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BYTE
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Volume 12, Number 7

NEW

Eureka: The Solver™

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

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

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

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

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

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

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

How to use Eureka: The Solver

It's easy.

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

You can then tell Eureka to

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

Eureka: The Solver includes

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

Some of Eureka's key features

You can key in:

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

All this power for only $99.95!

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

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

That kind of savings you can calculate with your fingers!

System requirements

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

*Introductory price—good through July 1, 1987

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BI-1103C

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Turbo C®

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

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

Turbo C: The C compiler for amateurs and professionals

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

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

Turbo C: a complete interactive development environment

Free MicroCalc spreadsheet with source code

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

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

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

System requirements

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

Technical Specifications

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

*Introductory price—good through July 1, 1987

Sieve benchmark (25 iterations)

	Turbo C	Microsoft® C	Lattice C
Compile time	**3.89**	16.37	13.90
Compile and link time	**9.94**	29.06	27.79
Execution time	**5.77**	9.51	13.79
Object code size	**274**	297	301
Price	**$99.95**	$450.00	$500.00

Benchmark run on a 6 Mhz IBM AT using Turbo C version 1.0 and the Turbo Linker version 1.0; Microsoft C version 4.0 and the MS overlay linker version 3.51; Lattice C version 3.1 and the MS object linker version 3.05.

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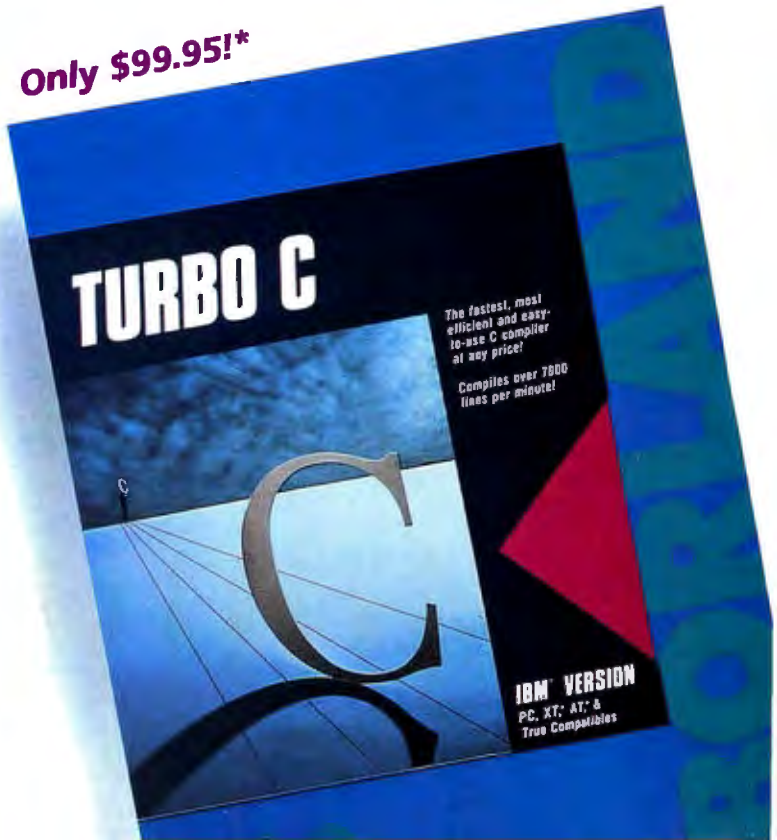

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NEW

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

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

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

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

The Critics' Choice

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

Steve Gibson, InfoWorld

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

John C. Dvorak"

Turbo Basic ends the basic confusion

There's now one standard: Turbo Basic.

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

Free spreadsheet included, complete with source code!

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

A technical look at Turbo Basic

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

System requirements

IBM PC, XT, AT and true compatibles, PC-DOS (MS-DOS) 2.0 or later. One floppy drive, 256K.

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Reflex is the acclaimed, high-performance database manager that's so advanced it's easy to use!

