program (impractical) or give it away (impossible). In either case, you'd run afoul of this package's absurd licensing agreement.

Macintosh Pascal. Sophisticated application of windowing makes it possible to watch output and/or data as the program proceeds step-by-step. This interpreted version of Pascal is compatible with LisaPascal but closer to the ANSI standard.

Microsoft BASIC. Allows for multiple window editing of programs, including an output window. Supports both the Mac's ROM-ware and access to Multiplan file data. Near-compatible with other computer implementations of Microsoft BASIC. Limited to a 20K workspace in the 128K Mac.

Wordprocessing

MacWrite. The infamous 8½-page limit on document size expands to 80 for 512K Mac users. A new resident-on-disk edition reportedly will free RAM for 128K Mac users who need to work with bigger files. Given the slow speed of the Mac disk drive, it remains to be seen how good a solution that will be.

**Microsoft Word* supports footnotes, page numbering in Roman numerals, two (or more) columns per page, a glossary of user-defined oft-used "boilerplates," and more . . . everything for the writer except a spelling checker.

Spreadsheets

Multiplan. The old standby is significantly improved thanks to its new Mac ROM-ware support features, most notably, the mouse interactions. This is one application that does not suffer from the Mac's lack of cursor control keys. Selecting cells, rows, and/or columns—not to mention menu options—with the mouse is significantly more efficient. Multiplan was the one piece of "power" software for the Mac in its first year.

Databases

1stBase is a relational database application allowing simple "programming"

PHOTO BY DAVID ARKY

using IF-THEN-ELSE statements to refine sorts. Special features support report formatting, printing up to five labels at a time, and mail merge. It's a straightforward database program, probably the best currently available for the Mac.

Filevision is the first database software to support user-designed symbols (i.e., drawings), an interesting approach to databases. But you have to know how to draw, and amazingly, you can't use MacPaint-created files. The program's rudimentary sorting capabilities also limit its utility.

Integrated Software

**Jazz* combines wordprocessing, database, spreadsheet, communications, and business graphics functions. Requires a 512K Mac with a second disk drive. It is by far the software that most Macintosh users prefer, as was demonstrated in the survey described on page 61.

Graphics

MacDraw, which can be used with illustrations as large as 8′ by 10′, employs rulers, many lines and shapes, and other sophisticated graphics aids.

Microsoft Chart is a serious business graphics program that can use data from Multiplan, MacWrite, or Word files. You can invoke the standard Mac font, type style and high-resolution graphics patterns to customize pie charts, bar graphs, point graphs, area graphs, etc. A capable, if unimaginative application that omits such niceties as three-dimensional effects on bar charts.

Communications

MacTerminal. Presuming you have a modem and the right cable, MacTerminal controls connections to commercial databases and bulletin boards and supports TTY, VT52, DEC VT100, and IBM 3278 terminal emulation.

PC to Mac and Back includes disks for the Macintosh and IBM PC (or PC compatibles) plus a cable to connect the two computers. It also includes a connector for modem communications. This package is a great "off the shelf" solution for people who need to transfer files often between the two computers.

Project Planner

MacProject. Electronic PERT-charting of projects allows dynamic editing of time parameters and work flow.

Entertainment

MacManager is among the first games designed expressly for the Mac. MacManager is a compelling business simulation that employs clever window-based graphics.

Conclusions

Regardless of the hardware and software support the Mac is now receiving, its future remains cloudy. We still wonder, "Is the Mac really a business computer?" Despite Apple's insistence that it is, we feel that it is not and that it probably won't become a general purpose business computer in the same sense that an IBM PC is a business computer.

We don't mean that the Mac isn't a serious computer or that it is a failure in any way. It only fails to fit its square little body into the round hole that corporate Apple is obstinately attempting to jam it into. The Mac, we feel, is the quintessential *personal* computer—for individuals, not corporations.

We think that the folks in Cupertino need to examine who is really buying the Mac, where they are using it and for what. A less expensive Mac (somewhere in the low teens) could sell to millions of individuals as an appliance computer to be used for both serious and frivolous purposes. The great market-stalling anxiety attack that followed the home computer shakeout of '82-'83 could be relieved by a machine of Mac's obviously high quality and ease of use. The dormant home market seems to be the obvious market for the 128K Mac—and it's where competition is weakest.

The Mac will also find a place in business, but not as an alternative to the IBM family of microcomputers. Rather, it will find corporate employment as a special purpose device: to do business, professional, and educational graphics with software like Microsoft's Chart, MacDraw, and exciting peripherals like the ThunderScan; for in-house publishing with a typeset-quality laser printer (a huge vertical market wherein the Mac could annihilate the omnipresent low-end typesetting systems of Compugraphic Corporation); and for training applications where the mouse/icon environment is typically strong. Only small businesses and independent professionals will adopt the Mac as their primary desktop computer—its most likely role in large companies is as a workstation for publications and presentations.

We hope that Apple would see this kind of future not as a defeat but rather as the enormous opportunity it is. IBM has not been very successful in the home market and is still weak in the educational market. The Mac is a natural winner in both. We think that Apple should acknowledge the direction that the Mac user has taken instead of insisting it knows better that its natural customers. If it does, we think that the Mac will live to see many more birthdays. ◇

THE NEW YORK MAC USERS GROUP

It's something of a cross between a religious revival and an EST seminar. The brightly lit CUNY Graduate Center lecture hall is filled with hundreds of yuppyish men and women intensely awaiting the beginning of the evening's proceedings. Here and there you can spot a plaid flannel shirt or a heavy-lensed stare of preoccupation, but mostly it's business suits (male and female versions) and bright-eyed enthusiasm. Significantly, the women are fairly well-represented, constituting about 25% of the crowd. Although this is ethnically diverse New York, the room is overwhelmingly white and middle-class, bespeaking the unintentional economic barriers raised by the hardware "entry cost" one must pay to be part of this genial mob.

It's the first Tuesday of the month. 7:00 p.m. The New York Mac Users Group general meeting has begun.

NYMUG sprang from the organizing energies of (president) Steve Doochin, Wayne Smith, Cheryl Sandler, and a supporting group of like-minded early Mac enthusiasts in the spring of '84. Starting with a core of 18 members and growing exponentially with each meeting, NYMUG can lay claim to being the largest nonprofit Macintosh users group in the country. Its more than 600 members seem to represent, in microcosm, the general population of Mac users.

Peter Bloom is a member of the still informally organized officer cadre of NYMUG. In the depth and breadth of his involvement in the group and with the Macintosh, he is a one-man model of Mac demographics in all dimensions except one—he knows much too much about computers. Still a member of the Boston Computer Society, Bloom has had quite a lot of user-group experience. From that vantage, he revels in the tremendous vigor of the "interchange of information going on in NYMUG." He notices, however, that the $32.00 annual dues, although barely covering operating costs, induce some members to think of the group as a service that they have paid for rather than a club in which they must be contributing participants. Nonetheless, he is very enthusiastic and positive about the future of NYMUG.

In his work for an investment banking firm, Bloom uses an IBM PC and believes Apple is engaged in a Sisyphean struggle to penetrate that world: "I don't think the Mac will ever crack the Fortune 500 in any way that represents a significant market gain over IBM." Nevertheless, he is optimistic about the Mac's future as a high-end home computer. After many fruitless attempts to get his PhD-candidate fiancee to use his personal Kaypro or business IBM to write her dissertation, he finally weaned her from the electric typewriter by introducing her to Mac: Within minutes she was busily and happily word processing her way to her doctorate. "The reason I became a certified developer is that there are a lot more people out there like my fiancee than there are Fortune 500 customers".

A Case History

The story of a computerphobe being won over by Mac is repeated by Eileen Sandler, head of the writers' SIG, who used to be bored into catatonia by her Atari-using husband's constant microjargonizing. Then he got a Mac, and within ten minutes of seeing it she got so excited by it that soon she was almost monopolizing it. Now she uses the Mac as a file system and writing tool for much of her advertising copywriting work. Sandler's husband uses the Mac to mock up ads as well as for more traditional business uses.

Very proud of the diversity and strength of her SIG, Sandler can tick off an impressive list of news magazine writers, fund-raisers, newsletter publishers, and freelance authors that she counts in her membership. Nevertheless, the SIG is frustrated with the dearth of available word processing software for the Mac and the limitations of MacWrite.

The Forth language SIG is one of the happy side-effects of the lack of a Mac built-in language. Nick Karp, the SIG leader, was urged to try Forth by a non-Mac-owning friend. Since there was no Pascal at the time (the language he knew when he bought his Mac at Princeton) and Creative Solutions MacForth was the only language that provided a reasonable amount of program space on the 128K Mac, he gave it a whirl. He is now firmly hooked—so much so that he's built a SIG with over 20 members to exchange notes on Forth programming and to introduce Mac users to the lan-

guage. Currently the group works with MacForth, which Nick considers to be "a very professional package . . . limited by its expensive ball-and-chain licensing agreement." He looks forward to Mountain View Press's public domain Forth and Laboratory MicroSystems license-free Forth for the Mac.

Nick's buddy, Eric Lee Smith, is another Forth convert who also acts as the managing editor of NYMUG's impressive 16-page newsletter, *The Mac Street Journal*. The MSJ is, of course, produced entirely on the Mac and is a good showcase for the computer-assisted graphic capabilities of the machine. "One of the most important yet seldom mentioned powers of the Mac," says game-designer Smith, "is the power it gives to the self-publishing artist and writer." Don Ross, the *Journal's* art director, concurs. He is busily marketing a MacPaint-drawn syndicated comic strip. One of the hurdles Ross faces is convincing Luddite editors that a computer is a legitimate drawing medium (some mistakenly believe that the computer actually originates the drawing, concept and all!).

"If the Apple II was a Model-A Ford, the Mac is the Volkswagen (and the IBM PC is an old Packard)," says Carol Lekashman, the NYMUG business SIG captain. The 40 lawyers, traders, bankers, investors, and marketing professionals in her group are naturally very applications-oriented. Carol notes that many of them typify the Mac-owning business user, powerful and/or independent enough to make determinations about what computer to use at work. Still and all, many use the Mac at home.

The SIG considers the *PC-to-Mac and Back* package from Dilithium (and other software like it) to have special importance because of the mixed machine environment that they often have to endure. Lekashman, if granted a magic wand to alter the Mac, would have it packaged with two drives in a KayPro-style transportable configuration with multitasking software. A banking operations and marketing consultant, thoroughly familiar with the computing environment of the corporate U.S., she wholeheartedly embraces the Mac user-interface concept: "I have three programs that I can make productive use of without ever having read the documentation."

New SIG's have been forming at virtually every NYMUG meeting. There's a graphics SIG (of course), assembler, video, and technical SIG's as well as a new C-language SIG. These workshop units are the living cells of the NYMUG main body. The New York Mac Users Group, and the other groups much like it across the country, are the leading crest of the Mac wave. In the vigor, enthusiasm, and optimism of its members, one can see a bright and active future for Macintosh.

User Survey

Last fall, 59 members of the NY Mac Users Group assessed the machine, returning a 20-question survey mailed to over 300 members of NYMUG. Members of NYMUG are representative of the Mac audience: young urban professionals for whom the Mac and computing are a great new adventure.

We asked members to rate various aspects of the Macintosh, on a scale from 0 to 9. The most popular features of the Mac turned out to be the user interface, the mouse, and MacPaint. The least popular features include MacWrite, the disk drive, and the peripheral port configuration:

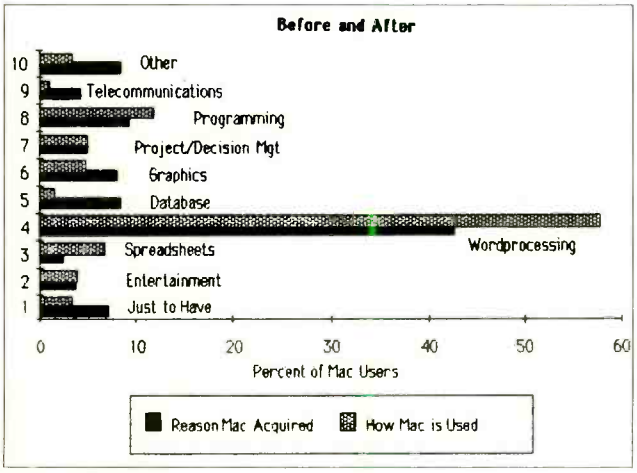
8.53—User Interface
8.03—Mouse
7.83—MacPaint
7.75—Imagewriter
7.71—Keyboard
7.69—Video Hardware
7.50—Macintosh (overall)
7.18—Peripheral Ports
6.79—Disk Drive
6.75—MacWrite

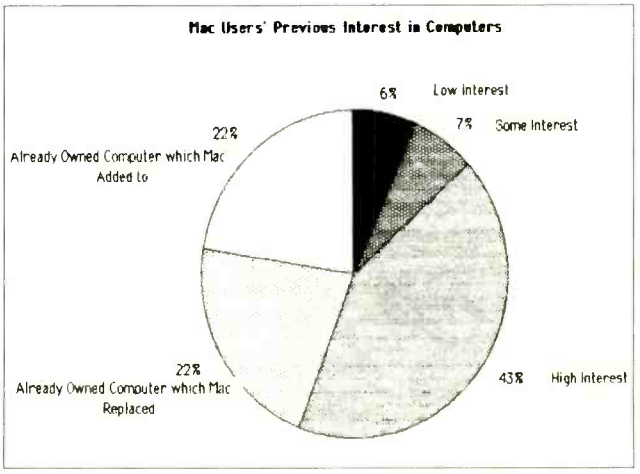
Respondents have had Macs for an average of 5.31 months; they spend an average of 2.69 hours/day at them.

We also asked members to name the single category of use that most nearly matches the main reason they acquired their Macs, and then we asked them to name the category that most nearly matches their *actual* use of the Mac (see the bar chart below). Of all respon-

(Continued on page 90)

RESULTS OF A SURVEY OF THE NEW YORK MAC USERS GROUP





THE DATA GENERAL/ONE

A head-to-head comparison of the two leading contenders for the lightweight MS-DOS crown.

BY ASHLEY GRAYSON & JOHN VORNHOLT

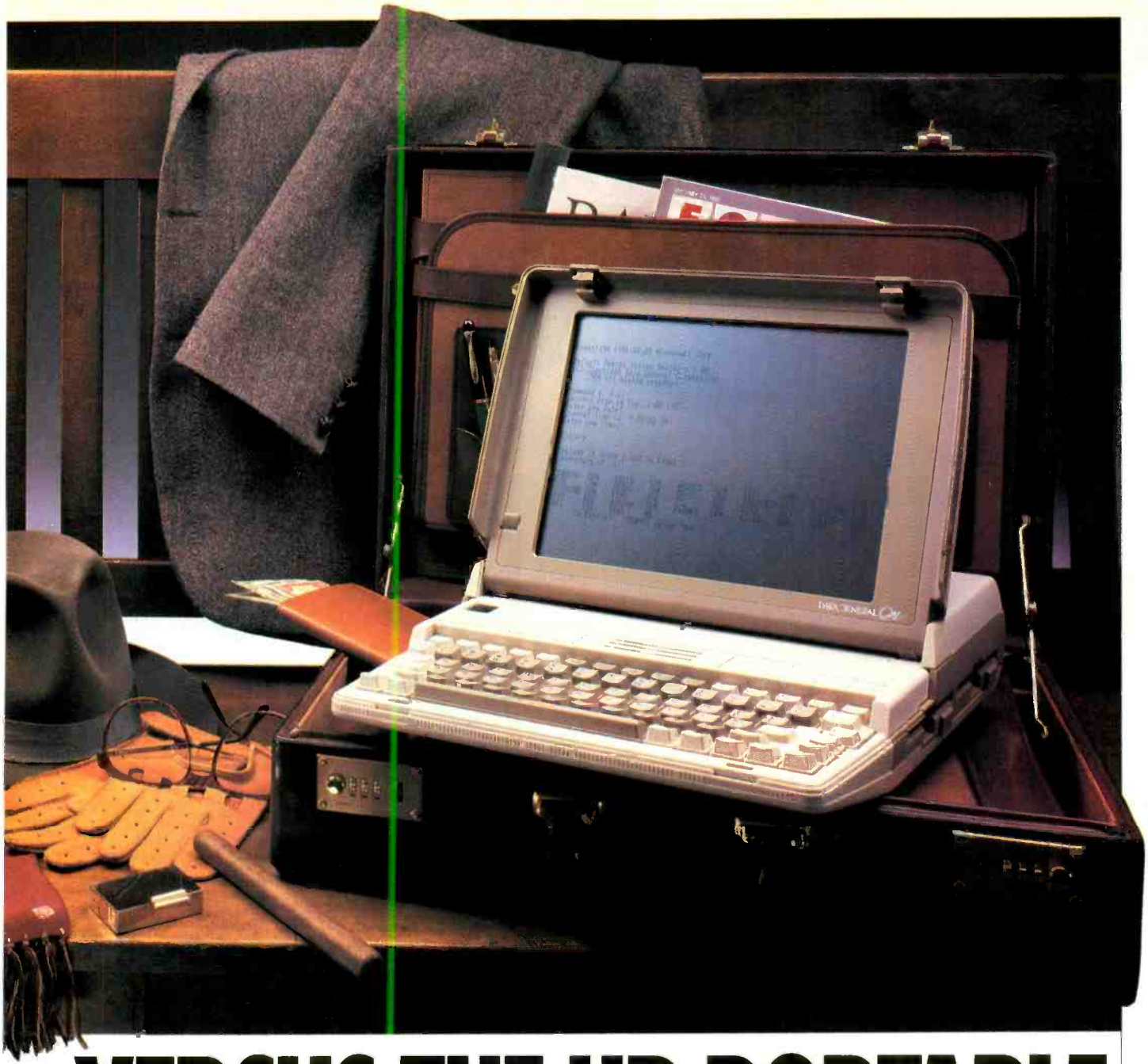
TAKE a trip and you'll see portable radios, portable TVs, portable cassette players, portable compact disc players—and portable computers. For many people, the ability to take computing "on the road" is a godsend and may very well, in the future, become a necessity. Two prominently advertised portable computers, the Hewlett-Packard HP-110 and the Data General/One offer much of the power and convenience of the IBM PC in portable form. Both are sleek, compact, and powerful. But they are quite different from one another.

The HP-110

Philosophically, the HP-110 is closer to earlier lap computers, such as Radio Shack's TRS-80 Model 100, than is the Data General portable. It's entirely self-contained and can be used without disk drives and external storage devices. It has a CMOS processor, the 16-bit 80C86, and 272K of battery-backed-up CMOS RAM, which means that programs and data do not vanish when the computer is turned off. This feature accounts for much of the popularity of the Model 100 and similar computers. The ability to turn the computer off without worrying about having to save data is a tremendous convenience.

Hewlett-Packard offers an external 700K 3½" disk drive for its portable and a system called Desktop Link, which is a hardware controller card you can plug into an IBM PC to give you access to its disk drives. Even so, HP expects you

PHOTOS BY BOB LORENZ



VERSUS THE HP PORTABLE

normally to keep data indefinitely in the portable's memory or upload information via the built-in modem or serial port to a larger computer for storage. All the software necessary to accomplish these tasks is furnished in ROM.

Hewlett-Packard is to be praised for fully exploiting the power and convenience of ROM-based programs. Most microcomputer users have come to depend upon three staples: word processors, spreadsheets, and database managers. Many also require telecommunications. Including these software applications in firmware is a marvelous idea. With 384K of ROM, the HP-110 leads all microcomputers in this area.

Hewlett-Packard guaranteed itself access to a base of experienced users by including Lotus 1-2-3 in ROM. This integrated spreadsheet/database/presentation-graphics package remains one of the most popular and useful programs ever offered for microcomputers. Even Lotus's more recent product, Symphony, has failed to win many users away from 1-2-3. A ROM-based version of Symphony was to have been offered for the HP-110, but plans to do so were recently abandoned. For manipulating spreadsheet data in any imaginable form, 1-2-3 is superb, and it runs faster from ROM than from disk. The best feature of all is that the program and its data are always there, accessible at the touch of the on-off switch.

The HP-110's ROM includes four other applications: the MS-DOS operating system, a menu-driven user interface called PAM (Personal Applications Manager), a telecommunications program (Terminal) designed to work with the built-in modem, and a simple word processor called Memomaker. Memo-

Ashley Grayson operates ADG, a high-techology marketing firm, and John Vornholt is a free-lance writer in Los Angeles. They have recently co-authored a book, Computers to Go—A Guide to Briefcase Portables, *published by Simon & Schuster.*

Accessories courtesy Barney's New York (gloves), La Bagagerie (Travel Organizer), Nat Sherman (lighter and cigar), Optyl Design (Dunhill Glasses), Crouch and Fitzgerald (attache case)

maker and Terminal are very usable programs, although neither one comes close to Lotus 1-2-3 in quality.

The average user may never need to learn a single MS-DOS command, because the PAM user interface handles every operation one is likely to need, from creating Unix-like directories to configuring the communication ports.

Still, if you own only the basic model, you may miss having a built-in disk drive if you want to access nonresident MS-DOS utility programs, such as SORT and MORE, the graphics printing routines for 1-2-3, or the system diagnostics, all of which are available only on disk.

The Data General/One

The Data General/One behaves much more like a traditional desktop computer. The basic unit comes equipped with a 730K 3½" disk drive and space for a second drive (which would add 3 lb). It uses an 8/16-bit IBM PC-compatible CMOS processor, the 80C88, and, like the HP-110, low-power CMOS static RAM. Data General decided, though, not to provide back-up power for that RAM, and anything in memory is lost when the machine is turned off. The disk drive(s) here are a necessity.

Because the Data General/One depends totally on disk to load the operating system, programs, and data, opting for the second internal drive makes as much sense as having a second drive on any desktop computer. A second drive makes backing up and copying files easier and safer. Further expansion with the 5¼" external drive or the full IBM PC-compatible expansion chassis gives the user the equivalent of two computers for the price of one expensive one.

Like the desktop computers it has tried to emulate, the DG/One contains a meager amount of ROM, only 32K. It contains standard MS-DOS booting instructions and two rather unimpressive programs. The DG/One's Notebook program appears at first glance to resemble the HP-110's Memomaker, but it can only create or edit a file in active memory—it cannot access the disk. This shortcoming can be serious: If you are forced to turn off the computer in the middle of a Notebook session, all your work will be lost.

Notebook and the terminal program work only with each other, allowing uploading and downloading of text files from a common 40K buffer. Since this buffer is volatile RAM, the text does not remain in memory after the computer is turned off. Furthermore, incoming data can be dumped only to this buffer or printed; files cannot be dumped to one of the built-in disk drives.

(Editor's note: Data General, when questioned about this problem, stated that these utilities were intended primarily for desktop use of the computer. Normally, you would use disk-based word processor and communications programs, thus circumventing the volatile RAM problem. The Data General/One's built-in modem, by the way, understands the Hayes "AT" command set. There should be little difficulty in adapting most commercial communications software to work with it.)

Data General has repeatedly said that it limited its ROM-based programs to avoid interfering with possible third-party software sales. This reasoning is consistent with the company's minicomputer tradition of providing hardware from which other people can make money by providing software.

Comparing the unexpanded basic units, we found the HP-110 is a more useful machine as a portable. Had Data General provided better ROM-based programs and battery backup for its computer's CMOS memory, it would have had a superior briefcase computer. As it is, IBM compatibility is the DG/One's main draw.

Specifications

Product: HP-110
Mfr: Hewlett-Packard Co.
11000 Wolfe Rd.
Cupertino, CA 95014
Suggested Retail: $2995
Weight: 9 lb
Dimensions: 13" × 10" × 3"
Operating System: MS-DOS
Features: 80C86 CMOS CPU, 272K CMOS RAM, 348K ROM, 80 × 16 LCD, 300-baud internal modem, 1-2-3, Terminal, Memomaker, PAM
Options: Thinkjet printer, 720K 3½" disk drive, Desktop Link interface

IBM Again

While the HP-110 is designed to work with an IBM PC, the DG/One can actually take the place of one. A Data General system that includes the optional external 5¼" disk drive and a full complement of 512K of RAM is remarkably compatible with the IBM PC. As much as three-fourths of all IBM PC programs will run right out of the box. Such popular and complex programs as dBase III, ThinkTank, Sidekick, Lotus 1-2-3, WordStar, and Multiplan run quite well. PC-DOS itself will boot from the larger drive, as will graphics-intensive programs like Microsoft's Flight Simulator. The DG/One can easily be configured to emulate any IBM PC display mode, from straight monochrome to 40-column color.

Even without an external disk drive, most IBM PC software would run on this computer if merely converted to the 3½" medium. Standard MS-DOS COPY and DISKCOPY commands do the trick quite nicely. Copy-protection schemes, of course, make that process a bit more difficult, and Data General hopes that software vendors will transfer their programs to the 730K double-sided double-density 3½" disks themselves. (And, as of this writing, about 150 programs—from spreadsheets, scientific packages and word processors to games—were available in this format.)

No computer, of course, is totally IBM PC compatible. Several IBM PC public domain modem programs would not run properly on the DG/One (probably because the UART IC used by the DG/One is different from the one used in the PC). Neither Compaq's nor IBM's BASIC would run on our evaluation unit, but GWBASIC, available from Data General, presented no problems.

The HP-110, on the other hand, does not really attempt IBM program compatibility. But it *can* read and write directly to IBM disk drives with the Desktop Link, the half-sized card that plugs into an IBM PC expansion slot. This special interface comes with a program on a 5¼" disk for the PC to allow the larger computer to emulate an HP-110 external 3½" disk drive. The HP-110, in turn, writes or reads files to or from the IBM's disk in standard IBM format. A version of Desktop Link is also available for Hewlett-Packard's own desktop unit, the HP-150.

Specifications

Product: DG/One
Mfr: Data General Corp.
4400 Computer Dr.
Westboro, MA 01580
Suggested Retail: $2895
Weight: 11 lb
Dimension: 12" × 14" × 3"
Operating System: MS-DOS
Features: 80C88 CMOS CPU, 128-512K RAM, 32K ROM, 80 × 25 LCD, 730K 3½" disk drive, 5½" internal disk drive, Notebook Terminal
Options: Portable printer, second internal 3½" disk drive, 5¼" external drive, IBM PC-compatible expansion chassis, 300-baud internal modem

Rather than aiming for PC compatibility, the Desktop Link is intended more to facilitate the transfer of files from the HP-110 to the IBM's disks for permanent storage. The idea is that if you already have disk drives on another computer, there's no reason to duplicate the hardware. You can just send files to the other computer for archival storage. This capacity is especially useful for 1-2-3 files, which can then be used by the PC.

Some very generic MS-DOS and text-only programs may run on the HP-110, and Hewlett-Packard has released some popular programs, like WordStar, configured for it. Luckily, even an owner who doesn't have a disk drive or Desktop Link can load programs into the HP-110 using its terminal program. That program can transmit text or binary (program) files over the built-in modem or through the serial port using MODEM7 (XMODEM) protocol, which is common on most electronic bulletin boards and database services offering public domain software.

LCD Screens

The world seems equally divided between those who can tolerate liquid crystal computer displays and those who cannot. Unlike a self-illuminating CRT that can be read in the darkest room, LCD's, which depend on reflected light, require optimum conditions for any sort of prolonged use. With the right screen angle, the right contrast adjustment, and the right lighting (not too high an angle, or the display will not be illuminated,

and not too low, or there will be glare), an LCD can actually make an acceptable monitor. Someone may get rich designing a briefcase computer with a fold-out reading lamp.

The DG/One is the first computer widely available in the United States with an 80 column by 25 line LCD. Others, including Apple, have promised one, but Data General was the first to deliver. The DG/One's screen can display the same bit-mapped high-resolution graphics as the IBM PC, 640 by 256 dots. The HP-110's display is only 16 rows by 80 columns, with a dot resolution of 480 by 128. While this is fine for displaying Lotus 1-2-3's bar and pie charts, complex graphics are out of the question.

The characters on the DG/One's screen appear darker and easier to read than those on the HP-110. But the angle of the screen is not adjustable, and its tilt doesn't quite reach a comfortable angle. And, when the ac power adapter or any external device is attached, the screen is tilted even further forward by a fold-down stand that normally covers and protects the computer's rear-panel connectors. You will probably find yourself stuffing books and papers under the front of the computer to improve the viewing angle. (DG is now offering a new pop-in lens which it claims will improve the aspect ratio of the LCD screen from 3:1 to 5:1. The lens will be shipped without charge to registered DG/One owners, DG told C&E.) The HP-110's display, while holding somewhat fewer characters and including less of a graphics capability, is generally more legible.

Unfortunately, neither computer makes provision for the connection of a CRT monitor. DG does offer an optional expansion chassis for IBM PC-compatible expansion boards. A video board is thus feasible but hardly as convenient as would be a simple composite video port built into the computer. The defunct Gavilan briefcase computer had a composite output, allowing it to work with many $99 monitors.

Power and Memory

The HP-110 is designed to be run for 8 to 10 hours from a gelled-electrolyte lead-acid battery pack, and ac is used only to generate dc to keep the battery pack charged. The computer can be used with the recharger plugged in; the batteries just won't charge as quickly. The basic DG/One is intended for operation from ac. It comes with a lightweight adapter that plugs into a wall socket. A quick-charge nickel-cadmium battery pack that can be charged to 80% of its 8-to-10-hour capacity in two hours is a $178 option and requires a separate adapter. To use the computer while the batteries are charging, *both* power adapters must be plugged in. The necessity for carrying two adapters while traveling can be a slight nuisance, but the units are light and relatively small and fit easily into the computer's carrying case.

The HP-110 makes efficient use of its CMOS technology and retains programs and data in memory indefinitely (you can shut off the display to conserve power, but you can never turn the computer completely off). In contrast, the DG/One's memory works just like that in a standard desktop computer—when the computer is turned off, all power to the RAM is removed and whatever data it contained are gone.

Both computers allow their memories to be used as solid-state disks. From the PAM menu, the HP-110's 272K of RAM can be divided into normal system memory (used exclusively by the current application) or an Electronic Disk (EDISK). EDISK is a partition of memory from 16K to 176K that can contain any number of files and is treated like a superfast disk drive by the operating system. In fact, it becomes MS-DOS drive A. EDISK is especially useful for storing small text and Lotus files.

In the case of the DG/One, while the computer is running, a portion of RAM can be set aside as a virtual or electronic disk with the MS-DOS utility VDISK; but, as has already been pointed out, no input is retained in memory after the computer is turned off. Using battery backup for CMOS memory is only natural in a portable computer, and it's a wonder Data General didn't afford its product this convenience.

Other Considerations

The Hewlett-Packard computer wins the telecommunications derby hands-down, with an internal 300-baud modem as standard equipment and a far superior terminal program. Data General charges $299 extra for its internal modem, and the only useful thing its terminal program does is to emulate a Data General dumb terminal. (To be fair, however, commercial communications programs will run on the DG/One. They cost extra, though.) Both computers can access external modems though RS-232 serial ports. The HP-110's RS-232 connector is somewhat less than standard, though, having only 9 pins instead of the usual 25.

Neither computer comes equipped

CHEVRON PICKS THE HP PORTABLE

THE Chevron Corporation's first venture into portable computers was with the Compaq. Employees used it to work at home evenings and weekends, and, occasionally, took it on trips. Traveling with a machine that size, however, was awkward. Also, they wanted the ability to operate from battery power.

The company experimented with Radio Shack TRS-80 Model 100s—it purchased some 20 or 30 of them—and had reasonable success with them, despite the machine's somewhat limited capabilities. What it really needed for its purposes, though, was a 16-bit computer that could run Lotus 1-2-3.

Chevron's criteria were practicality, ease of use, a workable keyboard arrangement, light weight, the ability to run from batteries for a reasonable length of time, the availability of peripherals and, of course, the capability to run 1-2-3.

Among the computers considered were the Gavilan and Convergent Technologies' Workslate. The HP-110 was also a candidate, and ultimately, the winner.

Cliff Hayes, the head of Chevron's Personal Computer Services Division, says that the reasons for selecting the HP-110 were the fact that it had 1-2-3 in ROM, ran it faster than other computers tested, had a word processor that was easy to use, and was built to a high standard of quality.

When asked whether, if it had to make the choice today, his company would consider the DG/One over the HP-110, Hayes replied that it would still stay with Hewlett-Packard. The Data General computer had been tested and found to have certain shortcomings, notably, difficulty in communicating with the corporate IBM mainframe computer, a difficult-to-read display, and memory that would not retain its contents when the computer was turned off.

Chevron currently has about 70 HP-110s, with quite a few more on order. The computers are used in the field, where they can transmit data back to the home-office mainframe and IBM PCs, and are also taken home by employees who are learning 1-2-3. ◇

with a parallel printer port, although Hewlett-Packard offers a $175 adapter that turns the proprietary HP/IL (Hewlett-Packard Interface Loop) into a Centronics-compatible port. The HP/IL works well with Hewlett-Packard peripherals, like the wonderful Thinkjet printer. Daisy-chaining on the Interface Link allows up to eight HP-110s to be joined in a sort of mini-network, with one of them acting as the host and transferring files to the others.

The DG/One, with its two 25-pin RS-232 ports, offers better compatibility with a wide range of printers, plotters, and peripherals. The company also offers an extremely compact Japanese-built printer with an RS-232 interface. It can print either on thermal paper or, with a special thermal-transfer ribbon, on ordinary paper. All the peripherals and add-ons for both systems are well designed for space-saving convenience, exceptional functionality, or both.

Conclusions

The Data General/One would be the logical choice for anyone wanting a briefcase computer reminiscent of an IBM PC that can run a large amount of PC software. That should be a sizable number of people. And, while the 25-line screen may sometimes be difficult to read, it should also add to the computer's appeal. You will undoubtedly end up spending more money for this one than for the HP-110, especially if you opt for the 5¼" disk drive or the IBM card chassis, but the additional outlay may be worth it if the computer meets your needs.

The HP-110 is a simpler machine. It doesn't need disk drives (which may prove to be too fragile in the long run for a lot of rough-and-tumble travel). Programs and data are always immediately accessible, even when you are in an airport terminal or while you are in flight. Most single users will find that 272K of CMOS RAM is more than enough for everyday Lotus 1-2-3 and text files. If not, the Desktop Link and Terminal afford a convenient means to transmit those files elsewhere. Nevertheless, the HP-110 makes a better second computer than it does an only one. ◇

LIFE OF VIRGINIA PICKS THE DG ONE

THE Life Insurance Company of Virginia has been using microcomputers for several years. Among those in its stable are Apples, Radio Shack computers, IBM PCs, and PC compatibles. It has developed its own proprietary software for these systems for use in writing custom-tailored "universal life" policies, which require the consideration of a number of variables and use complex algorithms to determine such items as payment schedules.

To afford its field representatives the benefits of computers, the company originally invested in 2000 Panasonic HHCs (Hand Held Computers). These, unfortunately were not particularly easy to use. The keyboards were extremely small, as was the LCD screen. Furthermore, full compatibility with main-office programs was not possible.

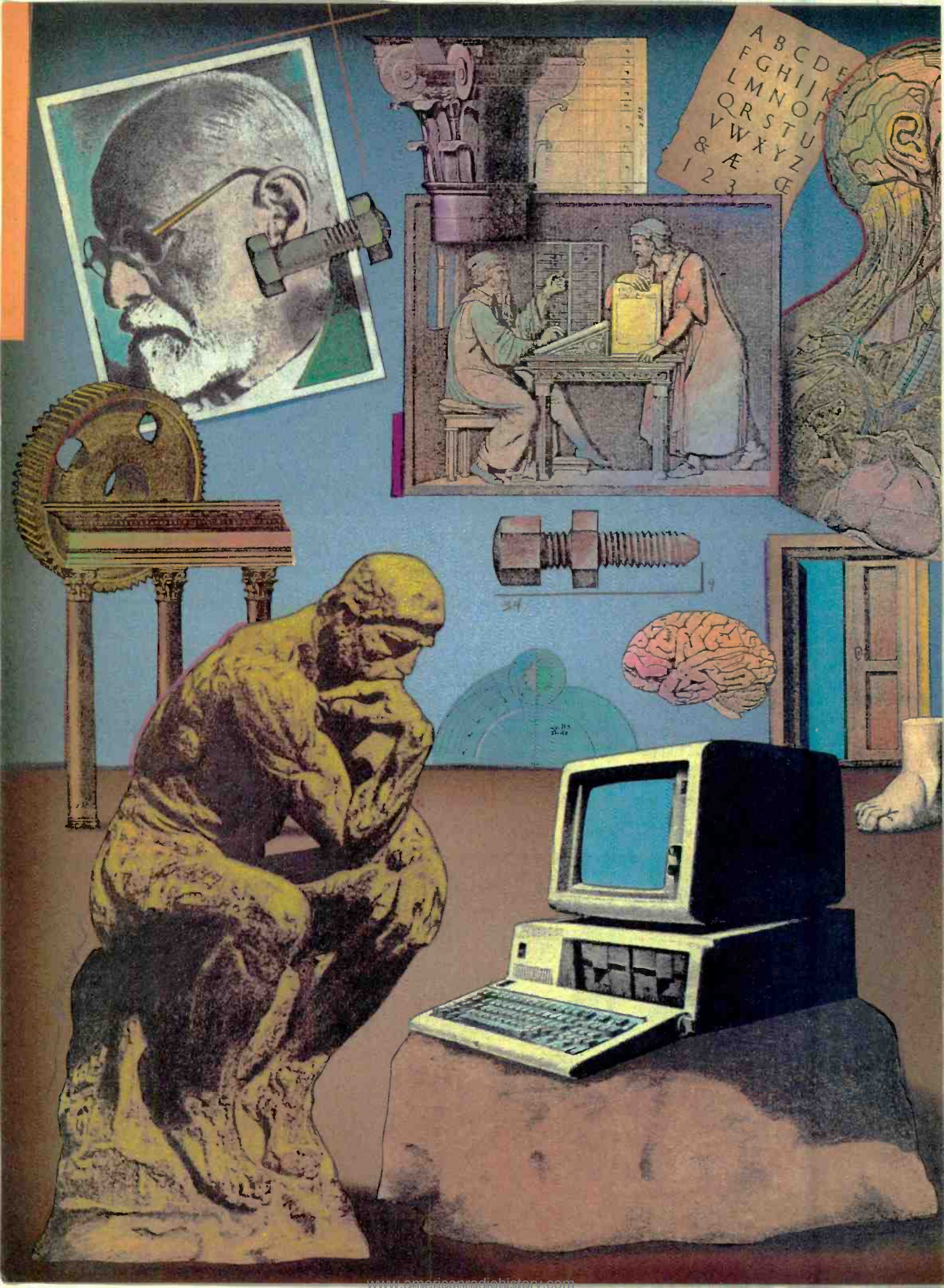
According to Dick Moschler, a vice president in the company's Information Systems Division, what was needed was a portable computer with a full-size keyboard and a screen capable of displaying 25 lines by 80 columns—the format used on the office computers.

The Life Insurance Company of Virginia evaluated every portable computer on the market, including the HP-110 (which it felt was not compatible enough with its software—it wanted a machine that would permit simple and complete transfer of data to any of its other systems without any intermediary steps, such as reformatting). The only one it felt met its criteria was the DG/One.

The firm has ordered 2000 of these computers, and has so far taken delivery on approximately 100 of them. About the only criticisms it has so far concern the legibility of the display and the scarcity of printer options.

Since most of the computer usage takes place close to the field office, the company isn't concerned about needing two power supplies for the machine—one to run from ac and the other to charge the battery pack. The computers are used in the field during the day, and the batteries get charged overnight.

The Life Insurance Company of Virginia is obviously pleased with the DG/One. Any company that makes a commitment for 2000 units must be. ◇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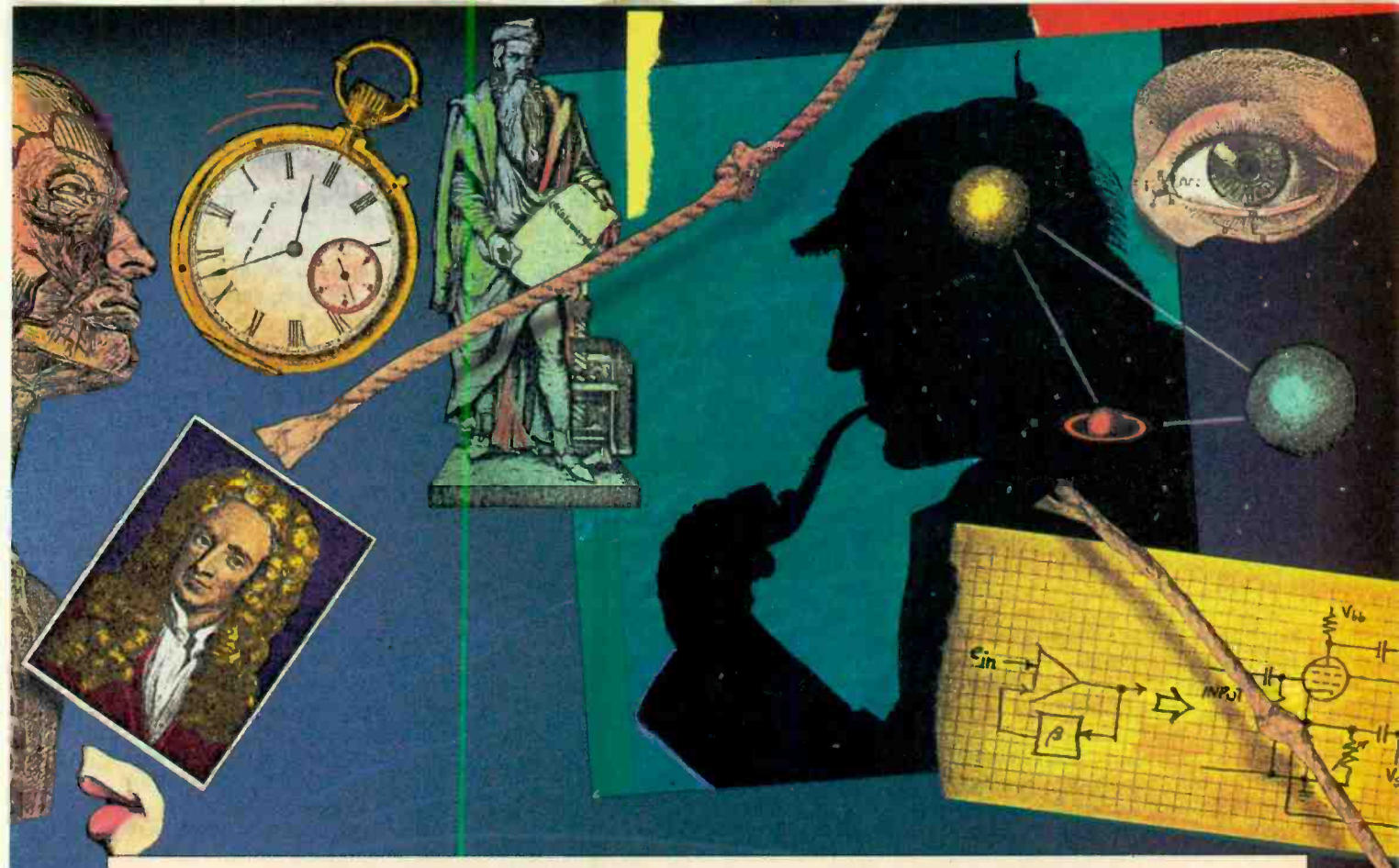

EXPERT SYSTEMS ON MICROCOMPUTERS

New products make it possible to experiment with artificial intelligence on a micro.

BY ROBIN WEBSTER

PERSONAL computer users who are modeling complex business or research problems can use a variety of decision support tools.

At the simplest level are "thought organizers" or "idea processors," such as Ashton Tate's Framework, which allow the user to organize notes (project plans, speeches, proposals, etc.) as linked "frames" or outlines. Next are programs, like VisiCalc and Lotus 1-2-3, that provide the ability to manipulate numerical data by means of spreadsheets (profit and loss sheets, sales forecasts, etc.). Once you have developed them, you can tinker with these spreadsheets until, for example, the bottom line meets some acceptable level.

Unfortunately, if you have ridiculous expectations about your ability to perform in some enterprise, a spreadsheet will not be able to inform you of this fact—it will merely come up with suitably ridiculous output according to the formulas you've constructed.

All these products are programmed to deal with tasks in the classical "algorithmic" manner. That is, for any given user input there is only one path or computational procedure that can generate the correct output. Idea processors do not "know" anything about your ideas. Spreadsheets do not contain any knowledge about a particular activity or event. These products cannot provide users with even the simplest consultation capability.

However, programs known as "expert systems" or "knowledge-based systems" do allow computer users to overcome the limits of the algorithmic approach. Among the more renowned expert systems that currently operate on mainframes are Myin (used by physicians to diagnose certain bacterial infections), Dendral (used by chemists to determine the molecular structures of unknown compounds), and Prospector (used by geologists for selecting sites for mineral exploration). Other areas where expert systems are being put to use include diagnosis of faulty oil drilling platforms, configuration of complex computer systems, and estimation of Social Security entitlement.

Generally, expert systems are considered to comprise two distinct components: the *knowledge base* (a collection of facts covering some specific topic) and the *inference engine* (a logic system that uses the rules in the knowledge base to make inferences from user input).

In addition is the *user interface*, which takes the form of a consultation between the user and the expert system. The user

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ILLUSTRATION BY CARL WESLEY

poses the problem to the expert system, which then elicits details from the user (Q&A fashion) and attempts, in a goal-oriented way, to apply its knowledge base to the problem. The consultation is always limited by the knowledge base—there is no general expert system that can both advise on mineral exploration and talk about the weather.

Many experts, regardless of their domain, solve problems without clearly understanding how they do it. Phrases such as "by the seat of my pants" or "I just had a hunch" highlight the uncertainty involved in the human approach to problem solving.

Expert system programs are unique in that they use ordered sets of task-specific (knowledge-based) rules to solve problems in much the way human experts would. Thus, Prospector accepts field study data from a geologist and then employs its "accumulared" knowledge about soil composition to make an inference or "guess" about rich deposits that may lie beneath the soil. Prospector, in particular, is famous for its "discovery" of a mineral deposit in the Mt. Tolman area of Washington State.

The essence of the expert system's inference engine is that it uses rules about probabilities and possibilities in order to make recommendations and come to its conclusions. One of the techniques used in this activity is called "fuzzy logic" because it allows expert systems to deal with attributions like those qualified by "about," "possibly," and "close to."

Whereas a binary system can be likened to a switch that turns a light on and off, a fuzzy logic system is more like a dimmer switch, which can turn a light "just" on or "almost" off. Systems that use fuzzy logic allow users to input data with qualifications—to say that there is a 60% chance that something is so or such-and-such is the case. In extreme cases, the user may even be able to indicate that a particular state is "unknown."

While most algorithmic programs would be stopped in their tracks by such input, expert systems can usually proceed to make some sort of recommendation.

Just as one can question an individual expert on the reasoning behind any decision he or she makes, well-designed expert systems can be asked to "justify" any problem-solving techniques they employ. This feature is usually invoked by typing in the word "why" whenever the user is asked a question not understood or thought to be irrelevant. The program will respond by displaying the rules it is currently using to generate the question.

Micro-based expert systems have been late in arriving for several reasons. First, the computing power of most personal computers falls far below that necessary to handle the knowledge-based rules contained in a typical expert system. The machine of choice might well be a DEC or IBM mainframe or an $80,000 special-purpose processor. Second, most early expert systems were developed using the LISP programming language. This language makes heavy demands on a computer both in terms of sheer computing power and in the amount of memory that must be made available. The average pc is not equipped with enough memory to do serious expert system work in LISP. Lastly, it is only recently that large corporations, seeking new and better ways in which to streamline company decision-making procedures, have been willing to commit substantial amounts of money to the development of expert systems.

In spite of these difficulties, the personal computer user does, at this point, have a choice of languages/systems for experimenting with expert system design and construction. Products are available for the Apple II and IBM systems as well as for a number of machines based on the Motorola 68000 chip.

The systems covered in this article are M.1 and M.1a (Teknowledge), Expert Ease (Expert Systems), and MVP-Forth (Mountain View Press). Although very different in type, these products all work on the IBM PC/XT.