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System requirements

Reflex: The Database Manager: IBM PC, AT, XT, or true compatibles. PC-DOS (MS-DOS) 2.0 and later. IBM CGA, Hercules Monochrome Card, or equivalent. 384K.

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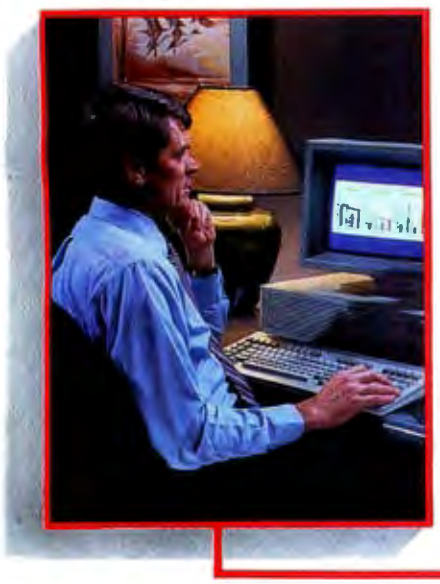
Print Master lets people share printers



Get the most out of your expensive resources—your people, your computers and your printers—with Print Master by BayTech. Not only does it let your people and computers share all of your printers, its buffer keeps them working instead of waiting.

Easy to set up, easy to use

Initial setup is menu-prompted and allows you to configure Print Master to your application. You decide which ports are input and which are output. You also set such functions as baud rates, handshaking, timeout, how you select a printer, etc.

After setup, you simply cable Print Master between your computers and printers, and you're ready to go. BayTech's Memory Resident Program lets your PC users select printers via function keys that correspond to a menu window.

Print Master keeps everything running

All users can send data simultaneously to Print Master's dynamically allocated buffer, keeping your people and computers working. This first-in-first-out buffer also sends data to all printers simultaneously to keep them running at full capacity. The buffer size? A big 512K that's expandable to one megabyte.

Eleven models with serial and parallel

An advantage of Print Master is its flexibility: Any port can be a computer port or a printer port. Choose from eleven models with different combinations of serial and parallel ports. Print Master internally converts serial to parallel and vice versa on combination serial/parallel models. Six ports, $795. Eight ports, $895. Ten ports, $995.

Non-buffered models from $339. GSA pricing available.

Want details?

Contact your dealer or Bay Technical Associates for information about Print Master and BayTech's complete line of data communications products, proudly made in the U.S.A.

BayTech

Bay Technical Associates, Inc.
Data Communications Products Division
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Bay Saint Louis, Mississippi 39520
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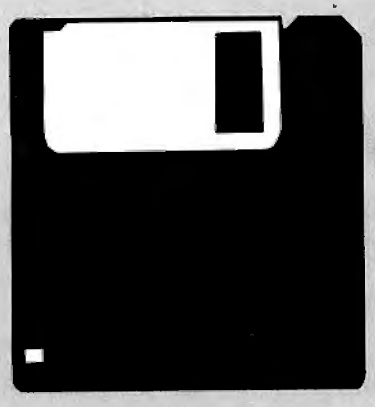

EDITORIAL

Everyware

You read BYTE—and we work hard to produce it—because we all share a fascination with personal computers. But our machines are more than objects of interest—they make us more productive, too. And the component that generates that higher productivity is software.

The results of our readership surveys show that BYTE readers own an average of 22 software packages. Nearly 90 percent of you use word-processing programs, along with spreadsheets, statistical packages, database managers, telecommunications software, and many others.

We know, therefore, that you need extensive coverage of the latest developments in application software. You want to know how the steady forward march of hardware horsepower is being translated into more efficient software to help you do your work.

We cover developments in software in every issue. However, this software coverage is mixed with articles on hardware technology and articles on system software. We've long felt the need to cover application software in one uninterrupted forum. We thus created this special, extra issue devoted in its entirety to examining software that helps us use our computers to accomplish more work.

We think this issue, with its focus on today's most advanced and sophisticated software, can help you become even more productive with your microcomputer.