Teknowledge's M.1 System

When it was announced in July 1984, Teknowledge's M.1 system had the rather startling price tag of $12,000—which included a four-day training course. Since then the Palo Alto-based company has reduced the price to $10,000 by turning the training course into a $2000 op-

AI ON A CHIP

BY T.J. BYERS

Until recently, artificial intelligence was the exclusive domain of the software community. Not to be left out though, chip manufacturers are rushing to implement artificial intelligence on silicon—some with rather amazing results.

Basically, AI chips are microprocessors with internal Forth programming. Forth is a very powerful and flexible language that adapts well to AI applications and is preferred by chip makers. By implementing Forth directly on the chip, speed increases of up to a hundredfold can be realized.

One chip that has been finding its way into several AI and robotics applications is the R65F11 by Rockwell International. The R65F11 is essentially a 6502 microprocessor—the one used in Apple computers—but with a Forth nucleus embedded in ROM. The ROM contains 133 high-level Forth functions that are translated into machine language the microprocessor can understand.

But the Rockwell chip can only emulate a Forth machine, because the Forth commands only exist in firmware and must be translated into machine code before they can be executed. Although this chip processes information much more quickly than operations running in software, it does require at least one machine cycle for each translation, which places an upper limit on speed. An analogous situation would be two persons conversing in different languages through an interpreter.

For this reason many feel the R65F11 doesn't strictly qualify as an AI chip. A true AI chip, most experts contend, must be able to process data in either serial or parallel fashion, be adaptive in its external inputs, and make no distinction between data and programming. These requirements spell out how the organic mind perceives information. In an effort to attain these goals, a Los Gatos, CA, corporation—Novix—has developed a true Forth machine in silicon.

Conceived and designed by Charles Moore, the creator of Forth, the Novix 4000 AI chip comes very close to being a true AI chip. Its strength is that it needs no interpreter. Instead, it contains a set of very simple, high-speed Forth commands implemented *directly* in silicon logic for immediate access and execution. These simple silicon-implanted codes affect the bits of the Novix microprocessor directly, with very little or no decoding.

As Reduced Instruction Set Computers (RISCs) have demonstrated, more work can be done in less time using a small set of simple, high-speed instructions than using a larger set of more powerful—but slower—commands. This approach is a radical departure

tion and has introduced M.1a, a smaller version of the product that costs about $2000 and that serves largely as a limited-power demonstrator version of the original M.1.

M.1 is most useful for "structured selection" tasks in which the number of variables is limited. One should not try to use M.1 in domains that require extensive calculations or analysis (such as VLSI design and other complex electronic work) or that might entail many possible conclusions (configuring computer systems, for example). Among the M.1 applications that Teknowledge has demonstrated are an aid to structural engineers using a complex Fortran program, a bank services advisor, and a wine selection advisor.

M.1 was developed using the Prolog programming language (short for PROgramming in LOGic). In order to use M.1 you must develop knowledge-based rules according to a Prolog-like syntax. (Prolog is a key artificial intelligence language in Europe and Japan, while LISP remains the preferred AI language in the U.S.) First you declare facts about a set of objects, and then you specify the rules that govern the relationships between them, saving your declarations in a text file that becomes M.1's knowledge base.

Most earlier expert systems required quite an advanced knowledge of LISP (or another programming language), and relied on a cryptic data-entry structure. In contrast, with M.1 you can develop rules using textual English-like statements, such as the following:

```
IF  DISTANCE-TO-SUBJECT
    = N FEET
    AND N < 12
    AND USING-FLASH
THEN SHUTTER-SPEED = 125
```

You can also incorporate variables in the rules you create and assign a "certainty factor" (or CF) to a particular situation:

```
IF  MAIN-COMPONENT = MEAT
      AND HAS-VEAL = NO
    THEN BEST-COLOR
= RED CF 90
```

The certainty factor in M.1 is a way of representing the likelihood or probability that a particular event will take place. This is where expert judgment comes into play. Setting the certainty factors for each of the 200 rules, an M.1 knowledge base can contain is an extremely important task. Any errors at this stage will throw the expert system off track. Expert systems are, after all, no "smarter" than conventional programs. They are simply more "knowledgeable," and any flaw in their knowledge will lead to unpredictable and unreliable results.

For an example of how the certainty factor works, the wine advisor demonstration of M.1 begins by asking the user for details about the meal at which the wine will be served (for instance, whether it will be drunk with meat, poultry, or fish, and whether a sauce will be served). Once it has the information it needs, it makes a wine recommendation. For instance, if you replied that you were serving meat with a heavy sauce, it might recommend a Cabernet Sauvignon with a confidence factor of 80%, but it would also provide a recommendation for a Zinfandel with a confidence factor of perhaps 30%, indicating that although the Cabernet is the option it recommends most strongly, a Zinfandel might be an appropriate substitute under some circumstances—such as the unavailability of a Cabernet. Thus, the certainty factor provides a form of fuzzy logic that enables the program to demonstrate flexibility in its responses.

One of the more innovative features in M.1 is what Teknowledge calls its "instrument panel," which can be used to

WHERE TO FIND IT

Expert 2 is available from the sources listed below. Write for prices and configurations.

Mountain View Press, Inc.
PO Box 4656
Mountain View, CA 94040

Miller Microcomputer Services
Lake Shore Rd.
Natick, MA 01760

Parsec Research
PO Drawer 1766
Freemont, CA 94538

from conventional chip-processing designs, which have traditionally concentrated on increasing the complexity of a single processor for more functionality and wider word-handling capability.

The elimination of internally microcoded instructions, such as those used by the Rockwell chip, is made possible by the Novix chip's architecture. The data and return stacks, for instance, are implemented in hardware—not software—and they are real—not emulated. Consequently, data enter the stacks directly from the input pins with no routing instructions. In other words, the data inputs exist separately from the instruction inputs, and the two types of information are entered in parallel. This structuring allows loop and subroutine calls to be executed in parallel with ALU (Arithmetic Logic Unit—the section of the microprocessor that performs all arithmetic and logical functions) operations. In fact, some commands, such as the NEXT command (which increments Forth instructions), exist as internal instructions and occur automatically within the cycle, eliminating the need for them to be input.

Novix expects its AI chip to execute well over 10 million operations per second—even though the clock speed is less than 10 MHz!

According to John Peers, founder of Novix, if the chip works as expected, an entire computer, containing the AI chip and supporting circuits, could be put on a single board 6" × 8" and sell for $4000. Add a terminal, and you could have a system possessing 20% of the power of a supercomputer that now sells for $10 million. Peers claims his new AI computer would be extremely fast, extraordinarily easy to program, and capable of self-modification. It would be able to "learn" from past experience.

Applications for the new machine would include speech recognition and graphics generation that would rival the best special effects Hollywood currently has to offer. Computing systems that now fill an entire room could be replaced by a unit the size of a breadbox. "Get enough chips," Peers speculates, "and they will emulate a neuron. If you put a great many of them together, you have the beginnings of a neurological array. You have, in other words, the beginning of a system that can learn on its own."

When will this chip be available? The first samples should be on silicon by the time you read this and might be commercially available by the end of the year.

The direct implementation of Forth on a chip optimizes the best features of both language and hardware. The result of this optimization will have a profound effect on the way we think about programming—and computers. ◇

debug or fine-tune a system under development. The instrument panel is a screen window divided into four panes as follows:

- Events, which lists the current goals of the system (i.e., what inferences the system is attempting to make);
- Conclusions, which lists the conclusions the system has already made;
- Reasoning, which shows the rule currently under consideration;
- Options, which lists the range of valid options to the current M.1 question.

Although the price of M.1 and M.1a put them beyond the reach of most personal computer users, they don't require much in the way of hardware. Both products will work on a 128K IBM PC, with or without a color monitor.

Expert Ease

Expert Ease, marketed in the U.S. by New York-based Expert Systems, is built around an inference engine developed by Donald Michie, of the University of Edinburgh, one of the pioneers of artificial intelligence research in the United Kingdom.

The program is a rule-inductive system, which means that it can evaluate a range of variables against a particular goal and then bypass those variables that are irrelevant. In contrast, a deductive system must move step-by-step through all the rule-processing procedures it possesses, whether or not they are relevant. For instance, when attempting to determine whether an object is a U.S. flag, a rule-inductive system could ask the user whether or not the object contained patches of red, white, and blue, and upon obtaining positive responses in each case, move on to questions of the pattern of those colors or the material of which the object was made rather than continue asking "Is it orange?," "Is it green?," and so on through the entire range of colors with which the system was familar. Thus, rule-inductive systems function faster and more efficiently than rule-deductive systems.

To develop an expert system application within Expert Ease, you begin by listing the attributes of the problem domain with which you wish to work on the spreadsheet-like attribute screen. This screen can contain up to 31 main attribute headings, 255 entries under each attribute heading, and 31 results/conclusions. The program can handle either logical values (value words, such as large, hot, heavy) or integer values (between −32,000 and +32,000).

The format for entering data in Expert Ease is:

Attribute 1 + Attribute 2 + Attribute 3 = Result 1

Thus, an investment system that deals with the age of a client, the investment period under consideration, and the type of risk the client is willing to bear might include the following entries:

Age	Invperiod	Risk	Invtype
25	Long	Low	IRA
38	Short	High	HighTech

While developing an expert system within Expert Ease, you can create questions to be put to the end user by linking the text of the question to a specific Attribute screen cell. You simply place the cursor on a specific cell, type the letter T and then start typing the question text. The care you take in working these questions makes the difference between a system that looks thrown together and one that engages the user in an interesting dialog.

Once you have entered the attributes and a range of possible values (i.e., possible answers) for each attribute, you create actual induction rules, or a decision network, from them.

To the end user, an Expert Ease system appears as a collection of questions (the question text linked to main attribute headings) and a numbered menu of possible values (possible answers). Once all questions have been satisfactorily answered, the system will use its induction procedure to come up with a conclusion.

The conclusion can take one of three forms: It can be a complete answer to user input; it can be a "clash;" or it can be a "null" response. A clash occurs when two or more rules in the system contradict. Expert Ease provides a simple debugging aid for use in such events. A null response occurs when no rule or something goes amiss in the program.

Most expert systems are intended to process knowledge from a predefined universe of knowledge available to humans. That is, an expert system written to diagnose faults in your personal computer will not be able to cure your headache as well. Limiting the universe of knowledge to be captured in an expert system makes it possible to put one inside a system the size of your personal computer and have it do something that appears intelligent. That, perhaps, is what artificial intelligence is all about.

An Expert System

A simple expert system can be written in at least two different ways: Listing A is an expert program as I would write it; Listing B is the same program written conventionally in BASIC. Both programs try to do the same thing: prove that an animal is a penguin. Penguins,

FORTH AND AI

BY JACK PARK

Editor's Note: Jack Park is the developer of a number of expert systems. Foremost of these is Expert 2, designed to help teach artificial intelligence techniques. Developed on a 48K Apple II, Expert 2 can run in any computer for which Forth is available. It is currently being used by graduate students, corporate engineering and science departments, consulting firms for fault isolation, and investment firms for investment analysis.

I AM often asked whether the Forth language is suitable for artificial intelligence (AI) work on personal computers. Before I attempt an answer, I would like to describe what AI is, what a computer language is, and then, whether a given language—in this case, Forth—is suitable for AI tasks.

Conceptions of AI are so diverse, I'll start with what it is *good for*, amplifying human intelligence. That's probably a rather narrow opinion, but it surely guides what I do in AI: I write programs that are intended to be intelligence amplifiers. (And, I write these programs in the Forth language.)

Intelligence Amplifiers

A variety of packages can amplify human intelligence. Some, when fully programmed and tested, permit replication of human expertise. These are the *expert systems.* Others aid in the learning process. These programs are usually classified as *knowledge refiners;* they aid in the reduction of vast amounts of information to more meaningful knowledge. That knowledge can then be passed along to an expert system to assist humans in solving problems.

Some of these intelligence amplifiers, especially the experimental "discovery systems," are intended to create original thoughts; others, like ones I develop, only create original thoughts when

rules can be found to make a suitable induction from user input. Again, it is possible to overcome this situation by re-entering Expert Ease and adding new rules as seem fit.

Because of its design, Expert Ease has a few limitations. The program only makes 100% correlations between attributes; in other words, it does not offer probabilistic or fuzzy logic capabilities. Nor does it offer any kind of rule explanation facility.

Expert Ease requires an IBM PC or XT with 128K RAM and two floppy drives. It is priced at $1000, and a demonstrator version of the product is available for $200.

MVP Forth/Expert System Toolkit

The MVP Forth/Expert System Toolkit, also known as Expert 2 (distributed by Mountain View Press), was developed by Jack Park of Nimble Software. The program is written in Forth, a language that tends to provoke strong reactions: You either hate it or you are magnetically drawn towards it. The language is fairly well suited to developing small expert systems because it has a stack-oriented architecture, something that BASIC, for example, does not have. In addition, the language is very portable, and thus Expert 2 can be used on CP/M, PC-DOS or Apple II computers.

Like M.1, Expert 2 employs an IF-THEN rule structure: Rules take the form "IF it is raining THEN there is a high probability of getting wet." (Naturally, the example itself would be backed up by other rules stating that when it is raining, water falls from the sky, and that water tends to make things wet.)

The Expert 2 package includes three sample expert systems that demonstrate the program's use. One is a version of the game "Animals" in which the computer descends a rule tree to guess the animal you've got in mind. For instance, it will ask "Does the animal have feathers?" and if you answer yes, it will ask further questions that attempt to identify the feathered animal you have in mind. Your answer of "No" will result in the program beginning work on another hypothesis (for instance, "Does the animal live in the water?").

The other sample files are a simple stock analysis program and a digital circuit analyzer.

You can enter the question "Why?" at any point while using an Expert 2 application. The program will display a brief justification, or explanation, of why it is asking the current question (in other words, what it is trying to prove). When you enter "Why?", Expert 2 displays the hypothesis currently under scrutiny and the rule currently being checked.

Systems development within Expert 2 makes use of its Forth command vocabulary. It includes such operators as IF, THEN, IFNOT, ANDIF, ANDNOT, THENRUN, BECAUSE, and THENHYP, which are used to create rules to be used in making conclusions or deductions.

Take the following "Animals" rule sequence as an example:

```
IF animal is bird
ANDNOT animal flies
    AND animal swims
BECAUSE penguin is
    bird that swims
AND animal is black
    and white
THENHYP animal is
    penguin.
```

Loosely translated, this means: "If the animal in question is a bird and the animal does not fly, and the animal swims, because a penguin is a bird that swims, and the animal in question is black and white, then I can hypothesize that the animal in question is a penguin."

In an expert system, the inference engine does all the hard work by connecting the data presented to it with the rule base at its disposal. Expert 2's inference engine is quite simple in that it merely looks for very obvious links between rules. In a more complex systems environment, the inference engine would take into account more subtle interactions between rules than is possible with Expert 2. Thus, Expert 2 is, as its manual suggests, "primarily a teaching tool" that will allow Forth programmers to get an idea of how to design and develop an expert system.

Expert 2 is available from Mountain View Press, Mountain View, California, for $106.50. ◇

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first, are birds. Second, they swim, but do not fly. Notice that almost all information on animal identification has been left out; we use only two criteria to determine whether an unknown animal is a penguin. It may be that we have left out more information than we should have; there may be other birds that swim but don't fly. For now, though, let's use the simple programs in Listings A and B to discover some interesting facts about expert systems.

There's a big difference between Listing A and Listing B. Both try to identify the animal as a penguin. Both end with the conclusion that the animal is a penguin or with nothing else to say. But, Listing A contains some rules—that is, some encoded knowledge about animals, but no control programming. Listing B includes both the information and the control programming—GOTOs, ENDs, PRINTs, INPUTs and so on. For reference, I've included the same program, written in Forth, as Listing C. To run the program written in BASIC, type "RUN". To run the program written in Forth, type "PENGUIN?".

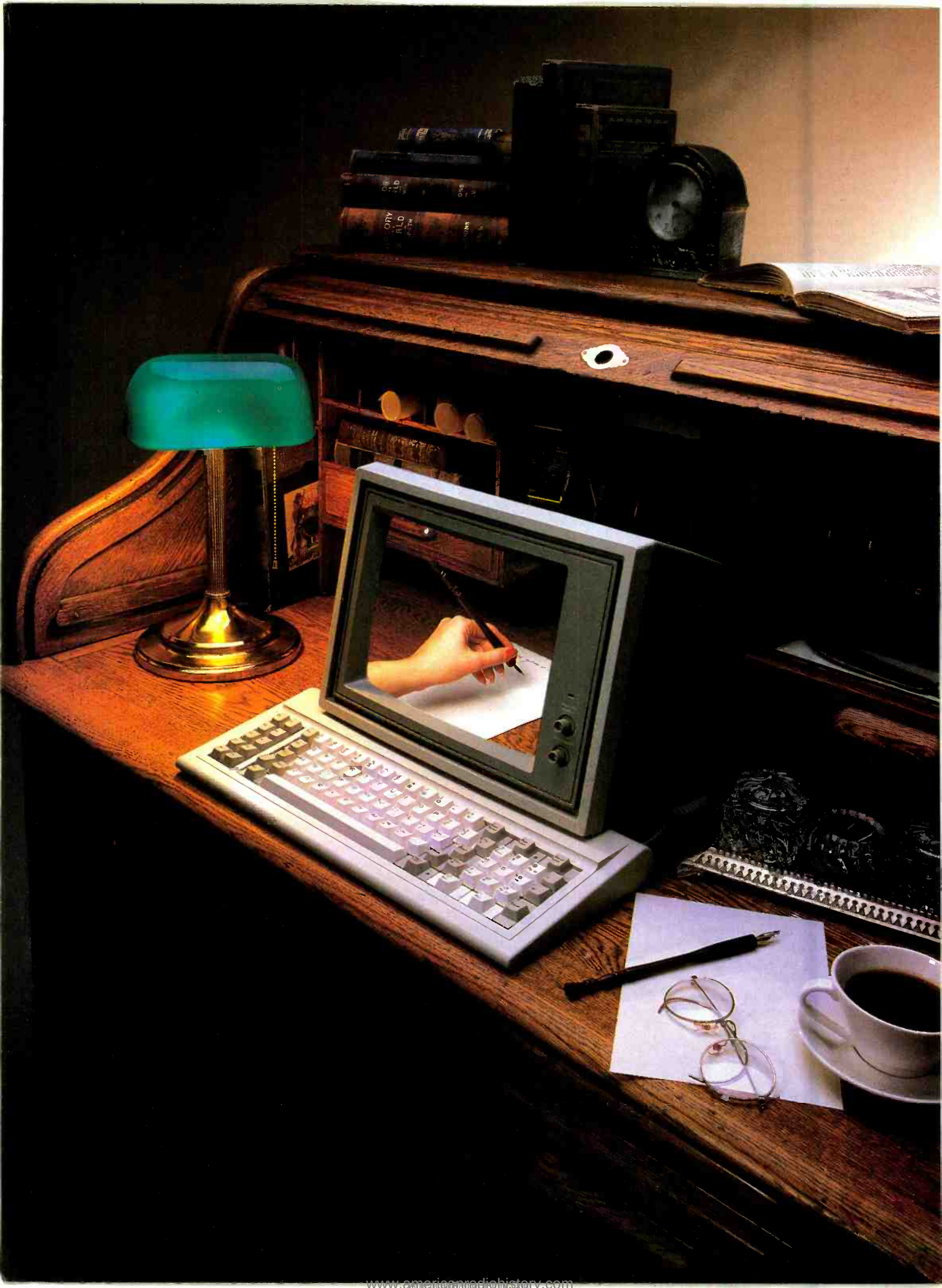
To run a program like the one in Listing A, you first have to invoke a different one altogether. That's the point of showing the three listings: If a program is written as an expert system, knowlege, or information, is encoded conveniently and is separate from control programming. Looking at Listing A, you might think of the IFs, ANDs, and THENs as control operators; but they are not. They happen to be logical operators, which, only indirectly, affect program control. Control is thus completely separate from knowledge.

This simple example shows that you can accomplish the objective of identifying an animal quite easily either with a program written specifically to encode knowledge about animals or with a conventional linear program containing both its usual IF-THEN control elements and knowledge. The key issues are: which is easier to modify or make additions to and which requires that you not only be knowledgeable in some field but also be a good programmer.

These issues separate an expert program from a linear program. The latter is general purpose and eventually gets the job done but requires expertise and programming experience. The former is highly specific, but requires only that expertise or knowledge be available.

The expert program uses, sad to say, yet another computer language. It is introduced because a specific language tends to be easier to use when used in the task areas for which it is designed and impossible to use outside that area. General purpose languages, on the other

(Continued on page 94)



COMPUTER BASED *Writing* AIDS

Not all spelling checkers are created equal

BY JOHN SMITH-RICHARDSON

WORD processing equipment and software put you in gear for "power typing"—you plow ahead at maximum speed knowing that what you are writing now you can easily edit later. You will be able to correct misspelled words, typos, errors in grammar, and phrasing. Unfortunately, even the best human editing cannot catch all the errors produced by fingers traveling faster than the brain. So, even from the earliest days of word processing for personal computers, writing aids have been among the most desired and popular software.

A writing aid is anything that helps improve the quality of the written word. It can be something that checks punctuation, corrects grammar, provides wordlists and/or synonyms, or most important, checks and corrects spelling errors.

Some products are good, some mediocre, and some just awful. The ones we mention here are among the better ones.

Bear in mind that there are plenty of others, many of them quite good, that are already embedded in word-processing packages. The programs discussed here are aftermarket software: They can be added to your collection of utilities at any time and will work with the output of most word processors.

Spelling Checkers

Of all the types of writing aids, spelling checkers have received the most interest and been the most popular because many people are poor spellers or such sloppy typists that even the words they know how to spell come out wrong.

Many of the early spelling checkers were more trouble than they were worth: Some versions frequently did not catch a misspelling—their accuracy was only 80% to 90%. Others had difficulty learning new words. The first of the modern popular spelling checkers was *Spellguard*, which was written for what was then and still is the most popular personal computer word processor, WordStar. Typical of all spelling checkers, Spellguard had a word list—a dictionary—to which all the words in a document were compared. Spellguard marked words for which there was no match in the dictionary by changing their last letters to a single symbol, producing a new disk file that was identical to the original except for the marked words. If the original phrase was

It apears that autmbles can be . . .

it shows in the checked document as

It apear[that autmble[can be . . .

Notice that the last letters of the misspelled words have been changed to the left bracket symbol ("[").

You were (and sometimes still are) expected to use the word processor's SEARCH function to locate each marking symbol and manually correct the spelling. The manually corrected line would read:

It appears that automobiles can be . . .

As you might imagine, finding each mark and then individually correcting the errors took a lot of time. Although Spellguard zipped through the checking process in a matter of seconds or minutes, the manual correction process could be extremely tedious (depending on the length of the document) and relied on *your* spelling abilities.

The reason for this mark-and-search procedure lies within WordStar. Once a line is written and formatted by WordStar, any change that causes the line length to expand beyond the right margin requires you to reformat the line or paragraph. Spellguard, taking into account the reformatting that would occur if correcting an error extended the line beyond the right margin, did not correct misspelled words. Instead, it just marked the word so the user would make the correction and reformat the paragraph manually if necessary. Similar spelling checkers also use "marking" techniques.

The modern breakthrough in spelling checkers came with *Hexspell* and *The Word* (an enhanced version of which is *The Word Plus*), which appear to have inspired all modern spelling checkers for personal computers.

Hexspell was written specifically for Scripsit-type word processing programs used with the Radio Shack TRS-80 Model I and Model III computers. It doesn't mark words, but actually corrects the document as it is processed. Hexspell scrolls the document at a fast reading rate so you can observe everything in context. The screen freezes when it detects an unmatched word, which is highlighted. You can leave the word as is, correct it, or add it to the dic-

John Smith-Richardson has written articles in this and other magazines on computer-related subjects.

PHOTO BY VITTORIO SARTOR

tionary. At the end of the session the program automatically writes a completely corrected version of the document to disks, as well as an identical "safety" backup.

Newly entered words go into the main dictionary, which is dynamically rearranged each time the program is used so that the most commonly used words are moved to the front of the list for quick access during the checking process. When the dictionary fills the disk to the limit of its capacity, the infrequently used words are discarded (they can be added back if they appear in a check of a new document).

Unlike most of its contemporaries, which constructed words from prefixes, suffixes, and roots, Hexspell checks the word exactly the way it was written: It can take into account numbers, hyphens, even punctuation, and it checks for upper and lower case anywhere within the word. For example, it will check "WordStar" only as "WordStar." "Wordstar" or "wordstar" will be flagged as unmatched. However, if "wordstar" were also to be entered into the dictionary, from then on both "WordStar" and "wordstar" would be accepted as correct.

Because Hexspell learns the precise spelling of a word—including plurals, numerals and punctuation if desired—it is always 100% correct. This accuracy is of tremendous value when special dictionaries are being constructed for specialized vocabularies, say, in medicine, law, or engineering. Total accuracy is so important, that the same "memory" facility is used by the best of the current crop of spelling checkers, which we will get to shortly.

The Word Plus originally appeared as The Word in 1981, at about the same time as Hexspell. It is the spelling checker to which all others for non-Radio Shack computers are compared. It is designed to be used with documents created by virtually any word processor presently on the market, and although it was originally written for CP/M, it is now also available for PC-DOS and MS-DOS. Unlike much other software converted from CP/M to PC-DOS/MS-DOS, both versions of The Word Plus are functionally identical; in fact, the same manual is used for both—if you are familiar with one version, you can immediately use the other.

The Word Plus is really a collection of programs—referred to as "tools"—called by the main program as needed or used individually. The individual programs can look up the spelling of a particular word if you can even come close to it with a keyboard entry, can find words using wildcard letters, and will even unscramble anagrams. But it was as a spelling checker that this program defined the form that most modern spelling checkers would take.

The Word Plus reads a document and compiles a list of words not in its dictionary that it presents on the screen one at a time. It can also present a list of the words that it *thinks* you intended to type, each preceded by a number. You can correct the word (either by retyping it correctly or simply by entering the number associated with the correct spelling), accept it into the document without correction, add it to the main dictionary, or add it to a dictionary of specialized terms.

Like Hexspell, The Word Plus corrects the word within the document; when the corrected file is written to disk, the words are correctly spelled. For WordStar users The Word Plus also provides a marker for corrected words that are longer than the original, but unlike Spellguard, it places the marker in front of a word that has been corrected, without replacing any letters. Using our original example, The Word Plus would change the incorrect phrase:

It apears that autmbles can be . . .

to appear in the corrected document as:

It *appears that *automobiles can be . . .

You then employ the word processor's SEARCH function to locate the marker symbols ("*"), delete the markers, and reformat if necessary. The reformatting process takes but a minute or so because the spelling is correct.

The Word Plus is unusually fast by both older and current standards because it is memory efficient, being designed to run in only 32K of RAM. The entire program can fit on a single disk along with the word processor and its disk overlays.

But the tight code necessary for efficient use of memory means that some functions are not available. The most serious deficiency is that The Word Plus reads a word in upper and lower case, displays the word in upper case, displays the entry for a new word in upper case, but enters it into the document in lower case (unless you type it manually in upper and lower case letters). This is usually not much of a problem, but capitalization and mixed cases can get sticky. For example, if the program is taught the word "WordStar," it will also accept "Wordstar" and "wordstar" as correct. Similarly, it will accept "Ocean" and "ocean" as correct, even though you may not want the word capitalized.

To help untangle the cases and to

know which word is wanted when the spelling is so poor that you have absolutely no idea what the word should be, The Word Plus can display the word in a single line of text.

The Best?

For sheer power and convenience there is presently no add-on spelling checker the equal of MicroPro's *CorrectStar*, which is intended for use with WordStar running under PC-DOS/MS-DOS, MP/M, CP/M, and CP/M-86. CorrectStar has just about every major feature and convenience one can imagine, which justifies its need for at least 192K of RAM and two 360K disk drives, though one wonders where there is a CP/M machine with 192K of RAM. Since many of its features appear to be enhancements of the best of Hexspell and The Word Plus, one would guess that the team that wrote CorrectStar studied many spelling checkers and selected the best features of each for its program.

CorrectStar works in conjunction with WordStar and is called from WordStar's main menu. Because it is installed as part of the WordStar package, you can instantly switch back and forth between the spelling checker and WordStar's edit mode.

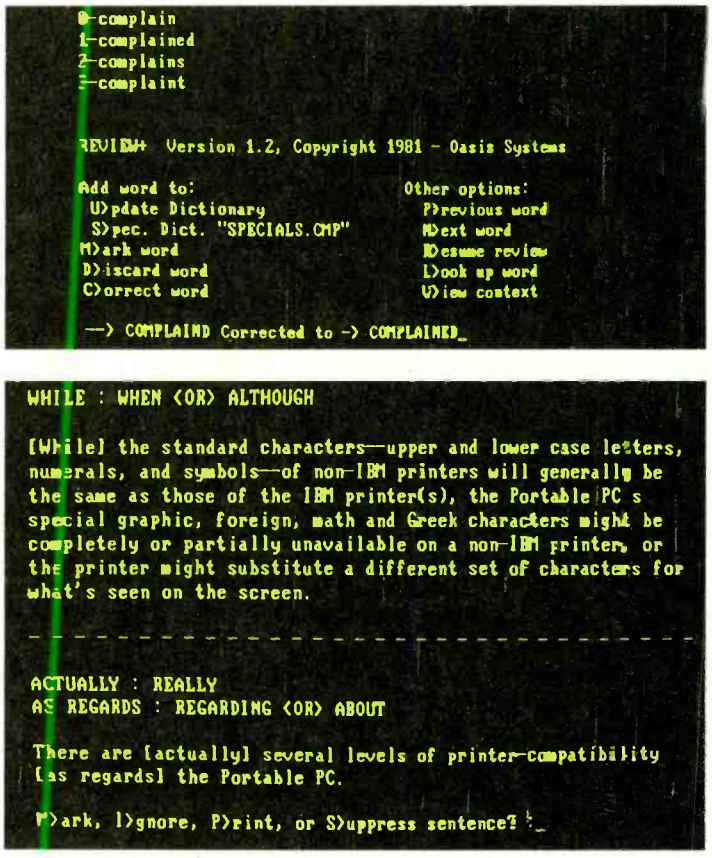
Like Hexspell, CorrectStar recognizes upper and lower case: It would treat "WordStar," "Wordstar" and "wordstar" each separately. The checker will not recognize "wordstar" if it is looking for "WordStar." It will also test and learn words containing numerals if the word starts with a letter. As an example, CorrectStar can check for and learn "MN1276Y," but it will pass over and cannot learn "1234." Also, it tests for and learns plurals and possessives, and will replace a single word with multiple words using up to 32 characters (an unusually long and convenient string for multiple word replacement).

CorrectStar highlights any word it does not recognize and uses all the available screen space (ten lines on the IBM PC) to display the text so the word can be seen in its entire context. You can bypass an unmatched word, accept it globally only for the document being checked, or add it to a dictionary. The program always attempts to prompt you by searching the dictionary for the closest spelling and will continually suggest words until it runs out of possibilities or you select a suggestion or you type in your own correction. If you desire, the change will be made to every similarly misspelled word. (This may sound time-consuming, but CorrectStar handles everything unusually fast except a global replace, which operates at an average speed.)

CorrectStar eliminates the reformatting problem by giving you the option of using either automatic reform (if a correction increases the line length beyond the right margin) or the conventional "ragged" right margin. If the automatic reform is turned on, at the completion of the spelling check you are left in the WordStar editing mode with a fully corrected and reformatted document. If you make additional changes to the document, you can check the spelling of the updating simply by switching between the edit mode and the spelling checker functions. In reality, CorrectStar makes WordStar into an integrated edit/spelling-check program.

CorrectStar is somewhat unwieldy because its main dictionary and a personal dictionary of up to 1500 words are so large they require a separate loading disk. Sometimes it takes a few seconds to find a match. However, spelling checks can be made lightning fast because CorrectStar's Install program allows the dictionary to be read from any disk drive. If the dictionary is loaded into a RAMdisk, the program runs faster than you can imagine—it can zip through 65,000 words in the blink of an eye to find a match.

As good as Hexspell, The Word Plus and CorrectStar may be, there is always something new and better coming into the marketplace. Whatever functions a new spelling checker offers, it will at the very least have to provide the best features of Hexspell, The Word Plus, and CorrectStar or it will be outmoded before it is released. CorrectStar, in particular, will be a tough act to follow, but it works only with WordStar. There's room for its equivalent in PC-DOS/MS-DOS and CP/M versions that could be used with *any* word processor.



Above: The Word Plus can suggest alternatives for misspelled words. Below: A screen from Punctuation + Style.

Punctuation and Style

If a computer could store all the rules of punctuation and all the idioms, phrases and synonyms used in English, it could check a document for correctness of punctuation and grammar. And, while there is a practical limit to the amount of data that can be stored in a personal computer, several programs for personal computers have appeared purporting to check documents for punctuation, grammar and style. Among the better known is *Punctuation + Style,* available for CP/M and PC-DOS/MS-DOS systems. It contains configuration files for, or can be user-configured for, most word processors. In practical terms, "configuring" means instructing the program to recognize the word processor's special marking characters and

symbols, which are to be passed over, such as WordStar's "dot command."

Punctuation + Style really consists of two programs: one, called Cleanup, checks punctuation; the other, called Phrase, checks word usage.

The punctuation program tests for missing punctuation, extra spaces between punctuation marks, incorrectly spaced ellipses, incorrect abbreviations, improper capitalization, unbalanced quotes (very useful for BASIC programmers), unpaired word processing commands, doubled words, and incorrectly expressed numbers ($2,50.51). About the only thing the program does not handle is commas. As the manual explains, the use of commas depends on many factors, including a writer's discretion. Since it is nearly impossible to codify the rules for their usage, commas are ignored.

The program works exceptionally well, but somewhat slowly—to be effective you must use the MARK mode, which places error marks and notes on corrections to be made throughout the manuscript. These marks and notes must be located with the word processor's SEARCH function and then changed or eliminated. With the program instructed to make changes directly to the document, what you don't want changed you will have to go through the document to locate and preserve.

Overall, the punctuation checker is best for short documents, such as letters or short reports, that you might want polished to perfection. On long documents making the corrections could take longer than typing the original words.

The phrasing program checks for single words or phrases that match 500 commonly misused or overworked ones.

The program scrolls the text on the screen until it finds a sentence with a problem. Then it stops and suggests improvements. If desired, the phrasing program will mark the spot in the document and add suggestions, which you can use when re-editing the text. If the document contains a sentence or phrase you want to use, you can suppress the correction throughout the document.

This process, too, is slow. In fact it is *deadly* slow because you have to remove the comments even if you decide to keep sentences and phrasing as they are. While the comments can be suppressed, you still have to dig out the markings.

But the major problem is interpretation. Because the computer cannot store more than a small portion of English's overworked and misused phrases, many of the suggestions made by the program have absolutely no relation to the subject, particularly in such specialized areas as computers, medicine and law.

For example, the program suggested that a line from a manual on an IBM computer that read "these programs are provided on the DOS Supplemental Programs disk . . ." be changed to "these programs are if on the DOS Supplemental Programs disk. . . ." The phrase simply doesn't make sense when "if" is substituted for "provided" in this context. On the other hand, Punctuation + Style's suggestion that "if you experience difficulty consult the manual . . ." be changed to "if you have trouble consult the manual . . ." is not only acceptable, it might be preferable.

Punctuation + Style's basic problem is that it requires too much effort to untangle the valid suggestions from those that might destroy meaning. But it does have its place. If you have to prepare a document that is proper (although, perhaps somewhat bland) in all respects, this program will help you do the job.

Product Sources

Hexspell
Hexagon Systems
PO Box 397, Station A
Vancouver, B.C. Canada V6C 2N2

The Word, The Word Plus, Punctuation + Style
OASIS Systems
2765 Reynard Way
San Diego, CA 92103

CorrectStar
MicroPro International Corp.
33 San Pablo Ave.
San Rafael, CA 94903 ◇

The Next Steps

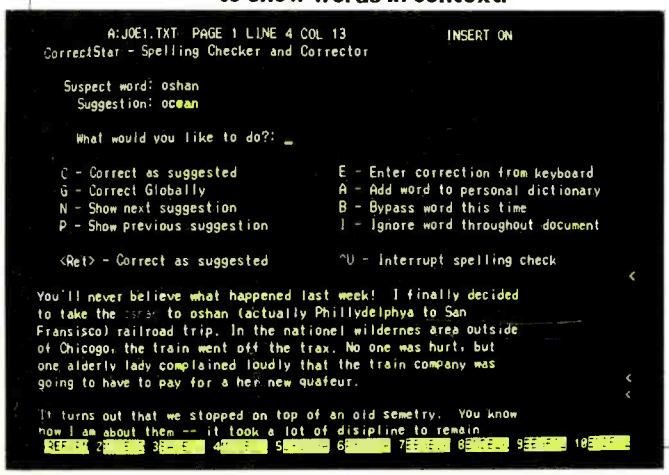
Most current writing-aid programs share several faults. First, they are slow. As the programs evolve and the code in which they are written is optimized, their speed will improve. Furthermore, as memory prices continue to drop, it will be possible to store more information directly in RAM rather than on floppy or hard disks and dramatically improve access time to it.

Today's programs are also rather dumb. Too much human intervention is required to make them really efficient. As AI (Artificial Intelligence) programming develops to a point at which it becomes feasible to use AI techniques on microcomputers, much of the question-and-answer between computer and computer user will be eliminated.

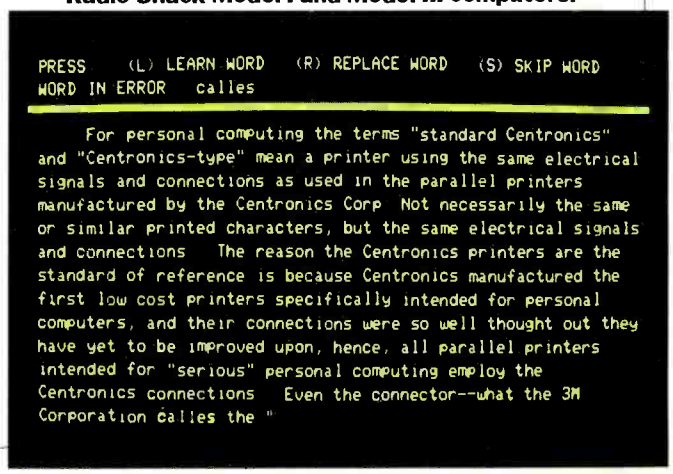
The style checker of the next generation will learn to think the way you do, and, once it does, will be able to understand why you used a certain word or phrase in a certain context. There will be no need for a constant dialogue between the program and you since, to a large extent, the program will *be* you.

And, farfetched as this may sound, we are almost there. Your computer may not be able to write your next novel, article, or memorandum. But, almost on its own, it will be able to make sure that what you write is letter perfect. ◇

CorrectStar fills the screen with text to show words in context.



Hexspell is an easy to use spell checker for Radio Shack Model I and Model III computers.



Critical Judgements

(Continued from page 52)

necessary to the health and full rationality of the human individual and society?

Closely related to the development of imagination and feeling-intellect is the part played by the *image in thinking*. In an exclusive emphasis on the development of logical, problem-solving skills as the main task of education the all-important role of the image in all thinking tends to be forgotten. As a consequence, thinking becomes tied increasingly to old, habitual—unconscious and unexamined—images, and fresh insight that alone can release logic from its habitual grooves and compartments and guide it into new paths becomes impossible. New insight announces itself in new images (one recalls immediately, in this respect, Newton, Einstein, Kekulé, Poincaré, among others). To be sure, the full meaning and implications of the initial images must be worked out through hypotheses, formal logic, and calculation. But formal logic, the exceeding great importance of which is not in question here is even in science secondary to insight via images and is never the source of new knowledge. Formal logic and discursive reasoning not in the service of insight lock us all the tighter into our presuppositions and rigid mental compartments. Images may be of many kinds (visual, auditory, kinetic, and so forth), and a rich, vital imagery and image-making capacity are essential for new insight.

It is particularly in relation to the centrality of the image in all thinking that much serious thought must be given to the appropriate educational use of the computer with its powerful and, hence, seductive, but highly specific and very limited form of imagery.

This becomes even clearer when it is considered that not only insight but all thinking is guided and shaped by our images, and that the quality of our images determines the quality of thinking and its consequences. We must of necessity rely constantly on our mental images in our efforts to integrate and understand the world. Even those physicists who engage in so-called imageless mathematics are guided by deep-lying images of the nature of the world they are probing, and they must have recourse to explicit imagery every time they seek to embody their calculations in instrumentation and experiment. The nature of our imagery and the health of our image-making capacities, therefore, become all important, for they will shape the kind of world we come to know and the kind of world we come to give ourselves.

One of the most pervasive, probably the dominant, image of the modern mind set is that of the machine. And the kind of thinking embodied in the computer is also basically mechanistic. It is certainly the case that science, and the scientism that has come to shape most people's view of reality, is dominated by an imagery that is mechanistic. "It is no exaggeration," the eminent biologist R. C. Lewontin wrote in *The New York Review of Books* (January 20, 1983), "to say that most scientists simply do not know how to think about the world except as a machine." Even the so-called life sciences are dominated by the mechanistic imagery that attempts to locate the secret of life in the inanimate. The noted biochemist Erwin Chargaff has spoken of what he calls "the paradox of biochemistry," namely, that biochemistry cannot deal with life itself, but has to kill the organism in order to study it. This mechanistic imagery has made it possible to manipulate life, and with some undeniably useful results. Whether or not it leads to an understanding of life itself is highly debatable. For an understanding of a living world and its requirements for survival, do we not need—in addition to the mechanical—living, mobile images that alone can guide a living-thinking?

Our images will eventually give us the kind of world we come to know through them. If we persist in an exclusive preoccupation with mechanistic images, we will get a mechanical world—and little mechanical selves, or nonselves, to go with it. It makes all the difference whether our images are living, mobile, and fresh or dead, rigid, and habitual; whether they are more or less conscious or unconscious and, thus, likely to insert themselves unnoticed into our thinking; or whether they are responsibly employed or wantonly chosen and applied irrespective of the consequences.

It is, therefore, in the imaging capacity of the mind that we find the moral element at the heart of all our thinking. We have a responsibility for the images we make and use in our efforts to integrate, understand, and shape the world. The development of a rich, healthy, living image-making capacity is the chief task of an education that is concerned with the development of a creative, responsible living-thinking, and of a living world.

This is what makes the feeling-life of the school-age child of paramount importance for education, for it is here that the education of feeling intellect and the education of a strong, vital image-making capacity are joined. It is in the picturing- and feeling-life of the school-age child that the creative, image-making capacity begins to come fully into its own and to cry out for nourishment. The provision of an education rich in sensory experience and with opportunities for developing fine discrimination becomes essential for a living-thinking in which penetrating insight and strong logic undergird one another. The most serious questions must, therefore, be raised and weighed in considering the place of the computer in education.

We live at a time when the feeling, image-making capacities of the child have been already pushed aside and ignored in modern education by a misplaced emphasis on ever-earlier development of analytical, narrowly conceived functional skills. Are we in danger of now further subjecting the child to a technology that would seem to eliminate entire sources of sensory experience and living imagery—while accentuating out of all proportion images of a very limited type, all the while inserting the latter directly into the child's mind during its most plastic and formative years? What is the effect of the flat, two-dimensional, visual, and externally supplied image, and of the lifeless though florid colors of the viewing screen, on the development of the young child's own *inner* capacity to bring to birth living, mobile, creative images of his own? Indeed, what effects does viewing the computer screen have on the healthy development of the growing but unformed mind, brain, and body of the child?

Will those children who are locked too early into the abstract and experientially impoverished world of computer learning be precisely the ones whose imaginations will be crippled—the ones who will lack the power later on for genuinely creative, independent thinking? Will they be the ones who later lack the experience and imagination for a truly creative use of the computer itself? Will they be the ones in whom the illusion will have been fostered that the most important human problems are computable, and that all that is required for living is more data and calculation, rather than understanding, empathy, and, often, sacrifice? Will it be the young people subjected too early to computer learning who will really need help later, not just academically but also in living well as persons? These would be only some of the sad ironies in this affair.

These are the kinds of urgent questions we must begin to ask and to wrestle with. The computer has great potential for human benefit, but its thoughtless use can only degrade the human being. By becoming critical and caring about our use of the computer in education, we can take the essential first step in realizing the full potential of the computer and of the human being alike. ◇

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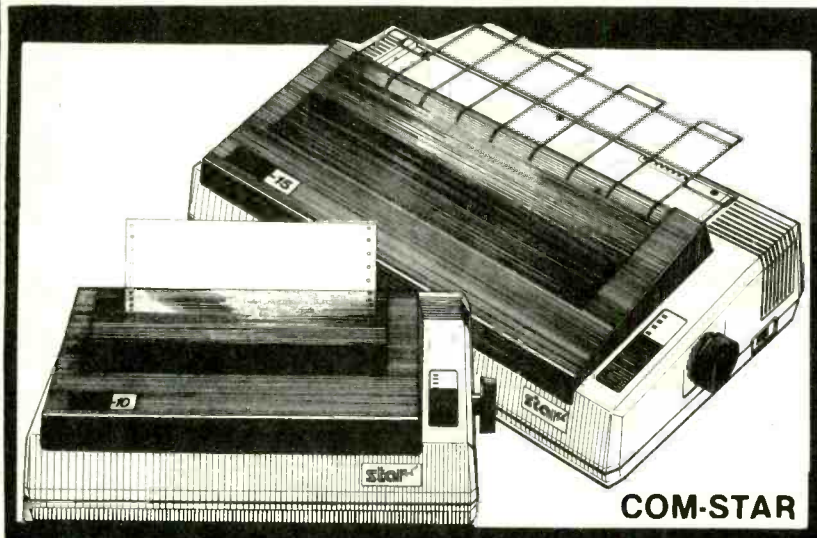

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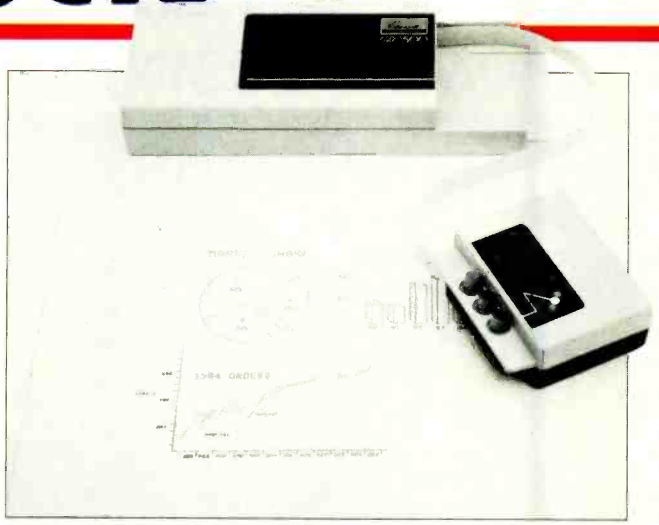


NEW ROBOT PLOTTER

The Penman plotter is a self-propelled, three-pen plotter for paper up to 3' by 3'. The 4" square, multicolor graphics device works with any computer with an RS-232 serial interface. The U.S. distributor for Penman, Axiom Corporation of San Fernando, CA, says the unit is accurate to within 1 mm when its built-in character set is used and plots at about 2"/sec. It is designed to work with any software that produces data interchange format (DIF) files, including dBase, 1-2-3, SuperCalc, Symphony, and VisiCalc. Penman may also be controlled directly from BASIC, LOGO, or the computer keyboard. A ribbon cable connects the control unit to the robot plotter, which also can be used as an obstacle and light-sensing robot, a mouse to move the computer's cursor and select from menus, and a desktop turtle for use with LOGO. $399.