This unique forum examining the latest application software may be just the beginning. As such, we chose mainstream software genres—word processing, spreadsheets, database managers, telecommunications, and accounting—for our exploration. In future issues, we plan to cover more specialized genres, like statistics, project management, CAD, engineering, finance, and many others.

The Future

Our coverage of application software moves in two directions. The feature articles that open the issue attempt to glimpse the future to provide a preview of what the programs we'll all be using in a few years might look like. We've enlisted the aid of people who have a good track record in knowing what software tomorrow might bring.

Bill Gates of Microsoft has made millions creating system software, but these days he thinks a lot about application software, too. His article "Beyond Macro Processing" attempts to explain what he thinks is a logical evolutionary next step for application software architectures. Gates's scheme may lead to applications that easily share data and to programs that can use the same user-written, macro-like routines.

Philippe Kahn's Borland International gave the world software that spans applications and utilities. Borland's attempt to solve the memory-resident program battles for memory and interrupts led to the creation of an application program interface that Kahn and Steven Boye describe in an article about SideKick Plus. Lotus Development Corporation has come up with a similar method to deal with the problem of proliferating TSRs. They could not provide us with complete details about their plan, however, in time for this issue.

Dave Kruglinski writes about the differences between the relational and network model for database managers. Ezra Shapiro looks at some useful programs you may not have heard of. Research pros from Datapro in New Jersey speculate on the promise of application software and discover three major trends that will become increasingly evident in evolving software. Looking out for accounting software design flaws is the realm explored by Gary Hedge in his article.

The Present

The second direction covered in this issue is current software. We've called on our most trusted reviewers and assigned them the task of doing roundup reviews of products in several categories. We asked them to concentrate on the advanced and sophisticated features of the programs in a given group. In word processing, for example, you don't want to know about insert and delete; you want to learn about kerning and PostScript output.

These reviews examine programs with an eye to both features and performance. We've come up with some new performance measurements that show the strengths and weaknesses of many of the programs tested.

The reviews rely on the skills of some of the most knowledgeable people in the computer journalism business—Phillip Robinson, Rich Malloy, Charles Spezzano, Brock Meeks, and Jon Edwards. Collectively, they have been using and writing about microcomputer software for 35 years.

The Judges

The final judgment on the utility of this issue, however, must be made by you. If you find this all-application-software approach useful, please let us know. We also want to know what applications interest you most so that future application software issues can examine the programs you need to learn more about.