Circle No. 75 on Free Information Card

SOFTWARE SOURCES

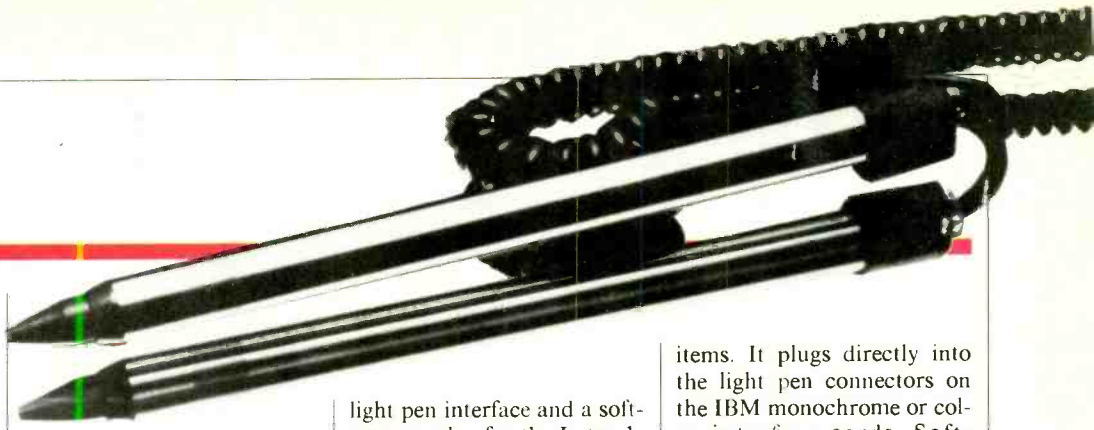
Smarter Mac. The Apple Macintosh gains spoken communications capabilities with a program that combines speech, graphics, and text. Called Talkshow, it allows you to use MacPaint and MacWrite to create a picture, graph, chart, or diagram that can be accompanied by a vocal description. One application: a realtor could show pictures of properties, and with the click of a mouse at some point, a specific description of a room would come forth. Each room could be detailed visually and aurally. Talkshow runs on the Apple Macintosh with 128K and a single drive. $149. **Address:** Rune Software, Suite 214, 80 Eureka Sq., Pacifica, CA 94044.

C Interpreter. C-terp, development tool for the C language, does for C what BASIC interpreter does for BASIC. It converts C programs into tokens that are then interpreted. On an error, the program dumps you into an editor at the source of trouble. The editor lets you access "include" files and has a facility to search for string patterns in all files currently loaded. The program lets you use library routines compiled with either Lattice C or C86 compilers and also assembly code that conforms to the conventions of either of those. Works on the IBM PC under PC DOS 2.X with 128K RAM. $300. **Address:** Gimpel Software, 3207 Hogarth Lane, Collegeville, PA 19426.

LETTER-QUALITY PRINTER INTERFACES WITH MAC

Cardco's MLQ/1 interfaces directly with the Macintosh computer. With friction feed standard and tractor feed optional, it prints at 14 cps and uses standard daisy-wheel and ribbon cartridge. $649.95.

Circle No. 76 on Free Information Card



LIGHT PEN & SOFTWARE FOR 1-2-3

Penquin and Soft-Pen.123, two new products from L-PC, the Lite-Pen Company, give IBM microcomputer users a light pen interface and a software overlay for the Lotus 1-2-3 spreadsheet. The Penquin works with either color graphics or monochrome screen and includes a touch-sensative activator in the point to initiate on-screen commands or select menu items. It plugs directly into the light pen connectors on the IBM monochrome or color interface cards. Soft-Pen.123 allows the Penquin to work with Lotus 1-2-3 and offers some enhancements to this popular spreadsheet. Light pen: $199.95. Software: $79.95.

Circle No. 89 on Free Information Card

BIG TAPE FOR MICROS

Large insurance companies, wholesale distributors, and government agencies are among companies that routinely store and ship computer data on nine-track reel-to-reel tape. Now microcomputer users can install Lancore Technologies' Reel-Core 7 nine-track desktop system for big machine compatibility. According to the company, each 7" reel holds up to 900' of tape and will store 33M bytes of information. Software for file copy and hard disk backup is supplied. Transfer rate is nearly 5M bytes/min, 1600 or 3200 bits/in. $4495 with IBM PC interface and software.

Circle No. 85 on Free Information Card

ADD 4M BYTES TO IBM PC OR AT

AT Power from Profit Systems can add up to 4M bytes memory to an IBM PC or AT. When coupled with PSI's Tascmaster software, the board allows running up to nine different computing tasks simultaneously by dividing the memory into independent sections. Board has 128K parity-checked memory, serial and parallel I/O ports and an optional second serial and/or game port. $495.

Circle No. 83 on Free Information Card

AT-LIKE LOCK FOR IBM PCS

CVI Laser Corporation's KBD-Lock adds a key lock to the IBM PC or XT. The rear panel installation permits network servers to operate and lengthy programs to execute without fear of unauthorized access. With the key in the off position, the computer continues to operate normally, except the keyboard is disabled. CVI says the "average" computer user can install the $49.95 device in just 5 minutes.

Circle No. 84 on Free Information Card

COLOR MONITOR

Sumicom's 2120 Color Monitor is a 12" RGB video monitor that provides dot addressability of 640 × 200 pixels in 16 colors; displays 80-column by 25-line text format; has a high-contrast, nonglare screen; and has front-panel contrast, brightness, and horizontal and vertical hold controls. $499.

Circle No. 86 on Free Information Card

KEEP 'EM STRAIGHT

DiskPorter is a notebook-sized disk organizer that keeps 20 5¼" disks within easy reach. A replaceable, numbered index card catalogs each disk. The transparent plastic cover also serves as a stand to present the stair-stepped disks for selection. DiskPorter may also be stored in a desk drawer. $29.95.

Circle No. 87 on Free Information Card

APPLE IIc TELECOM CABLE

The H adapter cable, from Anchor Automation, connects an Apple IIc to a Volksmodem via the computer's modem port. With the H cable, the low-cost modem can operate with Apple IIc communication software packages. $12.95.

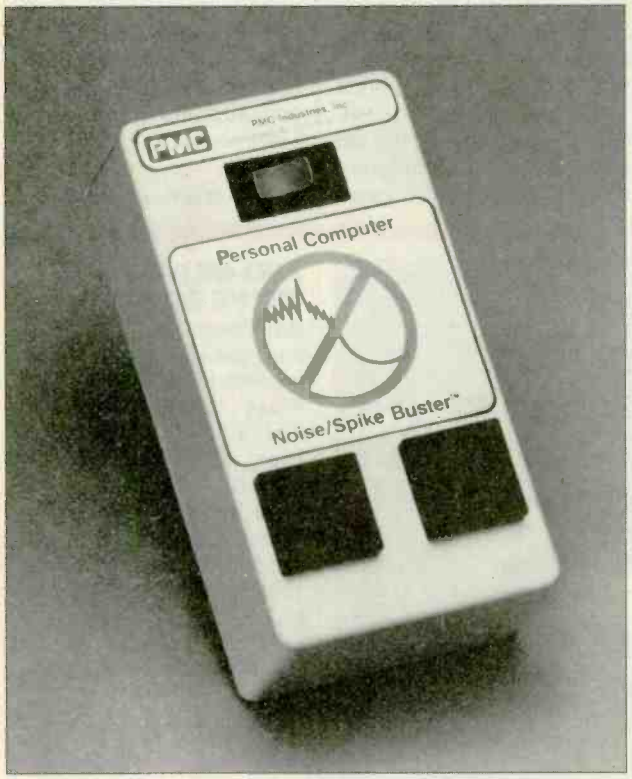
Circle No. 88 on Free Information Card

NEW PRODUCTS

POWER LINE PROTECTOR

The Model 062 Noise/Surge Buster from PMC Industries, Inc., is designed to protect computers and their data from ac line noise, transients, and high-voltage surges. It has a master ON/OFF switch and two surge- and spike-protected outlets. A two-stage RFI/EMI filter eliminates common-mode noise to 55 dB, and differential-mode high-voltage and high-energy spikes to 70 joules (6500 A, 780,000 W). $79.95.

Circle No. 80 on Free Information Card



LOW-COST COLOR PRINTER

The Okimate 20, from Okidata, prints full-color high-resolution graphics and letter-quality text on continuous form paper or single sheets. Printing, by thermal transfer, occurs at 80 cps for draft quality, 40 cps for letter-quality. Users can dump entire color screen images with one keystroke. Graphics resolution is 144 × 144 dots per inch. Hardware/software interface packages for the IBM PC and *jr* are now available; those for Apple and others will come shortly. $268.

Circle No. 82 on Free Information Card

NEW POINTING DEVICE

The Puck Pointer from the KA Design Group combines the functions of a mouse and joystick in a package only 3" square and ½" thick, designed to fit into a standard keyboard. It is intended to remove the errors and frustration experienced when trying to position a cursor accurately within a line of text or diagram on the screen. Specially designed springs resist vertical motion while the device is tracking horizontally, a problem when using a conventional mouse or joystick. The automatic tracking feature can be easily disabled.

Circle No. 81 on Free Information Card

SOFTWARE SOURCES

Planning and Plotting. With the Project Manager by Software Projections, Inc. (published by Wiley Professional Software), you can manage up to 200 different tasks with as little as 64K of memory. It lets you do a critical path analysis plan for complex projects and schedule the use of resources in the most efficient way, juggling deadlines, details and delays, and letting you experiment with "what if" situations through the course of a job. The program also produces reports that can be printed with a plotter. For IBM with 64K under DOS 1.1 or higher, one drive. $495. **Address:** Wiley Professional Software, John Wiley and Sons, Inc., 605 Third Ave. New York, NY 10158 (212-850-6000).

Mac Printing. Now you can use a software utility to run an Epson printer from an Apple Macintosh. The program, called Epstart, modifies the standard Macintosh printer drivers. It lets you use MacPaint, MacWrite, Multiplan and other programs without interfering with their normal functions. It also lets you print anything displayed on the Mac's screen. Works with Epson JX-80, FX-80, or FX-100 printers with 8143, 8145, 8148, or equivalent serial interface. $39.95. **Address:** Softstyle, Inc., 7192 Kalanianaole Hwy., Suite 205, Honolulu, HA 96825 (808-396-6368).

AT&T 6300

(Continued from page 25)

IBM's. It seems that people with a lot of computer experience on machines other than the IBM PC like the 6300 keyboard. People used to IBM's klacky keys and heavy base think the AT&T is mushy and cheap.

The monochrome monitor supplied with the test unit is a 12" green screen mounted on a very serviceable tilt and swivel base. A single umbilical carries both signal and power from the system unit. The screen swivels over 120 degrees on its base and tilts up or down approximately 20 degrees. The only complaint we had was the location of the adjustments for contrast and brightness. They are located on the underbelly of the display and unlabeled.

AT&T's ROM BIOS gets a high (IBM) compatibility rating. It was implemented by Phoenix Software Associates. We tested a wide variety of IBM PC software and most of it ran flawlessly. Where there were problems, the probable cause was timing loops that were upset by the 6300's different clock speed.

Potential Problems

The most obvious potential problem in trying to run IBM PC software or add-in boards on the AT&T is the different clock speed. The AT&T system clock runs at 8 MHz, but the bus converter board produces a bus timing signal of 4 MHz and 50% duty cycle on bus pin 39. In the IBM PC, this signal runs at 4.77 MHz and has a 33% duty cycle. When this signal is used exclusively for synchronization to the processor, there should be no problems. If any board requires the frequency and duty cycle to be identical to IBM's, though, there could be trouble.

AT&T has tried the full line of boards from several manufacturers, however, and so far has found only one problem. The Tecmar Bosun didn't work properly, but that problem should be corrected by the time you read this. Other offerings from Tecmar, AST and Quadram reportedly work as well with the AT&T as with the IBM PC.

AT&T also decided to depart from the IBM world in the design of its 16-bit expansion scheme. It is not compatible with IBM's AT, and so far no boards are available for it. But AT&T and probably other manufacturers will support the AT&T scheme. AST Research already has agreed to produce four 16-bit communcations boards and may offer other boards later.

Documentation for the 6300 is excellent. The manuals are well organized and don't assume the user possesses prior knowledge of the operating system.

One strong point in favor of AT&T computer products is an impressive service and support network. A toll-free hotline, staffed by knowledgeable, helpful people, is available on an unlimited basis to equipment purchasers. You can also choose on-site, carry-in, or mail-in equipment and software service. AT&T will provide contractual hardware and software support for any 6300-compatible application, even to the point of providing dedicated service, offering customers full-time technicians on-site, 24 hours a day, seven days a week.

Conclusions

Overall, we were impressed with the 6300. Rather than being a simple clone of the IBM PC, the 6300 offers significantly better performance, improved ergonomics and a competitive price, while maintaining excellent compatibility with the IBM PC. Of course, now AT&T has to respond to the IBM AT. This machine isn't the one to do it. The AT outperforms it and the AT's 80286 CPU will allow development of much more sophisticated and powerful software. Those who have seen it say AT&T's new 7300 box is a beautiful Unix engine, powered by the 68000 processor, in a dedicated mouse/windows/menu environment. A 9300 model already is on the drawing boards, so it seems AT&T is serious about playing the new microcomputer game.

Is the AT&T line equal to or better than IBM's offerings? Will it occupy a comfortable, long-term niche in the micro scheme of things? It may be early to say for sure, but the first offering is a significant contribution, one that makes AT&T-watching at least as interesting as keeping an eye on IBM. ◇

Habadex and MacPhone

(Continued from page 40)

When you enter a new number, you indicate whether you want it included in the menu bar and whether you want to use a long-distance service, credit card or outside line when you call it. You also can enter a billing rate (so you can record how much a call to this number is costing you), and a consultation rate (to know how much your valuable time is costing the person at the other end).

To dial, you just point to the number and double click. MacPhone automatically dials, including the "1" (unless you've suppressed it) and the area code (unless it's the same as yours). If you've opted to use a long-distance service (or outside line, etc.), MacPhone will connect with whichever one (of up to 20) you have selected.

MacPhone keeps a log of all your outgoing calls. If you've opted to record phone charges and/or consultation fees, all that info is included. (Unfortunately, MacPhone does not recognize incoming phone calls, which limits the usefulness of its fee-recording utility.) During the call you can also write notes, which can be added to the phone log.

MacPhone also features a "lifetime appointment calendar." In fact, the built-in calendar runs from January 1904 (?) to December 2039. The Calendar window shows a three-month segment anywhere between the dates you desire. Selecting a date calls up an appointment memo window, into which you can schedule any number of events.

Only one aspect of this well-executed, easy-to-use package rings false—the phone. It little justifies the $200 retail price of MacPhone; perhaps Intermatrix felt constrained to include it to warrant the name. But most people already have phones. The product would be better off with no phone, a less clunky base unit, and a lower price.

More generally, neither MacPhone nor Habadex succeeds in providing enough convenience to justify a dedicated Macintosh. If either program could run "in the background" while another application was being used, or if MacPhone could track incoming calls and thereby be substituted for an expensive automatic billing system, it would be different. As it stands, such literal-minded attempts to transform the computer into a desktop fall flat. ◇

Specifications
Product: Habadex **Mfr:** Haba Systems 15154 Stagg St. Van Nuys, CA 91405-1025 **Price:** $199.95 **Requirements:** 128K Macintosh

Specifications
Product: MacPhone **Mfr:** Intermatrix 5547 Satsuma Ave. No. Hollywood, CA 91601 **Price:** $199.95 **Requirements:** 128K Macintosh

Morrow Pivot

(Continued from page 30)

without problems, even when we ran them continuously during some bumpy traveling. Most important, we were able to swap our disks directly with our IBM PC, without experiencing any of the hassles that often beset data or program transfer on other portables.

The Display

The weakest part of the Pivot is its display. The same problem plagues all truly portable computers currently on the market because all are forced to use the same general type of LCD (liquid crystal display) screen. The screen is difficult to read under the best lighting and nearly useless under less favorable conditions.

The best legibility comes with strong light shining into the screen from directly behind the user and a minimum of overhead or indirect light. If the Pivot is used in a typically lighted home or office, it would be best to use a 60 to 100 watt incandescent lamp over the viewer's shoulder.

The viewing angle is also critical; seen from the wrong angle, the display turns into a mirror. This factor also makes it difficult to share the display with another person. Some improvement can be had by using a control on the left side that adjusts the viewing angle of the display crystals. Unfortunately, it happens to be dangerously close to the off-on switch, which might be accidentally turned off.

The Pivot currently uses a 16-line display, which Morrow plans to supplant with a 25-line display as soon as they become available in quantity. In anticipation, the system produces 25 lines but displays only 16 at once. The user can toggle between the top and bottom 16 lines by pressing the disk icon key. This very clever arrangement allows the Pivot to run many common MS-DOS programs without modification.

We understand that most of the problems with the display screen are due to the limits of current technology, and Morrow is working on improvements, such as nonglare glass. Precisely because of these problems, Morrow should include an output for a composite video monitor, so the Pivot could be used at work or home with reasonable viewing comfort. This output would also allow it to support real color graphics. Unfortunately, Morrow has no plans to add such a feature to the Pivot any time soon.

The CPU and Memory

The Pivot uses the 80C86 CMOS microprocessor, which is a true 16-bit processor running at 3.33 MHz. As for memory, there are three types in the Pivot: 32K bytes of ROM for scheduling and phone dialing software, 4K bytes of nonvolatile RAM for the storage of appointments and phone numbers, and a choice of 128K, 256K, 512K or 640K of RAM for main memory. The nonvolatile RAM has a small battery for backup in case all other power has been disconnected. This battery must be replaced every two years by a Morrow Service Center.

Expandability

The Pivot has three I/O ports on its back: the usual two DB-25 connectors (one parallel, one serial) and an RJ11 (standard telephone connector) for the internal 300-baud modem and autodialer. There is no provision for additional ports, for floppy or hard disks, nor for a bus expansion unit. Nor are there expansion slots inside the unit. The only expansion possible is dealer-installed memory.

Specifications

Product: Pivot
Mfr: Morrow Designs, Inc.
600 McCormick
San Leandro, CA 94577
Dimensions: 9½"H × 13"W × 5.6"D
Weight: 9.5 lb (one drive)
Price: $2895
Features: 80C86 CPU, 512K RAM, dual 5¼" floppy drives, 16-line LCD, internal 300-baud direct connect modem, RS-232 and Centronics ports, NewWord, and built-in calendar, communications and calculator software

The result is a system more or less limited to word processing, spreadsheets, and light-duty applications. While the Pivot succeeds within these limitations, users should be aware that it is not the "open architecture" box that the IBM-PC or most desktop compatibles are.

Power

Power can be supplied to the Pivot by its internal 2 amp-hour rechargable NiCd battery or from an external ac adapter/charger. A fully charged battery is capable of running the system for about 4 hours of normal use. The ac adapter/charger will recharge the battery in 8 hours. More recharging time is required if the computer is being used at the same time the battery is being charged. Unfortunately, there is no way to recharge the battery outside the computer and keep a ready spare.

We had no complaints about power. The Pivot ran quite smoothly on its battery, even generating a blinking, beeping warning when power started to run low. Since the Pivot's battery is of the NiCd variety, we suggest running it down and completely recharging it every couple of months to avoid its developing a "memory."

The ROM Based Software

The Pivot has time clock/appointment scheduler, telephone directory/autodialer, and calculator software stored in ROM, each of which is accessed by pushing one of the icon keys. When the Pivot is first turned on, it displays the current calendar, time and a world map. By using the function keys you can scroll days back and forth in the calendar or change time zones by scanning across the world map.

Pushing the scheduler function key will allow you to enter, and help you maintain, appointments. You can set alarms that will alert you 5 minutes before an appointment, even if the computer is executing an MS-DOS application program. The scheduler software is easy to use—we were able to figure it out in a few minutes without even using the manual.

Pushing the telephone icon will bring up the telephone directory and autodial software. You can maintain and dial stored telephone numbers or dial telephone numbers directly by entering them on the keyboard.

In general, the telephone software is easy to use, but we did have to look in the manual for a few minutes to figure out how to add phone numbers. A few extra prompts would have made it self explanatory.

If you dial a telephone number ending with an "M," the Pivot will go into a terminal emulation mode using the built-in modem. While the modem seems to work fine, the modem software lacks any file transfer functions. We quickly tried some off-the-shelf terminal emulation programs with file transfer functions but were unable to get any of them to work. We were, however, able to transfer a file from the Pivot to another computer using the MS-DOS copy command over the serial port. Morrow states it is working on adding file transfer functions to the Pivot. A more serious problem is that the current modem software seems unable to transmit a break; this could be important if your host computer uses a break to stop program execution.

The calculator icon opens a window on one end of the screen and freezes all but the numeric pad keys. The calculator is a simple four-function type with mem-

ory. It will accept numbers in a fixed, floating point notation or in adding-machine style. Results of up to 16 digits can be rounded or truncated.

You can use any of these ROM software functions at any time, even in the middle of an MS-DOS program. For example, you could be working with a word processor, push the telephone icon to make a phone call, and while on the phone push the clock icon to update your appointment schedule. You would then use the disk icon to return to the word processor.

Bundled Software

Breaking from its usual practice of bundling lots of application software, Morrow provides only MS-DOS and NewWord, a well-known WordStar/Mailmerge clone. NewWord, amply reviewed elsewhere, is a more than adequate word processor with output and functions almost completely compatible with WordStar.

Compatibility

The Pivot appears to be one of the few true portables that has what we would call "functional compatibility" with the IBM PC. This means that users can run most of their favorite personal software and swap disks as desired. In our use of the Pivot we found nothing that seriously undercut this kind of compatiblity.

As we mentioned earlier, however, the Pivot's limited expandability makes it somewhat less than a total clone. This should bother few in its target market; the Pivot is clearly a personal productivity tool for people on the go. However, buyers should be aware that in paying the Pivot's PC-like price they are buying compactness, not total compatibility.

The Bottom Line

Lately, we have been overwhelmed by IBM PC clones. The Pivot, however, clearly offers something different—real portability and functional compatibility at a reasonable price. It even works as advertised. If you need these features, the Pivot should certainly be high on your list.

If you hope to use the Pivot heavily in your office or home, be prepared for some uncomfortable viewing, unless Morrow has, by this time, offered some sort of external video option. Also be aware of the Pivot's somewhat limited expansion capabilities. Otherwise, we can't see any reason why the Pivot cannot take on most of the personal computing functions of your desktop PC. We liked the Pivot, and hope it achieves the success it deserves. ◇

Statistics Packages

(Continued from page 42)

Super Manual

Documentation is critical in a package like this; and, fortunately, the manual abounds with examples and discussions about statistics. It's a large manual, apparently designed for several audiences. There is a statistics guide for the new user who has little experience with statistics or computers. More experienced users will be pleased with the comprehensive reference manual. In addition, a tutorial disk describes the program in even greater detail. In fact, the supporting literature and disk could be used as a teaching tool to introduce students to statistical analysis.

The package makes efficient use of the PC hardware. It's in compiled and optimized code, which makes for speed—a two-way correlation of 1000 cases took less than a minute. Moreover, the program will automatically detect and use an 8087 numerical coprocessor when it is present, which can mean a significant increase in speed.

SPSS/PC is a large program. It uses about 3M bytes of disk storage. It's provided on eight program disks (only about a half hour for installation). An additional "key" disk must be in drive A at all times, or the program won't work. I can tolerate this copy-protection technique because at least it allows work to proceed on a different machine if there is a hardware failure. (The license agreement requires that only one copy be in use at any given time.)

SPSS/PC begins with the power and ease-of-use of the mainframe version. It adds the fixed cost, guaranteed resource, and privacy of personal computers. It's a simple-to-use, yet sophisticated, statistics laboratory that is sufficient for all except the largest statistical tasks.

StatPro

StatPro, from Wadsworth Professional Software, is a menu-driven system—the menus are among the best I have ever seen. The program makes clever use of highlighting to show currently selected options. Every screen allows you to accept, correct, or reject the entered data, and at most points you can use the "escape" key to go back to a previous screen. This feature is particularly helpful, and contrasts with some other programs that lock you into processing or stopping altogether.

StatPro offers two ways to make data entry easy: You can create an input screen with a convenient facility or you read (and write) a variety of external data formats. These include ASCII, dBase, and VisiCalc files on either PC/DOS or P-system disks.

StatPro runs on the UCSD P-system operating system, which gives it the advantage of small code, but makes installation potentially difficult. For instance, if you have DOS already installed on an entire fixed disk, you must make a full backup, remove the DOS partition, create a smaller one, and restore the DOS files. This nuisance can take several hours. Moreover, you must define maximum work file size when you install the system, and cannot change it.

StatPro's "database manager" is used to collect and edit numeric data from the keyboard. It supports file definition, data collection with limited error checking, and data correction and retrieval.

The automatic error-checking features include range checking and verification. You set a range by giving the minimum and maximum values for each field. You cannot, however, restrict the input to integers, and thus you may still have to check data before use.

StatPro has a convenient data manipulation feature that includes hundreds of preprogrammed unit conversions, such as degrees Fahrenheit to degrees Centigrade. Users can also define their own transformations, though each one can use only a single system-supplied function. Data can be manipulated by using general algebraic formulas, normal variates, and coordinate transforms.

Varied Routines

StatPro's statistical routines are diverse. They're arranged into five groups: descriptive statistics, regression, analysis of variance (ANOVA), time-series, and multivariate analysis. Using the routines is easy, primarily because of the excellent menus. There is one menu for each of the groups. After you select an analysis, you give the criteria for record selection and processing options. Options include details about what should be computed, such as particular descriptive statistics or nonlinear regression.

The regression routines are generally simple to use. However, to perform a multiple regression, the StatPro user must first produce a matrix and then perform the regression. Each regression type is performed by its own screen, with an additional screen for residual analysis. These limits undoubtedly result because StatPro uses only 128K RAM, half of what the more flexible SPSS/PC needs.

Of particular note are the time-series analysis routines, including a moving average routine and an exponential forecasting routine. These analyze chronological data, such as stock market listings or reports of seasonal purchasing behavior, which are important to many businesses, particularly financial analysis.

There are many ways to compute and verify any given statistical analysis. StatPro's support for these variations is sufficient for most users: there are 33 different routines. This capacity, however, gives less control than SPSS/PC does.

Statistics can be graphed for exploration or for reporting results. This is another of StatPro's strong points. With the graphics module you can recall data from statistical routines, graph them on the screen in several formats, and label them. You can also place multiple graphics, which can make use of color and fonts, onto one screen for a sophisticated presentation. You can also save graphics on disk for future reference.

Compromises

Despite getting a generally favorable impression of StatPro, I found that its usefulness is compromised by two factors. First, the user cannot set up a standard sequence of operations to be routinely executed on the sample data. There is no facility to "stream" or batch. Second, only one data transformation may be done at a time, thus doing 10 transformations requires you to make 10 passes over the data. I also wonder about the implementation of disk I/O. I noticed that the hard-disk LED flashed once for every record, which leads me to believe StatPro reads one record at a time rather than buffering the data.

Trajectories

Trajectories is a menu-driven program that provides both basic and some advanced statistics. Given the simplicity, the program is a good choice for users whose requirements or budget limit them to essential features. However, there are definite limits to what the package can do. In particular, its data handling abilities are not extensive, and not fast. An uncompiled program took 80 seconds to sort 50 cases of 6 variables.

Trajectories is written in Basic and supplied as source code. Thus, knowledgeable users can modify or compile it.

The program has a more serious limitation: It does not directly document its data, so you may want to use a companion package. It puts a limit of four characters to each variable name, and it does not keep an online description of the variables. As a result, you must maintain very accurate handwritten notes to describe the data file. This is a shortcoming because, conventionally, a program maintains data and description together

Statistics Packages

to assure that data can always be identified.

Not being able to save enough information makes several procedures difficult to use. In particular, the program can plot regression lines, but only when extreme caution and note-taking are exercised. The reason is that the computation proceeds in steps that require manual input.

Data Input

Trajectories has adequate provisions for essential data collection and editing. For input, you may define the fields of the file and the program prompts. It can read and write fixed-length ASCII files and then store data on disk in a special program-dependent manner for simplified access in the future.

The statistics routines deliver, as promised, to seven decimal digits of precision. The documentation is clear, although it makes no attempt to teach statistics. There are algorithm references, examples, and a description of the program's limitations. These include the largest problem it can handle. For example, the program's General Linear Regression Routine states its limitation as "a 1500 element matrix (for example: four independent variables, including the intercept, and 375 observations)."

In summary, Trajectories provides useful statistics in a simple-to-use format. Although it lacks the features required by a professional statistician, it should be adequate for many users. ◇

Computer Scientist

(Continued from page 16)

number of character spaces in the line of text. Since the second number is 0, the pen remains on the same line and doesn't move up or down the page. Finally, LB tells the plotter to print the line, and CHR$(3) terminates the label mode.

Centerplot is simple to use, but since the program asks for a new set of specifications for each line, it's best suited for short bursts of text like letterheads and posters. Using the program requires a little planning since there are no provisions for detecting excessive character dimensions or overly lengthly lines of text. If you fail to input enough linefeeds in response to line 110, for instance, the characters in a printed line may be partially superimposed over the text in the preceding line.

Special-Purpose Text Formatting

The power of HPGL and some other plotter languages permits many innovative approaches to printing. Consider, for example, the HPGL absolute direction (DI) instruction that controls the direction of printing. This instruction permits text to be printed vertically, upside down or at any angle.

Though the DI instruction is particularly useful for labeling the *y*-axis of a graph, it has many other applications. Listing 3, for example, is a simple program that prints "-STOP-" in eight different directions to form the octagonal stop sign shown in Fig. 4.

In operation, line 60 establishes the plotter's scale and selects pen 1. The eight "-STOP-" labels are printed by lines 70–140. The plotter begins printing the initial "-STOP-" label anywhere the pen is positioned on the paper. Therefore it's important to make sure there is adequate space for the complete octagon to be printed or a portion of it will be *clipped* (not drawn). Since the plotter begins printing each label where it stopped printing the previous label, instructions aren't needed to move the plotter pen to the next printing location.

Line 150 moves the pen near the left side of the inside of the octagon, assigns size dimensions and then prints a final "STOP" label larger than those printed around the sides of the octagon. The plot relative (PR) instruction in this line means the pen is moved *relative* to its previous location rather than to absolute coordinates. This means the final "STOP" label is printed in the same location within the octagon no matter where the octagon is positioned on the paper.

Going Further

Advanced plotter languages like HPGL provide a powerful tool for creative text formatting. Although some plotters are equipped with multiple character sets and many special characters and symbols, it's even possible to custom design your own character fonts, symbols and logos. This topic will be covered in a subsequent installment of this column.

Meanwhile, for more information about *xy* plotters see the articles cited above. If you have never before seen a plotter in operation, try to find a computer store that has a salesperson who can give you a plotter demonstration. After you see one of these pen-manipulating robots in operation, I'm sure you'll understand my enthusiasm for this very versatile and eminently practical personal computer peripheral. ◇

Evaluating Macintosh
(Continued from page 61)

dents, 43% bought the computer to do word processing, and that is what 58% use it for primarily. Possibly reflecting the weak state of database software in the Mac universe is the decline among the respondents from would-be (8%) to actual database users (2%).

We also asked members where they keep their Macs. Home computers ran ahead of work computers by about 2:1. However, the "work" number is slightly inflated by the effect of a dozen respondents who answered both "at home" *and* "at work," indicating that they work at home; such answers were treated as half a vote for each category.

We asked members if they would, given their experience with the Mac, still buy it if they had it to do over again. The Mac is very popular with these users—76% said they "definitely" would buy the Mac if they had it to do over again, and 19% answered "maybe."

When asked if they got their money's worth with the Mac, 77% felt they got a "fair" or "very good" value. The rest felt that the Mac was "somewhat overpriced."

Another question we asked concerned the previous computer knowledge of people attracted to the Mac. For more than half the respondents, as shown in the pie chart on page 61, the Mac is their first computer.

Finally, we asked members to name the one piece of software they would most like to have for the Mac. The easy winner was an integrated spreadsheet/word-processing/database product (37%), with sophisticated graphics a distant but clear second (16%).

The address of the New York Mac Users Group is Box 6686, Yorkville Sta., New York, NY 10128. ◇

MANUFACTURERS OF EQUIPMENT FOR THE MACINTOSH

Apple Computer
(MacWrite, MacPaint, MacTerminal MacDraw, MacProject, Mac Floppy Drive, Apple Modem)
20525 Mariani Ave.
Cupertino, CA 95014

Creative Solutions
(MacForth)
4701 Randolph Rd., Suite 12
Rockville, MD 20852

Creighton Developments
(ProPrint)
4931 Birch St.
Newport, CA 92660

Corvus Systems, Inc.
(OmniDrive)
2100 Corvus Dr.
San Jose, CA 95124

Davong Systems, Inc.
(Mac Disk)
217 Humboldt Ct.
Sunnyvale, CA 94089

Desktop Software Corp.
(1st Base)
228 Alexander St.
Princeton, NJ 08540

Dilithium Press
(PC to Mac & Back)
8285 SW Nimbus, Suite 151
Beaverton, OR 97005-6401

Géneral Computer Co.
(Hyperdrive)
215 First St.
Cambridge, MA 02142

Harvard Associates, Inc.
(MacManager)
260 Beacon St.
Somerville, MA 02143

Hayes
(Smartmodem)
5923 Peachtree Industrial Blvd.
Norcross, GA 30092

Lotus Development Corp.
(Jazz)
161 First St.
Cambridge, MA 02142

Microsoft Corp.
(Multiplan, BASIC, Word, Chart)
10700 Northup Way
Bellevue, WA 98009

Novation, Inc.
(SmartCat Plus)
20409 Prairie St.
Chatsworth, CA 91311

Okidata
(ML 92, ML 93)
532 Fellowship Rd.
Mt. Laurel, NJ 08054

SoftStyle
(Epstart)
7192 Kalanianaole Hwy. #205
Honolulu, HI 96825

Tecmar
(MacDrive)
6225 Cochran Rd.
Solon, OH 44139-3377

Telos Software Products
(Filevision)
3420 Ocean Park Blvd.
Santa Monica, CA 90405

Thunderware, Inc.
(Thunderscan)
19 G Orinda Way,
Orinda, CA 94563

WordStar 2000
(Continued from page 35)

command from within a file. Trouble is, the change does not show on the screen. If you deliberately put in a double-line space (two carriage returns), and then reformat the file for double spacing, you get four-line spacing on the printout. In my opinion, this is a giant step backwards.

WordStar 2000 lets you have three files open at one time, each showing as a window. When you save the active file, that is, the one with the cursor flashing in it, the cursor jumps to one of the other windows that remain on the screen.

By the way, the delete and backspace keys follow the usual IBM keyboard conventions. If you press the delete key, the character under the cursor disappears. If you press the backspace key, the character to the left of the cursor disappears and the cursor moves to the left, dragging any following text along. The original version of WordStar ported to the IBM PC ignored these conventions.

WordStar 2000 lets you create keyboard macros, too, which can include control characters. You can plug a sequence of keystrokes into a document wherever you want it, "boilerplate" phrases, for instance. The feature is a little more involved to use than a third-party keyboard utility such as Prokey: You must create a file with the keystrokes in it, then call that file, rather than using an ALT/keystroke sequence. Execution is as fast as Prokey, however.

Old-time WordStar computerists may miss the menu option of running a program from within WordStar 2000—you have to exit to the operating system, run the program, then restart WordStar. The speeds of some of the cursor moves, unfortunately, remain the same. It still takes a long time to move from the top to the bottom of a long file—even on an IBM AT equipped with a hard disk. The cursor tracks the text better, however. With the original WordStar, as the cursor moved down a page of text, it stayed in the same column until it got to the bottom of a paragraph, at which point (if there was a blank line between paragraphs) it would jump to the first column. From then on it would continue moving down in the first column. In WordStar 2000, the cursor jumps back to the original column as it moves past a blank line.

The color/graphics mode shows underlining, boldfacing and other printer effects in various color combinations of inverse video. That is, words that are to appear in italics, when you're using a printer that can do italics, show on the screen in green letters in a blue box if you choose (you can change the colors with

the installation program). On a monochrome monitor, the screen shows true underlines.

When printing a file, you are offered the choice of making multiple copies, up to 1000 if you believe the menu. The program supports up to eight fonts, if your printer is capable. You can change print fonts in mid-sentence, if not mid-word, from the print menu.

To change print modes from within WordStar 2000, however, you have to use the Print Color command and select Near Letter Quality or Draft or other options, depending on your printer.

If you have a printer with a sheet feeder aboard, you can select between paper feed trays. The one problem I noted with the print routine was the long time it seemed to take to print to a file (instead of to a printer).

In WordStar 2000, you can do footnoting, but the program does not put your footnotes at the bottom of the referenced page automatically—they all go to the end of the document (which makes them endnotes). It does automatically renumber them, however.

I noted a few other annoyances: When working with a formatted file, you can't turn off the ruler line, even if you never plan to refer to it. It sits there occupying a line of the screen. Another thing is that while using an unformatted file, you cannot easily change it to a formatted one. You first have to create a blank document with a specified format and then read the unformatted one into it.

In one area MicroPro claims to have mended its ways. The company is making an effort to reverse what many felt was a cavalier attitude toward support. You may be hard-pressed to tell they've changed by calling their help line—it stays busy much of the time. When you eventually do get through to their number, invariably you hear a recording that asks you to hold. However, once you talk to a human being, however, you do get prompt, informed service.

A Lot to Like

Lest you get the wrong idea, I like WordStar 2000. There will be many purists who are somehow insulted or initially shocked at the affrontery MicroPro demonstrated by hanging the WordStar name on this product, since it transfers very little of the old package to the new. The company, however, denies that it is abandoning users of the original. In fact, it intends to continue to market it. With the name so highly visible, it makes little marketing sense to call the product something else. It's understandable that many users would have misgivings; they've made their peace with the original WordStar—through all the lost files, the murky documentation, the awkward commands—and found in the end that it could be a useful tool.

WordStar 2000, however, offers as many functions as its predecessor and many additional features, such as an UNDO command, on-screen math, block sorting, preformatted files, cursor jumps by page, and an improved dictionary that works even with phonetic spelling.

The Plus version adds telecommunications, mailing-list management with a simple database manager and indexing features. And even the shortcoming of not being able to see some of the formats on the edit screen is compensated for by the fact that you can design a format—a letter, outline, address form—one time and use it as often as you like thereafter (changes are stored with your document).

All in all, if you need this extra functionality or if you're a new user in need of a heavy-duty word processor, include WordStar 2000 on your shopping list—it's competitive with anything now on the market. ◇

Computer-Assisted Instruction

(Continued from page 47)

software. . . .I can't imagine it not being effective. I look at a program like Flight Simulator (Microsoft/Sublogic) and I would bet money that it is going to have an educational impact. But there isn't any hard evidence to back me up."

Dave Weaver of MicroSIFT confirmed Bitter's statement, noting that the MicroSIFT evaluation "is not an evaluation of a program's effectiveness in terms of 'Do kids really learn from it?' We don't do that. I wish we could, but it's incredibly expensive and time-consuming to do. It would require setting up control groups and using the package with one group and not with the other and doing pre-testing and post-testing and so on. What our evaluations are, are collections of peer opinions about a particular package's usefulness. That's what EPIE reports are, that's what most evaluations are. How does a peer think a package would run in a given school setting."

Verifying a program's effectiveness becomes especially difficult with simulations, because even if you go to the trouble and expense of pre- and post-testing, there is a question of exactly what skills or knowledge you should test. Most simulations are designed to help develop problem-solving or "higher cognitive" skills rather than to pass a specific body of knowledge on to the student. Thus, Weaver said, while "research studies have shown that drill-and-practice can be effective in some circumstances, it's a little bit harder to get the same studies to verify the value of those exploratory activities and simulations. You can sit down after students have gone through a simulation and ask 'What did they learn from going through that experience?' Many educators are hard pressed to come up with an answer. They know that it's a valuable experience, but it's not a tangible kind of thing."

Because evaluations of simulations are so few and so unwieldy, some programs are marketed as educational simulations when they have scarcely any right to be called educational in the first place. Many simulations resemble games to one degree or another, and thus it is possible for a manufacturer to pass off games as educational programs. In fact, one software manufacturer admitted that his firm had released a series of interactive adventure games under its education label simply because "We don't have an entertainment category and we had to call them something."

The key to determining whether a simulation game has educational value, according to Sivin, is to "ask what is my student or my child going to get out of it, and how can I verify that the child will in fact get that out of it." He also noted that some products that are billed entirely as games may be educational if used correctly: "Some of it may be a matter of the child playing the game and also interacting with knowledgeable adults. An example in the language arts area is the genre of detective murder mystery programs. Those clearly were not designed to be educational or schoolike experiences, but if a creative parent or teacher follows the guides with consideration of certain kinds of problem solving and note taking skills, they can be turned into rather useful educational experiences. Perhaps that kind of thing cannot be used on its own. Perhaps a parent or teacher has to be there to ensure that certain elements of those skills are explained to the child."

A Better Future?

There has been, in Dave Weaver's words, "an evolution in educational software. Two things are changing at once. The actual products are getting better. They're using more graphics, and developers are beginning to get a handle on what people really want. At the same time, as users get more of a handle on what the computer can really do, they begin to refine their expectations. Overall," Weaver said, "it's moving in a positive direction."

But is it moving fast enough? And will it move far enough? There is still much to learn about how to use computers effectively in education. As Molly Hepler of Conduit said, "We certainly don't think we've reached the ultimate or have the ideal model or models to follow when looking at computer-based instruction. It's still pretty much groping in the dark."

There is also a shortage of people with the special blend of talents necessary to create good educational software. "It's hard to produce high-quality high school software, because you need someone with a rather sophisticated body of knowledge plus knowledge of instructional design, plus good programming ability," Jay Sivin told us. As a result, the most interesting and highly acclaimed educational software all seems to occupy very narrow niches—usually in an area of expertise for someone who happens to be a fine programmer. This factor may also account for the preponderance of educational software in technical subjects, and, especially in the use of computers. Sivin noted that attempts to create a program or series of programs that cover the entire subject matter of a course are often flawed and unimpressive. "I don't think there's anything wrong with the whole-course approach, but there seems to be a natural phenomenon that the producers don't put the same kind of care into each piece of a whole course that they put into tightly focused programs. There are some exceptions, but when we evaluate whole courses, we usually find some part that we like better than others, and when we recommend the program we're recommending it on the strength of some but not all of its parts."

The task of producing good educational software is complex enough that Francis Pandolfi, President of Scarborough Systems (publishers of educational and home software), stated, "I wouldn't know how to go about building a broad line of educational products. It is so hard to make them fun and easy to use that if we had the goal of developing 30 products this year I wouldn't know where to get them." Pandolfi added that Scarborough's approach is to go and find people who are fine authors and let them figure out what kind of product to make rather than to say, "I need a math product" and try to find the author to do it.

That approach leads to some very impressive programs, but it also makes the entire field of educational software rather hit-and-miss. There might be a very fine program covering one aspect of a subject, but nothing of interest to cover the points that precede or follow it in most curricula. A number of authoring systems are designed to allow nonprogrammers to develop programs in their specialties or areas of interest, but the programs they develop tend to be dull drill-and-practice routines.

Market forces may offer the most hope for improvement in educational software. Buyers are demanding more of educational software today than they did a few years ago, and manufacturers are responding to their demands. Dave Weaver, for one, is hopeful. He notes that, "The general public is becoming much more critical of software. A couple of years ago, if something ran on the computer, people were anxious to get their hands on it. But over the past couple of years opinions have changed. What was a good package then isn't a good package now. As the art of developing an instructional package evolves, so do the opinions of the audience. What it is, is just free enterprise taking over."

Technological advances will also play a major role in determining the appearance of educational software in the future. Educators and manufacturers seem to become starry-eyed as they talk about what laser videodisk technology, artificial intelligence, and speech technology will bring to educational courseware. Advances in artificial intelligence are expected to make possible a level of interaction between student and computer rivaling that of a one-to-one exchange with a teacher. Developments in speech technology should allow voice input of commands, which could remove the barrier of the keyboard between the student and the computer. Finally, laser videodisk technology will put vast amounts of information at the disposal of the student. None of these developments will occur overnight. Nor will they automatically correct the problems that plague educational software today. But the process of correcting those problems is underway already. Given time and effort, the computer may yet become the potent educational force it has so long been proclaimed to be. ◇

Forth and AI
(Continued from page 73)

hand, tend to be more difficult to use but can be used for more tasks. The key point is that an expert language makes it quite easy for you to "code up" information and not worry about how it gets used. Just make sure the information is correct, and the control program, called an *inference engine,* will do the rest.

A Forth Inference Engine

I have written an inference engine program in Forth. Other inference engines have been written in BASIC, in Pascal, and, in many cases, in LISP. Before I say a few words about the Forth inference engine, let's see what the program does.

Suppose you type into your computer, "I am thinking of an animal." Your goal is to set the computer off on the task of figuring out what animal you are thinking of, just as you might instruct it to diagnose the cause of a headache, find a failed IC in a computer circuit, or locate minerals up in the hills. These are suitable tasks for an expert system provided that adequate knowledge can be captured in the expert program.

To guess which animal you are thinking of, the inference engine must perform deductions. To perform deductions, it starts with an hypothesis—a potentially correct answer—and tries to prove its correctness. These answers are stored in an *hypothesis table,* which is intrinsic to the expert program, just as is the table of rules.

Suppose the hypothesis is "animal is a penguin." The inference engine reads Rule 3 (in Listing A), which tells it which facts must be true in order to prove the hypothesis. It first must determine whether the animal is a bird. Here's where the expert program and the linear program take different approaches. In the expert program there are no GOTOs, which are inherent in the line-number calls of the BASIC listing or in routine calls of the Forth listing. Thus, the BASIC and the Forth programs are *procedural,* while the expert program is *nonprocedural.*

Procedural programs require that the programmer specify where to go for the next question or conclusion. The expert program does not specify where to go or what to do for any procedure. Instead, it specifies what information is required to support other information, what the qualities of "birdness" are, and so on.

The nonprocedural (expert) program makes use of a SEARCH function to find what to do next. That may sound inefficient, but it's quite fast and lets us separate knowledge from control. By searching for another rule to help decide whether the animal is a bird, procedural program control requirements (e.g., where to go, what to do) are satisfied. The inference engine will proceed without being told explicitly in your program where to go to see whether the animal is a bird. The inference engine's search routines will perform the task of finding any and all knowledge captured in the expert program that will help it deduce the correctness of the hypothesis it is proving.

When the inference engine searches and finds Rule 1 to help it determine whether the animal is a bird, it will look at that rule to see what is needed. It must then see whether the animal has feath-

LISTING A

```
Rule 1   IF animal has feathers
         THEN animal is a bird
Rule 2   IF animal has hair
         THEN animal is a mammal
Rule 3   IF animal is a bird
         AND animal does not fly
         AND animal swims
         THEN animal is a penguin
```

LISTING B

```
 10 PRINT "1 - animal has feathers"
 15 PRINT
 20 PRINT "2 - animal has hair"
 25 PRINT
 30 INPUT "which number applies?" ;
    TYPE
 40 IF TYPE = 1 THEN 50
 45 END
 50 INPUT "can this animal fly?
    (Y/N)" ; A$
 60 IF A$ = "N" THEN 70
 65 END
 70 INPUT "can this animal swim?
    (Y/N)" ; A$
 80 IF A$ = "Y" THEN 90
 85 END
 90 PRINT "I conclude animal is a
    penguin."
100 END
```

LISTING C

```
: BIRD? (-- t f) CR
   ."1 - animal has feathers" CR
   ."2 - animal has hair" CR
   ."which number applies?" KEY CR
   ASCII 1 = ;
:FLY? (-- t f) CR
   ."does animal fly (Y/N)?" KEY
   ASCII Y = ;
:SWIM? (-- t f) CR
   ."does animal swim (Y/N)?" KEY
   ASCII Y = ;
:PENGUIN? (--) BIRD? (is animal a
   bird?)
   IF FLY? (does animal fly?) NOT
      IF SWIM? (does animal swim?)
         IF CR . "I conclude animal is
            penguin."
   THEN
      THEN
         THEN;
```

ers. Notice it must bypass questions about hair. It looks in a database it maintains to see whether it already knows about feathers. That's another feature of an inference engine: It keeps a database of facts it already knows. If it already knows a fact, it will not try to find rules to help it learn that fact again.

Suppose it does not yet know about feathers. Notice there are no rules in Listing A about feathers. The inference engine will ask you if the animal has feathers. Your answer will become a new fact for the database. If you answer "YES," the inference engine will then deduce that the animal is a bird. This new deduction becomes another fact to be added to the database. If you answer "NO," the deduction will not be recorded, and, in fact, the entire proof process will collapse because no other hypothesis is available for proof.