—G. Michael Vose
Senior Technical Editor

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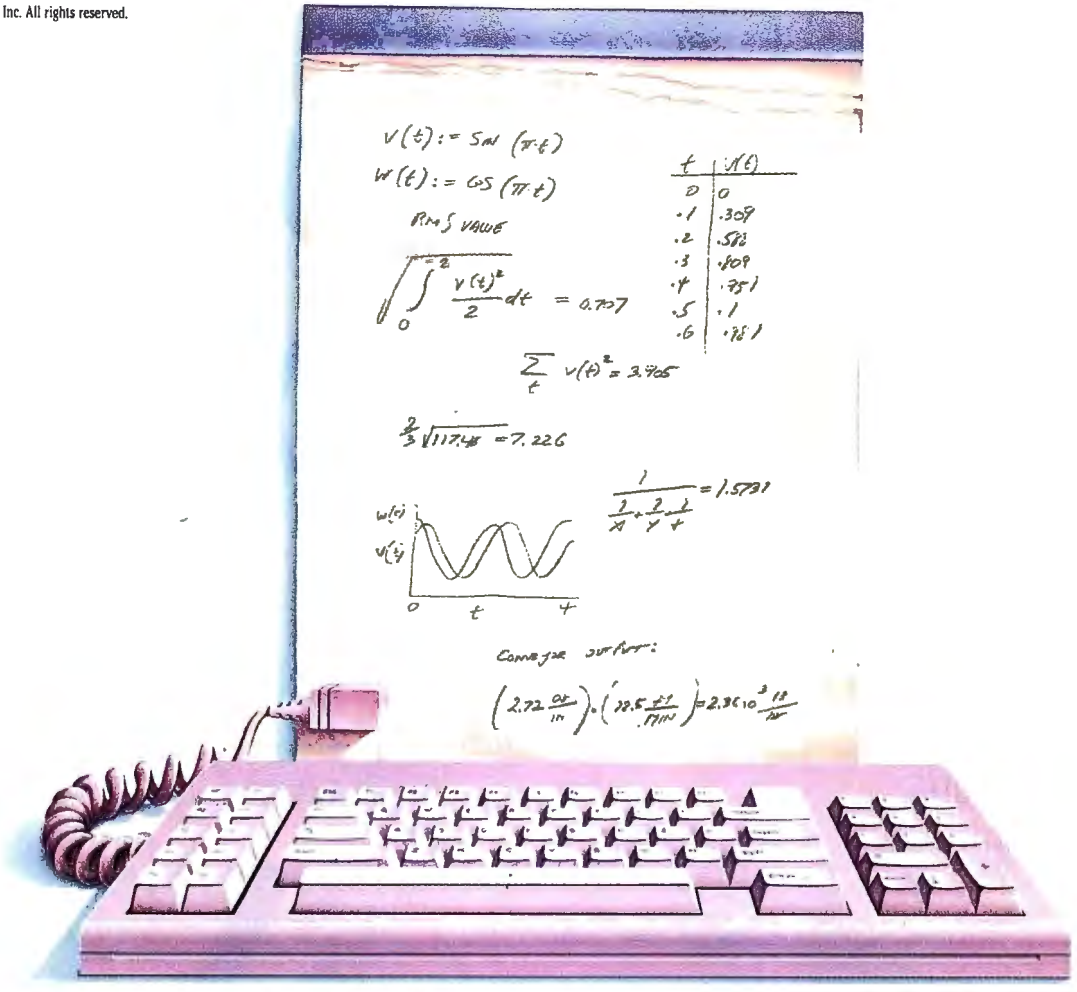

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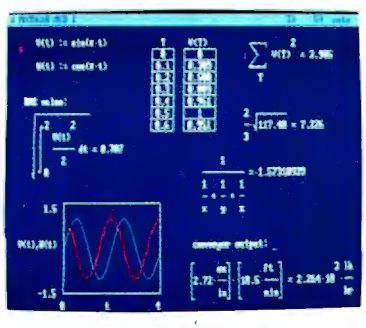

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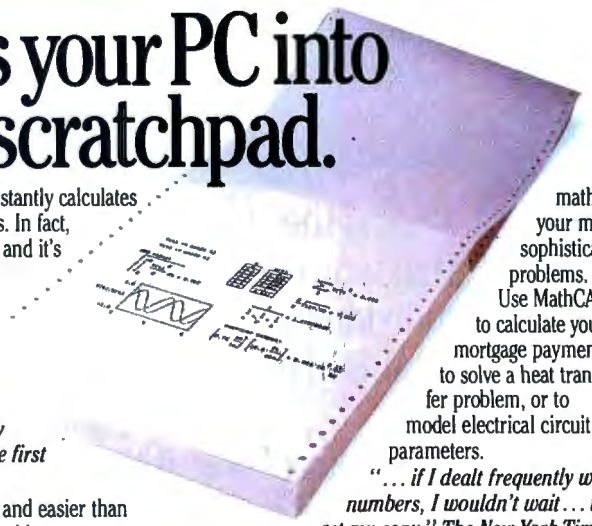

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Beyond Macro Processing

A strategy for customizing applications software

■ Bill Gates

Macro languages are a powerful and effective tool to create programs, but they are limiting in three major ways. First, too many of them exist. Each specific application has its unique macro language, creating problems for those who must learn several different macro languages. Second, each macro language is bound to an individual application. No existing macro language lets you call routines from several different applications. Third, macro languages do not have the power and flexibility of traditional programming languages. With a traditional language, you can access the hardware directly and perform data manipulation down to the bit level. You can't do either of these tasks with existing macro languages.