The Case for Forth

The tasks the inference engine must perform are searching, database management, and one not yet mentioned, language compiling. Since an expert program is yet another computer language, it requires a program that can recognize its limited vocabulary. It's hard to imagine a computer language as powerful as an expert language with such a limited vocabulary. It really only knows IF, AND, NOT, and THEN, and a few other words made of combinations of these.

Forth is called an *extensible* language. That means you can very easily extend the number of things Forth can do for you. Because of this extensibility the new expert language that is implemented in Forth is actually just a high-powered extension of Forth. On that count, the Forth approach to computer programming actually makes it easy to write new languages.

SEARCH is what the inference engine substitutes for explicit control in your expert program. SEARCH is a form of pattern recognition, one of the big buzzwords in AI research. The expert language rule compiler reads your rules from disk and builds a file of symbols that represents the various assertions in each rule. There are different symbols for "animal has feathers" and for "animal is bird." The inference engine simply compares symbols stored in memory. When a symbol is found, its location tells the inference engine which rule is being tested. If no symbol is found, the symbol being searched for is converted back to the assertion it represents, and it appears as a question on the screen: "Does the animal have feathers?"

(Continued on page 104)

7400

Part No.	Pins	Price
SN7400N	14	.29
SN7401N	14	.29
SN7402N	14	.29
SN7403N	14	.29
SN7404N	14	.35
SN7405N	14	.49
SN7406N	14	.59
SN7407N	14	.59
SN7408N	14	.29
SN7409N	14	.35
SN7410N	14	.29
SN7411N	14	.29
SN7412N	14	.49
SN7413N	14	.39
SN7414N	14	.49
SN7416N	14	.49
SN7417N	14	.59
SN7420N	14	.19
SN7421N	14	.59
SN7422N	14	.59
SN7423N	16	.69
SN7425N	14	.39
SN7426N	14	.39
SN7427N	14	.25
SN7428N	14	.59
SN7430N	14	.35
SN7432N	14	.39
SN7433N	14	.49
SN7437N	14	.25
SN7438N	14	.49
SN7439N	14	.79
SN7440N	14	.19
SN7441N	16	.89
SN7442N	16	.45
SN7443N	16	1.25
SN7444N	16	1.25
SN7445N	16	.69
SN7446N	16	.75
SN7447N	16	.75
SN7448N	16	.75
SN7454N	14	.19
SN7459N	14	.35
SN7460N	14	.39
SN7470N	14	.39
SN7472N	14	.39
SN7473N	14	.39

Part No.	Pins	Price
SN7474N	14	.39
SN7475N	16	.45
SN7476N	16	.39
SN7479N	14	4.95
SN7480N	14	.89
SN7482N	14	1.49
SN7483N	16	.55
SN7485N	16	.59
SN7486N	14	.39
SN7489N	16	2.25
SN7490N	14	.49
SN7491N	14	.79
SN7492N	14	.45
SN7493N	14	.45
SN7494N	14	.89
SN7495N	14	.49
SN7496N	16	.49
SN7497N	16	3.25
SN74100N	24	1.95
SN74105N	14	1.19
SN74107N	14	.29
SN74109N	16	.39
SN74116N	24	1.49
SN74121N	14	.45
SN74122N	14	.69
SN74123N	16	.55
SN74125N	14	.49
SN74126N	14	.49
SN74128N	14	.79
SN74132N	14	.59
SN74136N	14	.69
SN74141N	16	.89
SN74142N	16	3.95
SN74143N	24	3.95
SN74144N	24	3.95
SN74145N	16	.65
SN74147N	16	1.29
SN74148N	16	.89
SN74150N	24	1.49
SN74151N	16	.49
SN74152N	14	.49
SN74153N	16	.99
SN74154N	24	1.49
SN74155N	16	.49
SN74156N	16	.59
SN74157N	16	.49

Part No.	Pins	Price
SN74159N	24	1.95
SN74160N	16	.59
SN74161N	16	.59
SN74162N	16	.59
SN74163N	16	.59
SN74164N	14	.69
SN74165N	16	.69
SN74166N	16	.69
SN74167N	16	2.95
SN74170N	16	1.59
SN74172N	24	4.95
SN74173N	16	.85
SN74174N	16	.59
SN74175N	16	.59
SN74176N	14	.79
SN74177N	14	.79
SN74179N	16	1.49
SN74180N	14	.69
SN74181N	24	1.95
SN74182N	16	1.05
SN74184N	16	2.29
SN74185N	16	2.29
SN74190N	16	.69
SN74191N	16	.69
SN74192N	16	.69
SN74193N	16	.69
SN74194N	16	.69
SN74195N	16	.49
SN74196N	14	.75
SN74197N	14	.75
SN74198N	24	1.19
SN74199N	24	1.19
SN74221N	16	1.19
SN74251N	16	.79
SN74273N	20	1.95
SN74276N	20	2.49
SN74279N	16	.79
SN74283N	16	1.39
SN74284N	16	2.95
SN74285N	16	2.95
SN74365N	16	.55
SN74366N	16	.55
SN74367N	16	.55
SN74368N	16	.55
SN74390N	16	1.49
SN74393N	14	1.49

74LS

74LS00	14	.29
74LS01	14	.29
74LS02	14	.35
74LS03	14	.29
74LS04	14	.39
74LS05	14	.35
74LS08	14	.35
74LS09	14	.35
74LS10	14	.35
74LS11	14	.35
74LS14	14	.59
74LS15	14	.35
74LS20	14	.29
74LS21	14	.35
74LS26	14	.29
74LS27	14	.35
74LS28	14	.39
74LS30	14	.39
74LS32	14	.39
74LS37	14	.35
74LS38	14	.39
74LS42	16	.49
74LS47	16	.89
74LS51	14	.29
74LS73	14	.39
74LS74	14	.49
74LS75	16	.45
74LS76	16	.39
74LS85	16	.89
74LS86	14	.39
74LS90	14	.55
74LS92	14	.55
74LS93	14	.59
74LS96	16	.89
74LS107	14	.39
74LS109	16	.39
74LS112	16	.45
74LS114	14	.39
74LS122	14	.49
74LS123	16	.79
74LS125	14	.59
74LS126	14	.59

74LS132	14	.65
74LS133	16	.59
74LS136	14	.39
74LS138	16	.59
74LS139	16	.59
74LS145	16	1.19
74LS147	16	1.95
74LS148	16	1.79
74LS151	16	.59
74LS153	16	.59
74LS154	24	1.49
74LS155	16	.69
74LS156	16	.69
74LS157	16	.69
74LS158	16	.59
74LS160	16	.69
74LS161	16	.69
74LS162	16	.69
74LS163	16	.69
74LS164	14	.89
74LS165	16	.89
74LS168	16	1.19
74LS169	16	1.49
74LS170	16	1.49
74LS173	16	.69
74LS174	16	.69
74LS175	16	.69
74LS181	24	2.49
74LS190	16	.79
74LS191	16	.89
74LS192	16	.79
74LS193	16	.89
74LS194	16	.69
74LS195	16	.59
74LS196	14	.89
74LS197	14	.89
74LS221	16	1.09
74LS240	20	1.09
74LS241	20	.99
74LS243	14	1.09

74LS244	20	1.29
74LS245	20	1.49
74LS251	16	.59
74LS253	16	.59
74LS257	16	.59
74LS258	16	.59
74LS260	14	.59
74LS266	14	.49
74LS273	20	1.49
74LS279	16	.49
74LS280	14	1.95
74LS299	20	2.95
74LS322	20	3.95
74LS323	20	3.95
74LS347	16	.79
74LS353	16	1.09
74LS364	20	1.95
74LS365	16	.49
74LS366	16	.49
74LS367	16	.49
74LS368	16	.49
74LS373	20	1.49
74LS374	20	1.49
74LS375	16	.69
74LS386	14	.39
74LS393	14	1.19
74LS399	16	1.49
74LS490	16	1.95
74LS533	20	1.95
74LS534	20	1.95
74LS540	20	1.49
74LS541	20	1.49
74LS640	20	2.19
74LS641	20	2.19
74LS644	20	2.19
74LS645	20	2.19
74LS670	16	1.49
74LS688	20	2.95
81LS95	20	1.49
81LS96	20	1.49
81LS97	20	1.49
81LS98	20	1.49

74S/PROMS*

74S00	14	.35
74S02	14	.35
74S03	14	.35
74S04	14	.45
74S05	14	.45
74S08	14	.45
74S09	14	.39
74S10	14	.35
74S11	14	.35
74S15	14	.35
74S20	14	.35
74S22	14	.35
74S30	14	.35
74S32	14	.45
74S37	14	.99
74S38	14	.89
74S51	14	.35
74S64	14	.39
74S65	14	.39
74S74	14	.55
74S85	16	1.99
74S86	14	.55
74S112	16	.55
74S113	14	.55

74S114	14	.55
74S124	16	2.75
74S132	14	1.89
74S133	16	.45
74S135	16	.89
74S136	14	1.39
74S138	16	.89
74S139	16	.89
74S140	14	.69
74S151	16	.99
74S153	16	.99
74S157	16	.99
74S158	16	.99
74S160	16	2.29
74S169	16	4.29
74S174	16	1.09
74S175	16	1.09
74S188*	16	1.75
74S194	16	1.49
74S195	16	1.49
74S196	14	1.49
74S240	20	1.95

74S241	20	1.95
74S242	14	2.19
74S243	14	2.19
74S244	20	2.19
74S251	16	.99
74S253	16	.99
74S257	16	.99
74S258	16	.99
74S260	14	.79
74S273	20	2.39
74S280	14	1.89
74S287*	16	1.79
74S288*	16	1.79
74S299	20	5.95
74S373	20	2.49
74S374	20	2.49
74S387*	16	1.95
74S471*	20	4.95
74S472*	20	4.95
74S473*	20	4.95
74S570*	16	2.95
74S571*	16	2.95
74S572*	18	4.95
74S573*	18	4.95

CA—LINEAR

CA3010H		1.09
CA3039H		1.25
CA3046N	14	.99
CA3059N	14	2.95
CA3060N	16	2.95
CA3065E	14	1.49
CA3080E	8	.99
CA3081N	16	1.15
CA3082N	16	1.15
CA3083N	16	1.15
CA3086N	14	.85
CA3089N	16	1.95
CA3096N	16	1.75
CA3130E	8	1.19
CA3140E	8	.85
CA3160H		1.79
CA3160E	8	1.49
CA3161E	16	1.79
CA3162E	16	6.95
CA3189E	16	2.79
CA3401N	14	.59

CD—CMOS

CD4001	14	.29
CD4002	14	.29
CD4006	14	.89
CD4007	14	.29
CD4008	16	.89
CD4009	16	.59
CD4010	16	.49
CD4011	14	.29
CD4012	14	.29
CD4013	14	.39
CD4014	16	.89
CD4015	16	.39
CD4016	14	.49
CD4017	16	.79
CD4018	16	.79
CD4019	16	.49
CD4020	16	.75
CD4021	16	.75
CD4022	16	.75
CD4023	14	.29
CD4024	14	.69
CD4025	14	.29
CD4026	16	1.59
CD4027	16	.45
CD4028	16	.69
CD4029	16	.79
CD4030	14	.39
CD4034	24	1.79
CD4035	16	.79
CD4040	16	.75

(More in Catalog)

CD4041	14	.69
CD4042	16	.69
CD4043	16	.79
CD4044	16	.79
CD4046	16	.89
CD4047	14	.89
CD4048	16	.59
CD4049	16	.39
CD4050	16	.39
CD4051	16	.79
CD4052	16	.89
CD4053	16	.79
CD4056	16	2.95
CD4059	24	3.95
CD4060	16	.89
CD4066	14	.45
CD4068	14	.39
CD4069	14	.35
CD4070	14	.29
CD4071	14	.29
CD4072	14	.29
CD4073	14	.29
CD4077	14	.35
CD4078	14	.49
CD4081	14	.29
CD4093	14	.49
CD4094	16	1.95
CD4098	16	1.95
CD4099	16	1.89

CD4503	16	.69
CD4506	16	1.29
CD4507	14	1.19
CD4508	24	1.95
CD4510	16	.85
CD4511	16	.85
CD4512	16	.85
CD4514	24	1.49
CD4515	24	1.49
CD4516	16	.89
CD4518	16	.89
CD4519	16	.59
CD4520	16	.89
CD4526	16	1.19
CD4528	16	1.19
CD4529	16	1.69
CD4531	16	.89
CD4538	16	1.49
CD4541	14	1.49
CD4543	16	1.19
CD4562	14	6.95
CD4566	16	2.95
CD4583	16	2.49
CD4584	14	.59
CD4723	16	1.19
CD4724	16	1.19
MC14410	16	8.95
MC14411	24	11.95
MC14412	16	7.95
MC14433	24	17.95
MC14572	16	1.19

74F00 NEW 74ALS00

Part No.	Pins	Function	Price
74F00	14	Quad 2-Input NAND Gate	.69
74F02	14	Quad 2-Input NOR Gate	.75
74F04	14	Hex Inverter	.89
74F08	14	Quad 2-Input AND Gate	.75
74F10	14	Triple 3-Input NAND Gate	.75
74F32	14	Quad 2-Input OR Gate	.79
74F74	14	Dual D Flip-Flop	.85
74F86	14	Quad Exclusive OR Gate	1.15
74F109	16	Dual JK Positive Edge Flip-Flop	.95
74F138	16	Expandable 3/8 Decoder	1.69
74F157	16	Quad 2-Input Multiplexer	1.69
74F158	16	Quad 2-Input Multiplexer (Inv)	1.69
74F193	16	4-Bit Up/Down Binary Counter	5.29
74F240	20	Tri-State Octal Line Driver (Inverting)	3.75
74F244	20	Tri-State Octal Line Driver	3.49
74F257	16	Tri-State Quad 2-Input Multiplexer	1.79
74F373	20	Tri-State Octal Latch	4.89
74F374	20	Tri-State Octal D Flip-Flop	4.59

Part No.	Pins	Function	Price
74ALS00	14	Quad 2-Input NAND Gate	.59
74ALS02	14	Quad 2-Input NOR Gate	.59
74ALS04	14	Hex Inverter	.59
74ALS08	14	Quad 2-Input AND Gate	.59
74ALS10	14	Triple 3-Input NAND Gate	.59
74ALS30	14	8-Input NAND Gate	.59
74ALS32	14	Quad 2-Input OR Gate	.65
74ALS74	14	Dual D Flip-Flop	.79
74ALS109	16	Dual JK Pos. Edge Flip-Flop	.79
74ALS138	16	Expandable 3/8 Decoder	1.25
74ALS240	20	Tri-State Octal Line Driver (Inverting)	2.25
74ALS244	20	Tri-State Octal Line Driver	2.25
74ALS245	20	Octal Bus Transceiver (Non-Inv.)	2.59
74ALS373	20	Tri-State Octal Latch	2.59
74ALS374	20	Tri-State Octal D Flip-Flop	2.59

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MICROPROCESSOR CHIPS

Part No.	Pins	Function	Price
D765AC	40	Floppy Disk Controller	16.95 ~~19.95~~
D3242	28	Addr. Multiplexer & Refresh Counter	7.95
TMS5501	40	Synchronous Data Interface (SIRC)	14.95
Z80, Z80A, Z80B, Z8000 SERIES			
Z80	40	CPU (MK3880N) (780C) 2.5MHz	2.75 ~~2.95~~
Z80-CTC	28	Counter Timer Circuit	3.49
Z80-DART	40	Dual Asynchronous Rec./Trans.	8.95
Z80-DMA	40	Direct Memory Access Circuit	12.49
Z80-P10	40	Parallel I/O Interface Controller	2.95 ~~3.49~~
Z80-S10/0	40	Serial I/O (TxCB and RxCB Bonded)	11.49
Z80-S10/1	40	Serial I/O (Lacks DTRB)	11.49
Z80-S10/2	40	Serial I/O (Lacks SYNCB)	11.49
Z80-S10/9	40	Serial I/O	11.49
Z80A	40	CPU (MK3880N-4) (780C-1) 4MHz	2.95 ~~3.49~~
Z80A-CTC	28	Counter Timer Circuit	3.95 ~~4.49~~
Z80A-DART	40	Dual Asynchronous Rec./Trans.	9.95
Z80A-DMA	40	Direct Memory Access Circuit	12.95
Z80A-P10	40	Parallel I/O Interface Controller	3.95
Z80A-S10/0	40	Serial I/O (TxCB and RxCB Bonded)	11.95
Z80A-S10/1	40	Serial I/O (Lacks DTRB)	11.95
Z80A-S10/2	40	Serial I/O (Lacks SYNCB)	11.95
Z80A-S10/9	40	Serial I/O	11.95
Z80B	40	CPU (MK3880N-6) 6MHz	8.95
Z80B-CTC	28	Counter Timer Circuit	11.95
Z80B-DART	40	Dual Asynchronous Rec./Trans.	19.95
Z80B-P10	40	Parallel I/O Interface Controller	10.95
Z8001B	48	CPU Segmented (10MHz)	79.95
Z8002B	40	CPU Non Segmented (10MHz)	59.95
6500/6800/68000 SERIES			
6502	40	MPU with Clock (1MHz)	4.95
6502A	40	MPU with Clock (2MHz)	4.95
6502B	40	MPU with Clock (3MHz)	8.95
6520	40	Peripheral Inter. Adapter	3.95
6522	40	Versatile Inter. Adapter	5.49
6551	28	Async. Comm. Interface Adapt.	5.95 ~~10.95~~
6800	40	MPU	2.95
6802CP	40	MPU with Clock and RAM	5.95 ~~7.95~~
6809	40	CPU — 8-Bit (On-Chip Oscillator)	8.95
6809E	40	CPU — 8-Bit (External Clocking)	9.95
68B09E	40	CPU — 8-Bit (Ext. Clocking) 2MHz	14.95
68B10	24	128x8 Static RAM (2MHz)	5.95
6821	40	Peripheral Inter. Adapt (MC6820)	2.75 ~~2.95~~
68B21	40	Peripheral Interface Adapter (2MHz)	5.95
6845	40	CRT Controller (CRTC)	9.95 ~~14.95~~
68B45	40	CRT Controller (CRTC) 2MHz	14.95 ~~19.95~~
6850	24	Asynchronous Comm. Adapter	3.95
6860	24	0-600bps Digital MODEM	7.95
68000L8	64	MPU 16-Bit (8MHz)	39.95
68488P	40	General Purpose Int. Adapter	9.95
8000/80000 SERIES			
8031	40	Control Oriented CPU w/RAM & I/O	12.95 ~~14.95~~
8035	40	MPU — 8-Bit	4.95 ~~6.95~~
8039	40	CPU—Sgl. Chip 8-Bit (128bts. RAM)	4.95 ~~5.95~~
8040N-6	40	CPU (256 bytes RAM)	9.95
8060	40	CPU — 8-Bit NMOS	12.95 ~~14.95~~
8073N	40	CPU w/Basic Micro Interpreter	29.95
8080A	40	CPU	3.95
8085A	40	CPU	4.95
8085A-2	40	CPU-8 Bit N-Channel (5MHz)	10.95 ~~11.95~~
8086-2	40	CPU 16-bit 8MHz	19.95 ~~24.95~~
8087	40	Arithmetic Processor	169.95 ~~189.95~~
8088	40	CPU 8/16-Bit	14.95 ~~19.95~~
8155	40	HMOS RAM I/O Port-Timer	4.95 ~~5.95~~
8156	40	RAM with I/O Port and Timer	6.95 ~~8.95~~
8205	16	Hi Speed 1 out of 8 Binary Decoder	3.95
8212	24	8-Bit Input/Output (74S412)	2.95
8224	16	Clock Generator/Driver	2.95
8228	28	Sys. Cont./Bus Driver (74S428)	3.95 ~~4.95~~
8237-5	40	High Perf. Prog. DMA Cont. (5MHz)	14.95 ~~19.95~~
8238	28	System Controller (74S438)	4.95
8243	24	I/O Expander for 48 Series	3.95 ~~4.95~~
8250N	40	Async. Comm. Element	10.95
8251	28	Prog. Comm. I/O (USART)	4.49 ~~4.95~~
8251A	28	Prog. Comm. Interface (USART)	4.95 ~~7.95~~
8253	24	Prog. Interval Timer	5.95 ~~6.95~~
8255	40	Prog. Peripheral I/O (PPI)	4.49 ~~4.95~~
8255A-5	40	Prog. Peripheral I/O (PPI) 5MHz	4.95 ~~7.95~~
8259	28	Prog. Interrupt Control	5.95
8272	40	Sgle/Dble Density Floppy Disk Cont.	16.95 ~~19.95~~
8274	40	Multi-Protocol Serial Cont. (7201)	14.95 ~~29.95~~
8279	40	Prog. Keyboard/Display Interface	6.95
8282	20	Octal Latch	6.49 ~~8.95~~
8284	18	Clock Generator/Driver	5.49 ~~6.95~~
8286	20	Octal Bus Transceiver	6.49 ~~7.95~~
8287	20	Octal Bus Transceiver (Inverted)	6.49 ~~7.95~~
8288	20	Bus Controller	14.95 ~~19.95~~
8303	20	8-Bit Tri-State Bi-Directional Trans.	3.49
8304	20	8-Bit Bi-Directional Receiver	3.49
8310	20	Octal Latched Peripheral Driver	3.95
8741	40	8-Bit Univ. Peripheral Interface	19.95 ~~29.95~~
8748	40	HMOS EPROM MPU	19.95 ~~30.95~~
8749	40	MPU 8-Bit (EPROM Version of 8049)	24.95 ~~39.95~~
8755	40	16K EPROM with I/O	39.95
80186-6	68	High Integration 16-Bit MPU	99.95
80188	68	High Integra. 16-Bit MPU (8 Bit Data Bus)	89.95
SPECIAL FUNCTION			
DS0026CN	8	Dual MOS Clock Driver (5MHz)	1.95
INS2651	28	Communication Chip	7.95
MC3470P	18	Floppy Disk Read Amp System	4.95
MM5321N	16	TV Camera Sync. Generator	9.95
MM54240N	24	Asynchronous Transmitter/Receiver	5.95
MM58167AN	24	Microprocessor Real Time Clock	8.95
MM58174AN	16	Micro. Compatible Time Clock	8.95
MM5369AA/N	8	Prog. Oscillator/Divider (60Hz)	1.79
MM5369EST	8	Prog. Oscillator/Divider (100Hz)	1.95

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DYNAMIC RAMS

Part No.	Pins	Function	Price
1103	18	1024x1 (300ns)	.99
4027	16	4096x1 (250ns)	1.49
4116N-15	16	16,384x1 (150ns)	1.39 — 8/10.95
4116N-20	16	16,384x1 (200ns)	.79-8/6.29 ~~1.16-8/8.95~~
4116N-25	16	16,384x1 (250ns)	.69-8/5.49 ~~.89-8/6.95~~
4164N-150	16	65,536x1 (150ns)	3.95-8/31.49 ~~5.19-8/40.95~~
4164N-200	16	65,536x1 (200ns)	3.75-8/29.95 ~~4.95-8/38.95~~
MM5261	18	1024x1 (300ns)	.35 — 8/1.95
MM5262	22	2048x1 (365ns)	.35 — 8/1.95
MM5270	18	4096x1 (250ns) MK4096	4.95
MM5280	22	4096x1 (200ns) 2107	3.95
MM5298-3	16	8192x1 (200ns)	.59
41256-150	16	262,144x1 (150ns)	16.95 ~~34.95~~
41256-200	16	262,144x1 (200ns)	14.95 ~~31.95~~
48128	16	131,072x1 (250ns)	24.95
STATIC RAMS			
2101	22	256x4 (450ns) 8101	1.95
2102	16	1024x1 (350ns)	.89
2102-2L	16	1024x1 (250ns) L.P. (91L02)	1.49
2111	18	256x4 (450ns) 8111	2.49
2112	16	256x4 (450ns) MOS	2.49
2114N	18	1024x4 (450ns)	1.29 — 8/9.95
2114N-L	18	1024x4 (450ns) L.P.	1.95 — 8/13.95
2114N-2	18	1024x4 (200ns)	1.39 — 8/10.95
2114N-2L	18	1024x4 (200ns) L.P.	1.69 — 8/13.49
2147HN	18	4096x1 (70ns)	4.49
2148HN	18	1024x4 (70ns)	4.95
TMS4045	18	1024x4 (450ns)	3.95
TMS40L47-45	20	1024x4 (450ns)	1.95
5101	22	256x4 (450ns) CMOS	3.95
MM5257	18	4096x1 (450ns) 4044	4.95
HM6116P-2	24	2048x8 (120ns) CMOS	7.95
HM6116LP-2	24	2048x8 (120ns) L.P. CMOS	8.95
HM6116P-3	24	2048x8 (150ns) CMOS	3.95 ~~4.95~~
HM6116LP-3	24	2048x8 (150ns) L.P. CMOS	4.95 ~~5.49~~
HM6116P-4	24	2048x8 (200ns) CMOS	3.75 ~~4.75~~
HM6116LP-4	24	2048x8 (200ns) L.P. CMOS	4.75 ~~5.49~~
HM6264P-12	28	8192x8 (120ns) CMOS	24.95 ~~37.95~~
HM6264LP-12	28	8192x8 (120ns) L.P. CMOS	24.95 ~~39.95~~
HM6264P-15	28	8192x8 (150ns) CMOS	19.95 ~~34.95~~
HM6264LP-15	28	8192x8 (150ns) L.P. CMOS	21.95 ~~37.95~~
27LS00	16	256x1 (80ns) L.P.	3.95
7489	16	16x4 (50ns) 3101	2.25
74C921	18	256x4 (250ns) CMOS	5.95
74C930	18	1024x1 (250ns) CMOS (6518)	5.95
74S189	16	16x4 (35ns) 93405	2.95
74S289	16	16x4 (35ns) 3101	2.95
82S10	16	1024x1 (50ns) O.C. (93415)	3.95
82S25	16	16x4 (50ns) O.C. (74S289)	2.25
PROMS/EPROMS			
1702A	24	256x8 (1μs)	3.95
2708	24	1024x8 (450ns)	3.95
TMS2516	24	2048x8 (450ns) 2716	4.95
TMS2532	24	4096x8 (450ns) NMC2532	5.49
TMS2564	28	8192x8 (450ns)	10.95
TMS2716	24	2048x8 (450ns) 3 voltage	7.95
2716	24	2048x8 (450ns)	3.95
27C16	24	2048x8 CMOS	12.95 ~~14.95~~
2716-1	24	2048x8 (350ns)	5.49
27160-5	24	2048x8 (550ns)	3.75
2732	24	4096x8 (450ns)	4.95
2732A-20	24	4096x8 (200ns) 21V	11.49
2732A-25	24	4096x8 (250ns) 21V	7.19
2732A-45	24	4096x8 (450ns) 21V	4.95 ~~6.49~~
27C32	24	4096x8 CMOS	14.95 ~~19.95~~
27C32A-30	24	4096x8 (300ns) 21V (CMOS)	22.95
2764-20	28	8192x8 (200ns) 21V	9.95 ~~14.95~~
2764-25	28	8192x8 (250ns) 21V	7.19
2764-45	28	8192x8 (450ns) 21V	6.49
27C64	28	8192x8 CMOS 21V	14.95 ~~22.95~~
MCM68764	24	8192x8 (450ns) 21V	14.95 ~~24.95~~
27128-25	28	16,384x8 (250ns) 128K 21V	14.95 ~~21.95~~
27256-25	28	32,768x8 (250ns) 256K (14V)	49.95 ~~99.95~~
74S188	16	32x8 PROM O.C. (6330-1)	1.75
74S287	16	256x4 PROM T.S. (6301-1)	1.79
74S288	16	32x8 PROM T.S. (6331-1)	1.79
74S387	16	256x4 PROM O.C. (6300-1)	1.95
74S471	20	256x8 PROM T.S. (6309-1)	4.95
74S472	20	512x8 PROM T.S. (6349-1)	4.95
74S473	20	512x8 PROM O.C. (6348)	4.95
74S474	24	512x8 PROM T.S. (DM87S296N)	4.95
74S475	24	512x8 PROM O.C. (6340)	4.95
74S476	18	1024x4 PROM T.S.	6.95
74S478	24	1024x8 PROM T.S.	9.95
74S570	16	512x4 PROM O.C. (6305)	2.95
74S571	16	512x4 PROM T.S. (6306)	2.95
74S572	18	1024x4 PROM O.C. (6352)	4.95
74S573	18	1024x4 PROM T.S. (82S137)	4.95
82S23	16	32x8 PROM O.C. (27S18)	2.95
82S115	24	512x8 PROM T.S. (27S15)	9.95
82S123	16	32x8 PROM T.S. (27S19)	2.95
82S126	16	256x4 PROM O.C. (27S20)	2.95
82S129	16	256x4 PROM T.S. (27S21)	2.95
82S130	16	512x4 PROM O.C. (27S12)	3.95
82S185	18	2048x4 PROM T.S. (TBP24S81)	9.95
82S191	24	2048x8 (80ns)	14.95
DM87S181N	24	1024x8 PROM T.S. (82S181)	9.95
DM87S184N	18	2048x4 PROM O.C. (82S184)	9.95
DM87S185N	18	2048x4 PROM T.S. (82S185)	9.95
DM87S191N	24	2048x8 PROM T.S. (82S191)	14.95
DATA ACQUISITION			
DC10		Mostek DC/DC Converter +5V to −9V	2.95
ADC0801	20	8-Bit A/D Converter (1/4LSB)	14.95
ADC0803	20	8-Bit A/D Converter (±1/2LSB)	4.95
ADC0804	20	8-Bit A/D Converter (1LSB)	3.49
ADC0808	28	8-Bit A/D Conv. w/8-Channel Analog	9.95
ADC0809	28	8-Bit A/D Converter (8-Ch. Multi.)	4.49
ADC0816	40	8-Bit A/D Conv. w/16-Channel Analog	14.95
ADC0817	40	8-Bit A/D Converter (16-Ch. Multi.)	9.49
DAC0806	16	8-Bit D/A Converter (0.78% Lin.)	1.95
DAC0807	16	8-Bit D/A Converter (MC1408-7)	1.49
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DAC1008	20	10-Bit D/A Conv. Micro. Comp. (0.20%)	6.95
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DAC1022	16	10-Bit D/A Conv. (0.20% lin.)	5.95
DAC1222	18	12-Bit D/A Conv. (0.20% Lin.)	6.95
DAC1230	20	12-Bit Up D/A Conv. (.05% Lin.)	14.95
DAC1231	20	12-Bit Up D/A Conv. (.10% Lin.)	13.95
AY-5-1013A	40	30K Baud UART (TR1602)	3.95

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Part No.	Pins	Function	Price
INS1771-1	40	Single Density	16.95
FD1791	40	Single/Dual Density (Inv.)	24.95
FD1793	40	Single/Double Density (True)	26.95
FD1795	40	Dual Density/Side Select (Inv.)	26.95
FD1797	40	Dual Density/Side Select (True)	29.95
WD2791	40	Single/Double Density (Inv.)	39.95
WD2793	40	Single/Double Density (True)	39.95
WD2797	40	Dual Density/Side Select (True)	39.95

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FE0202D	40	4 Digit LCD Display for 7106 & 7116	14.95
FE0203D		3½ Digit LCD Display for 7106 & 7116	14.95
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7215EV/Kit	24	4 Func. Stopwatch Chip, XTL (Evaluation Kit)	19.49
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7216DIPI	28	8 Digit Freq. Counter C.C.	21.49
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74HC High Speed CMOS

74HC00	14	.59
74HC02	14	.59
74HC03	14	.89
74HC04	14	.59
74HCU04	14	.69
74HC08	14	.59
74HC10	14	.59
74HC11	14	.69
74HC14	14	.89
74HC20	14	.59
74HC27	14	.59
74HC30	14	.69
74HC32	14	.79
74HC42	16	1.09
74HC51	14	.89
74HC58	14	.89
74HC73	14	.79
74HC74	14	.79
74HC75	16	.99
74HC76	16	.79
74HC85	16	1.69
74HC86	14	.75
74HC107	14	.79
74HC109	16	.79
74HC112	16	.79
74HC123	16	2.29
74HC125	14	1.75
74HC132	14	1.29
74HC137	16	1.59
74HC138	16	1.19

74HC139	16	1.05
74HC147	16	1.29
74HC151	16	.99
74HC153	16	1.09
74HC154	24	2.65
74HC157	16	.99
74HC158	16	.99
74HC160	16	1.39
74HC161	16	1.39
74HC162	16	1.39
74HC163	16	1.39
74HC164	14	1.35
74HC165	16	2.15
74HC166	16	2.49
74HC173	16	1.29
74HC174	16	1.09
74HC175	16	1.09
74HC190	16	1.59
74HC191	16	1.59
74HC192	16	1.49
74HC193	16	1.49
74HC194	16	1.19
74HC195	16	1.19
74HC221	16	2.95
74HC237	16	1.49
74HC240	20	2.29
74HC241	20	2.29
74HC242	14	2.15
74HC243	14	2.15
74HC244	20	2.29

74HC245	20	2.59
74HC251	16	.99
74HC253	16	1.09
74HC257	16	.99
74HC259	16	1.69
74HC266	14	.89
74HC273	20	2.79
74HC280	14	4.59
74HC299	20	5.59
74HC366	16	2.59
74HC367	16	2.59
74HC373	20	2.69
74HC374	20	2.69
74HC390	16	1.59
74HC393	14	1.59
74HC533	20	2.69
74HC534	20	2.69
74HC595	16	3.19
74HC688	20	3.59
74HC4024	14	1.75
74HC4040	16	1.49
74HC4060	16	1.49
74HC4075	14	.59
74HC4078	14	.59
74HC4511	16	1.95
74HC4514	24	4.19
74HC4538	16	2.59
74HC4543	16	3.75

74HCU04 is unbuffered.
All others are buffered.

74C—C/MOS

74C00	14	.29
74C02	14	.35
74C04	14	.35
74C08	14	.35
74C10	14	.35
74C14	14	.59
74C20	14	.35
74C30	14	.35
74C32	14	.39
74C42	16	1.19
74C48	16	1.79
74C73	14	.69
74C74	14	.59
74C85	16	1.39
74C86	14	.29
74C89	16	5.95
74C90	14	1.09
74C93	14	1.09
74C95	14	1.19

74C107	14	.79
74C151	16	2.19
74C154	24	3.25
74C157	16	1.75
74C160	16	1.19
74C161	16	1.19
74C162	16	1.19
74C163	16	1.19
74C164	14	1.29
74C165	16	1.29
74C173	16	.89
74C174	16	1.19
74C175	16	1.19
74C192	16	1.39
74C193	16	1.39
74C195	16	1.29
74C221	16	1.75

74C240	20	1.95
74C244	20	1.95
74C373	20	2.29
74C374	20	2.29
74C901	14	.59
74C902	14	.79
74C903	14	.59
74C906	14	.59
74C907	14	.89
74C911	28	8.95
74C912	28	8.95
74C915	18	1.19
74C917	28	8.95
74C922	18	4.49
74C923	20	4.95
74C925	16	5.95
74C926	18	5.95
80C95	16	.69
80C97	16	.69

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TL071CP	8	.79
TL072CP	8	1.09
TL074CN	14	1.95
TL081CP	8	.59
TL082CP	8	1.19
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LM109K		5.95
LM301CN	8	.39
LM302H		2.49
LM304H		1.95
LM305H		.99
LM307CN	8	.49
LM308CN	8	.69
LM309K		1.25
LM310CN	8	1.95
LM311CN	8	.59
LM312H		2.79
LM317T		1.19
LM317K		3.49
LM318CN	8	1.59
LM319N	14	1.49
LM320K-5		1.35
LM320K-12		1.35
LM320K-15		1.35
LM320K-24		1.35
LM320T-5		.85
LM320T-12		.85
LM320T-15		.85
LM320T-24		.85
LM322N	14	1.49
LM323K		4.95
LM324N	14	.59
LM329DZ		.65
LM331N	8	3.95
LM334Z		1.19
LM335Z		1.29
LM336Z		1.09
LM337MP		1.15
LM337T		1.89
LM338K		6.95
LM339N	14	.69
LM340K-5		1.35
LM340K-12		1.35
LM340K-15		1.35
LM340K-24		1.35
LM340T-5		.75
LM340T-12		.75
LM340T-15		.75
LM340T-24		.75
LF347N	14	1.49
LM348N	14	.89
LM350K		4.79
LF351N	8	.59
LF353N	8	.89

LF355N	8	1.09
LF356N	8	1.09
LM358N	8	.59
LM359N	14	1.79
LM370N	14	4.95
LM373N	14	4.95
LM377N	14	1.95
LM380CN	8	1.09
LM380N	14	.89
LM381N	14	1.79
LM382N	14	1.49
LM384N	14	1.95
LM386N-3	8	.89
LM387N	8	1.39
LM389N	18	1.19
LM391N-80	16	1.19
LM392N	8	.59
LM393N	8	.45
LF398N	8	3.95
LM399H		5.95
LF412CN	8	1.95
TL494CN	16	2.79
TL496CP	8	1.59
NE531V	8	1.79
NE544N	14	1.95
NE550A	14	1.95
NE555V	8	.35
XR-L555	8	.69
LM556N	14	.79
NE558N	16	1.59
NE564N	16	1.95
LM565N	14	.99
LM566CN	8	1.49
LM567V	8	.99
NE570N	16	2.95
NE571N	16	2.49
NE592N	14	1.19
LM703CN	8	1.49
LM710N	14	.69
LM711N	14	.79
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LM733N	14	.89
LM739N	14	1.95
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LM2878P		2.95
LM2901N	14	.79
LM2902N	14	.89
LM2907N	14	2.49
LM2917N	8	1.95
LM3900N	14	.59
LM3905CN	8	1.19
LM3909N	8	.89
LM3914N	18	2.39
LM3915N	18	2.39
LM3916N	18	2.39
RC4136N	14	1.25
RC4151NB	8	1.95
RC4195TK		5.95
LM4250CN	8	1.49
LM4500A	16	2.95
NE5532	8	1.69
NE5534	8	1.39
79M05AH		1.29
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14 pin LP	.17	.15	.14
16 pin LP	.19	.17	.16
18 pin LP	.26	.24	.23
20 pin LP	.30	.27	.25
22 pin LP	.31	.28	.26
24 pin LP	.33	.30	.28
28 pin LP	.40	.37	.35
40 pin LP	.49	.46	.43

Soldertail (Gold) Standard

Part No.	1-9	10-99	100-up
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16 pin SG	.55	.49	.45
18 pin SG	.65	.59	.51
20 pin SG	.75	.65	.59
22 pin SG	.79	.69	.65
24 pin SG	.79	.69	.65
28 pin SG	.95	.85	.75
36 pin SG	1.25	1.15	.99
40 pin SG	1.39	1.25	1.15

Wire Wrap Sockets (Gold) Level #3

Part No.	1-9	10-99	100-up
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10 pin WW	.69	.65	.59
14 pin WW	.75	.69	.65
16 pin WW	.79	.72	.65
18 pin WW	.95	.85	.75
20 pin WW	1.19	1.09	.95
22 pin WW	1.29	1.19	1.05
24 pin WW	1.35	1.19	1.09
28 pin WW	1.69	1.55	1.39
36 pin WW	1.89	1.79	1.69
40 pin WW	2.29	1.95	1.79

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16 pin HP	.69	.65	.59
24 pin HP	1.15	.99	.89

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1N5404	3 Amp 400PIV	Plastic	33	2.97	26.40	231.00
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2114-25	1024x4	(250ns)	8/10.95
2114L-2	1024x4	(200ns)(LP)	8/13.95
TMM2016-200	2048x8	(200ns)	4.15
TMM2016-150	2048x8	(150ns)	4.95
TMM2016-100	2048x8	(100ns)	6.15
HM6116-4	2048x8	(200ns)(cmos)	4.75
HM6116-3	2048x8	(150ns)(cmos)	4.95
HM6116LP-4	2048x8	(200ns)(cmos)(LP)	4.95
HM6116LP-3	2048x8	(150ns)(cmos)(LP)	5.95
HM6264P-15	8192x8	(150ns)(cmos)	24.95

LP=Low Power

DYNAMIC RAMS

4116-250	16384x1	(250ns)	8/6.95
4116-200	16384x1	(200ns)	8/8.95
4116-150	16384x1	(150ns)	8/10.95
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4164-150	65536x1	(150ns)(5V)	9/44.95
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5V=Single 5 Volt Supply

EPROMS

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2716-1	2048x8	(350ns)(5V)	4.95
TMS2532	4096x8	(450ns)(5V)	4.95
2732	4096x8	(450ns)(5V)	4.95
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2732A-35	4096x8	(350ns)(5V)(21V PGM)	4.95
2732A	4096x8	(250ns)(5V)(21V PGM)	6.95
2732A-2	4096x8	(200ns)(5V)(21V PGM)	10.95
27128	16384x8	(250ns)(5V)	19.95

5V=Single 5 Volt Supply21V PGM=Program at 21 Volts

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7404	.19	7474	.33
7405	.25	7475	.45
7406	.29	7476	.35
7407	.29	7486	.35
7408	.24	7490	.35
7410	.19	7492	.50
7411	.25	7493	.35
7414	.49	74121	.29
7416	.25	74123	.49
7417	.25	74132	.45
7420	.19	74151	.55
7425	.29	74154	1.25
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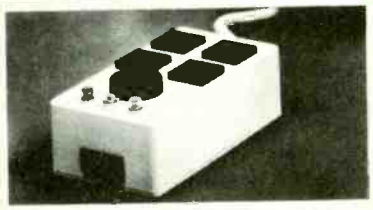

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Forth and AI

(Continued from page 95)

Forth is a language of tools. Some of those tools are handy for writing search routines. Thus, Forth is useful for implementing inference engines. And, since it's useful for writing new languages and for writing inference engines, Forth seems a good candidate for AI work.

Forth, LISP, and AI

That is not to say that Forth is *outstanding* for AI work; it is not. Extensible languages, like LISP and Forth, simply offer you the option of adding whatever it is you need if it's not already available in that language. Since LISP is the language of choice in academic AI projects, a discussion of Forth for AI doesn't seem credible without reference to it. So let's use LISP as a reference for the final points I think should be made. Where do LISP and Forth get their abilities to support AI programming?

Artificial intelligence requires the following program features: user interface, pattern recognition, and the ability to compile user expert programs in whatever new language is needed. The last point is crucial; without it, you obviously don't have much of an expert system.

LISP and Forth are both very powerful environments for creating knowledge representation languages. They are also very powerful environments for creating inference engines.

LISP was designed for just such an activity as AI programming, while Forth was originally created for linear programming projects. Therefore to get all the subtle features one *assumes* when using a good LISP system, you must add them to a standard Forth system. There's a side benefit here: If you don't happen to need a particular feature, you will not have to add it to your Forth system, which will leave you more room for your knowledge base and inference engine. Another benefit: If you do add it, you surely will know how it works.

Forth, as an AI language, does lack features which LISP offers and which you must add to your Forth system. One is a memory structure. LISP gives you *lists* that are incredibly convenient places to stick bits and pieces of knowledge you are performing inferences on. LISP also gives you tools with which to manipulate these lists—routines such as APPEND, DELETE, and MAKELIST—plus a host of useful, if obscure, routines to travel along lists of data looking for things. Forth, on the other hand, gives you no such tools; if you want them, you have to add them. But, because you can, and because I have, I think Forth is a pretty good artificial intelligence language. ◇

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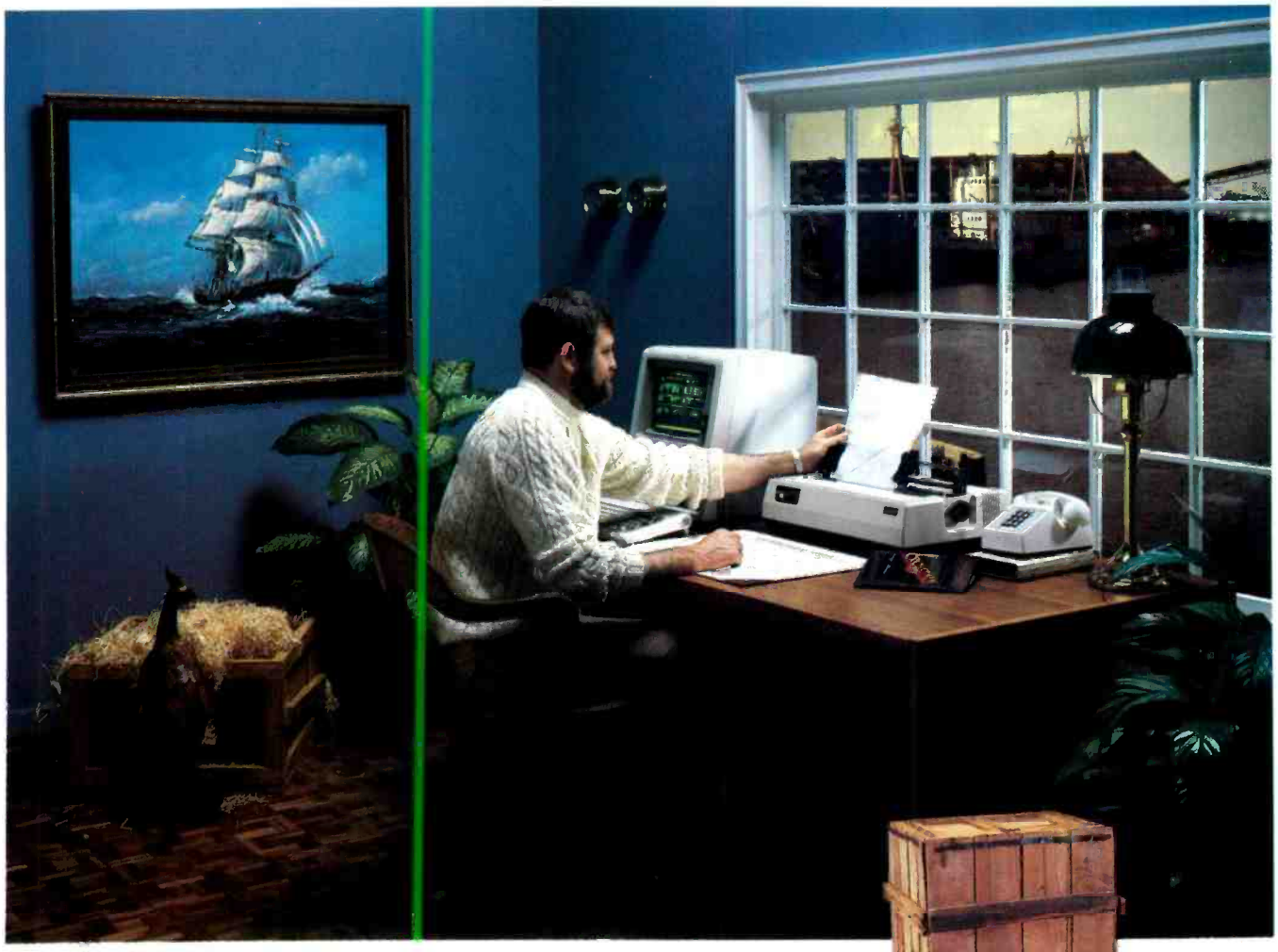

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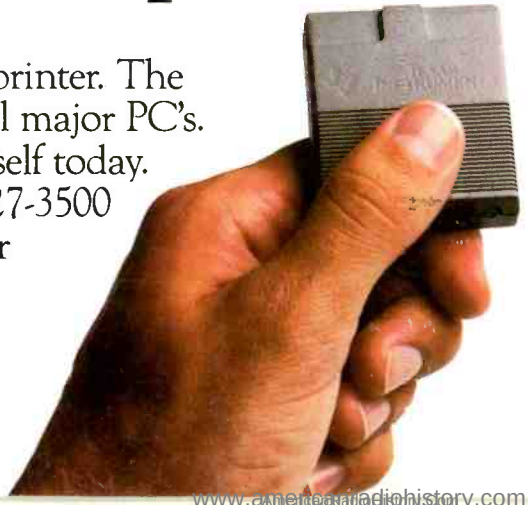

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