These drawbacks create an opportunity for the industry to move forward to a more advanced solution. I would like to propose a vision of a software architecture that would greatly extend the power and scope of macro languages inside applications. First I'll examine the development of macro and traditional languages and their respective merits and limitations. Then I'll propose a new language and environment with the strengths of both macro and traditional languages.

Macro-Language Development

Macro languages appear in every type of application, and each has a unique syntax and set of commands. Programming in macro languages has become popular due to the high level of embedded functionality they provide. Current macro architecture has reached its maturity.

Macro languages are not a recent development, nor are they unique to spreadsheet applications. One of the first popular applications with a macro language was dBASE II, which offered users both a forms orientation and a *programming environment*. Not all macro languages look like a programming environment.

You can find macro languages in communications packages and word processors. Many communications packages provide an *auto-login* feature that is a form of macro language. Microsoft Word has a form of macro language called the style sheet. You can assign a name to various formatting characteristics. Then, by selecting and applying the name to a paragraph or document, you can reformat the text. Perhaps the best known macro language is in the Lotus 1-2-3 spreadsheet program. While the 1-2-3 macro language was not the first, it might be the most widely recognized.

Each of these macro languages adds considerable functionality to its application. Unfortunately, each is unique. This causes problems in creating and using macro programs. You have to learn a new set of keystrokes or commands with each new application. You cannot use macros created for one application in another. This forces you to start from scratch with each application and eliminates any concept of a general-purpose macro program library.

The problem of unique macro languages becomes most evident in a multitasking environment. In present-day single-tasking environments, you have to shut down one application before running the next. During this process, you make a mental shift to the new application's interface and macro language. When you can run several programs simultaneously, you'll have a difficult time remembering the unique macro language for every application.

Being bound to a single application is the most limiting factor of the present macro-language architecture. Within each application, you can write programs using the power and functions of that specific application. You cannot write programs to combine the unique strengths of several applications.

Macro languages are evolving toward traditional programming languages. They incorporate many features of traditional programming languages. Branching constructs and file input and output are now standard. However, macro languages still do not provide low-level access to system resources.

Evolving Syntax

Macro-language syntax is also evolving from a keystroke orientation to a keyword orientation. Many of the original macro-language programs were files containing a series of keystrokes. The application would simply *play* the stored keystrokes at the user's request. To simplify the creation of macros, applications frequently included a *record* mode. When turned on, the record mode would capture all the subsequent keystrokes and store them in a file. A user would later ask the program to replay the file. Users never needed to know what was in the file. Even without a record mode, the programs were easy to create because the programming commands were identical to the program's commands.

The drawbacks of a keystroke syntax are difficulties in the readability and maintenance of macro programs. An example from a keystroke-style program might be `/RNCdatabase`. This calls the Range, then Name, then Create menu choices and creates a new range named `database`. Small programs using this syntax would be easy to create and modify. But a large program of these macros would be difficult to create and maintain.

Traditional languages use a keyword-oriented syntax. Each procedure and function is accessed by a command or keyword. An example from a keyword-style program could be `SET.NAME ("database",C1:D15)`. This command names cells C1 through D15 "database."

The evolution from keystrokes to keywords and the addition of branching and file I/O can be seen in the differences be-

continued

Bill Gates is the chairman of Microsoft Corp., 16011 Northeast 36th Way, P.O. Box 97017, Redmond, WA 98073-9717.

tween the macro syntax of Lotus 1-2-3 versions 1A and 2 (see figures 1 and 2).

Macro languages are popular because of their high level of embedded functionality. The application becomes a rich subroutine library that the macro program can access. You don't have to write all the routines from scratch. Complex routines such as sorting, formatting, and table lookup are already available. Many programs are much shorter and easier to create using a macro language.

The 14-line macro program from Microsoft Excel (see figure 3) demonstrates a table lookup program. The same program in any traditional language would be much longer.

Macro languages have fully exploited the capabilities of their existing architecture. The problems they now face—too many of them, all different, bound to a single application—cannot be overcome without a fresh look at the overall systems architecture.

```
/XI     is equivalent to the IF command
/XG     is equivalent to the BRANCH command
/XQ     is equivalent to the QUIT command
/XC     is equivalent to the SUBROUTINE_NAME command
/XR     is equivalent to the RETURN command
/XL     is equivalent to the GETLABEL command
/XN     is equivalent to the GETNUMBER command
/XM     is equivalent to the MENUBRANCH command
```

Figure 1: *Macros in Lotus 1-2-3 version 1A.*

```
{BEEP}          {GETNUMBER}     {QUIT}
{BLANK}         {GETPOS}        {READ}
{BRANCH}        {IF}            {READLN}
{BREAKOFF}      {INDICATE}      {RECALC}
{BREAKON}       {LET}           {RECALCCOL}
{CLOSE}         {LOOK}          {RESTART}
{CONTENTS}      {MENUBRANCH}    {RETURN}
{DEFINE}        {MENUCALL}      {SETPOS}
{DISPATCH}      {ONERROR}       {SUBROUTINE_NAME}
{FILESIZE}      {OPEN}          {WAIT}
{FOR}           {PANNELOFF}     {WINDOWSOFF}
{FORBREAK}      {PANNELON}      {WINDOWSON}
{GET}           {PUT}           {WRITE}
{GETLABEL}      {WRITELN}
```

Figure 2: *Lotus 1-2-3 version 2 macros.*

```
Command Animal_Babies
WindowTitle     ="Names of Animal Babies"
continue        ="Try another (Y or N)?"
correct         ="That's right!!! "
                =SET.NAME("animals",D1:E8)
select          =INT(RAND( )*8)+1
animal          =INDEX(animals,select,1)
baby            =INDEX(animals,select,2)
prompt1         ="What is the name of the offspring of "&animal&"?"
answer          =INPUT(prompt1,2,WindowTitle)
wrong           ="Wrong... The name of a "&animal&" 's offspring is "&baby&"."
prompt2         =IF(answer=baby,correct,wrong)&continue
next            =MID(INPUT(prompt2,2,WindowTitle),1,1)
                =IF(next="Y",GOTO(select))
                =RETURN( )
```

Figure 3: *A Microsoft Excel macro program called Animal_Babies. Animal_Babies is a guessing game where the program displays an animal randomly selected from a table named "animals" and asks the user to guess what the offspring is called.*

Traditional-Language Development

Traditional languages have three primary advantages over macro languages: primitive access to system resources, powerful development tools, and a large number of language choices.

The function of a language is to provide access to the system's resources. As computers have evolved, languages have grown to provide access to those resources. Traditional languages provide complete access to the operating system, a graphic user interface, and networking. Additionally, this access is at a primitive level. You can manipulate data and resources at the bit and byte level. This depth and breadth of access gives you complete control over the system.

The traditional programming-language environment has grown to include powerful development tools. Compiler and interpreter technology have continually evolved over the last 20 years. New tools greatly speed the program-development process. Symbolic debuggers, linkers, library managers, source-code control systems, and sophisticated editors all work together to create a highly productive software-development environment.

Dozens of programming languages are available running under MS-DOS. You can choose a language to match the requirements of the problem to be solved. Macro-language programmers do not have this variety. They must use the one language supplied by the application.

The major limitation of a traditional language is its inability to access the powerful routines found *inside* an application. The procedures and functions within an application can be viewed as a resource of the system in the same manner as the operating system's procedures and functions. Current traditional languages do not let you access this resource.

The Best of Both Worlds

The best solution to the weaknesses of the existing macro-language architectures would be a new programming environment that combines the strengths of both traditional and macro languages. The new environment would have the power and supporting tools of traditional languages as well as the ability to access routines within all applications rather than just one. This architecture would complete the language's function of providing access to all system resources.

The ability to access the routines of the application would also provide access to the application's data. Data would not be

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isolated as spreadsheet, word-processing, graphic, or database data with no way to transfer or combine the different types of data. This new environment would unlock the application's hold on its data. Data could be transferred and manipulated by the most appropriate parts of each application. The removal of data barriers would provide some exciting opportunities.

This architecture can be implemented only in a multitasking environment without the existing 640K-byte memory limit imposed by MS-DOS. But a multitasking environment is where the inefficiencies of the existing architecture will be most unacceptable. When two applications can run side by side but cannot easily share data, the user community will demand change.

A Proposed Solution

A solution to the macro-language problem requires more than just a new language. Several layers of software architecture also need to change. I'll examine a system architecture that would let a single language access multiple applications. The system would be made up of four parts: a program-creation tool, a program engine, a common applications protocol, and modifications to the applications (see figure 4).

The *program-creation tool* is the language tool used to create programs using routines from various applications. It is the *new* language. The program-creation tool produces programs that the *program engine* executes.

The program engine is the "black box" that executes the programs created by the program-creation tool. The program engine has no interface of its own. Its job is to manage the execution of program-creation-tool programs. As such, it initiates and terminates execution of the various applications that each program requires.

The *common applications protocol* is not a body of code or a program. It is an agreement between applications and the program engine on how to exchange commands and data. The common applications protocol provides the foundation upon which the new architecture is built.

Under this architecture, applications software will need to be extended to have a programmatic interface as well as a user interface. The programmatic interface would let the application become a library of routines that a programmer could access.

Program-Creation Tool

The program-creation tool is the new language used to create programs that the program engine executes. It is inaccurate to speak as if only one program-creation tool would exist. Just as there are several traditional languages, there could easily be more than one program-creation tool.

The most widely used program-creation tool would probably be a form of BASIC. BASIC is generally accepted as an easy language to learn and use and would be the obvious choice for end users who are writing macros today. The C programming language is widely used for complex program development due to its flexibility and speed. It would probably be the first low-level program-creation tool.

A need will exist for both interpreter and compiler program-creation tools, as each has inherent advantages. Interpreters are easier to learn because they have no compile step. They are easier to use because they provide immediate error checking when you enter the code. Current interpreter technology is sufficiently robust to meet the needs of most macro programs. Compilers provide the benefits of source-code protection and better execution performance. Programs that perform heavy data conversion and manipulation would greatly benefit from a compiler. Both will be needed.

The syntax of the new language would comprise two new classes of commands—general and application specific. The general class of commands would be found in every application and would be implemented consistently. An example of a general command might be screen updating. The procedure `SCREEN-UPDATE (off)` would stop the program from updating the screen after every command. You would enter this command if you didn't want to watch the intermediate screen updates while the macro program was running. Every application would have the same general command set.

The second class of commands includes those specific to an application. Each application would provide a library of commands necessary to access its routines. The application commands would not need to be unique from all other application commands.

The code sample in figure 5 shows one possible syntax for a program-creation tool based on BASIC. In this code sample, the `OPEN-APP` command checks to see if the application is already executing. If executing, the `OPEN-APP` routine returns a handle to the calling subprogram. If not executing, the `OPEN-APP` routine loads the application, begins execution, and then returns a handle to the calling subprogram. `SELECT` specifies that all subsequent application functions should be applied to the application until another `SELECT` is encountered.

Applications handles let you write gen-

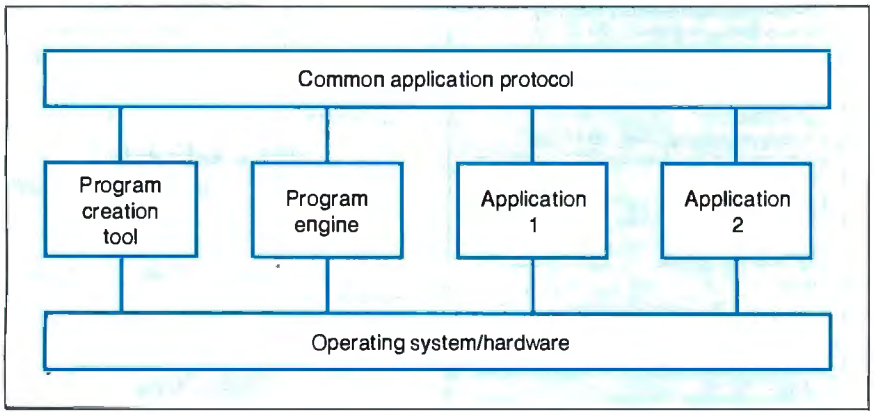

Figure 4: *A new architectural approach to applications-software design.*

```
App__Handle = OPEN-APP(MSWORD)
SELECT App__Handle
TRANSFER-LOAD ("acme.doc")
First__Occur = FIND ("sales proposal")
IF First__Occur THEN
        Position__Page = GET-POSITION(page)
        Position__Line = GET-POSITION(line)
        Whole__Line = READ-LINE(Position__Line)
ENDIF
CLOSE-APP(App__Handle)
```

Figure 5: *Code for a program-creation tool based on BASIC.*

eral-purpose subprograms. The subprogram is passed a handle. It selects the handle and applies its commands without knowing or caring with what application it is communicating.

A need exists for both procedures and functions. TRANSFER-LOAD is an example of a procedure. It does not return any data beyond the standard error-code information. FIND is a function; it returns data in a predetermined format. CLOSE-APP frees up the handle. If the application was loaded as a result of the OPEN-APP command, CLOSE-APP would terminate the program. If the application was already executing, CLOSE-APP would disconnect communication with it and remove the handle so it could no longer be used.

Program Engine

The program engine controls the execution of programs written with a program-creation tool. For interpreted program-creation tools like BASIC, the program engine is the interpreter. For compiled program-creation tools like C, the program engine is a set of dynamically linked libraries. In either case, the program engine's main function is to manage loading, executing, and terminating of the routines that the macro program uses.

When a macro program opens an application, the program engine attempts to initiate a *conversation* with the application. If the conversation fails, the program engine loads and executes the application and then initiates the conversation. When a macro program closes an application, the program engine terminates the conversation and issues a termination request to the operating system. The operating system manages the *use count* and removes the application from memory when the last program engine using the application issues a termination request.

Applications

To implement this architecture, applications packages must be extended. The success of convincing applications vendors to endorse this architecture rests on two issues. First, each application must remain autonomous and unique. The entire architecture would be designed around this requirement. The common applications protocol would be designed specifically to provide that separation. Applications and the program engine issue requests and wait for answers. Further, each application implements its own set of keywords. Two applications can use the same keyword for different tasks because the SELECT command specifies the current application.

Second, the programmatic interface must not require a complete redesign of the application. Vendors would not need to redesign their applications to conform to some universal programmatic-interface standard. Each command or action in the application's user interface would be given a programmatic command. This would let you create macro programs without learning a new set of program commands. The commands used when running the application would be similar to the ones used inside a program. For example, to open a file you would use the Microsoft Word menu commands TRANSFER and LOAD, then add the filename. This would be implemented at the programmatic-interface level as TRANSFER-LOAD ("filename").

Common Applications Protocol

The common applications protocol is the fundamental component that ties this new architecture together. It is not a piece of code but a predefined process used by programs to exchange information. Each application remains separate and autonomous. The macro program has no special knowledge of the application; it simply sends requests and receives answers and

continued

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data structures. This lets both the applications and macro programs be updated and enhanced without complicated and difficult synchronization.

One example of a common applications protocol in use today is in Microsoft Windows. Windows' Dynamic Data Exchange (DDE) performs the same function required for this envisioned architecture. DDE is simple and compact; it has only nine commands (see figure 6).

The data structure used to pass data between applications and macro programs would be based on shared memory. When a macro program issued a REQUEST command, it would specify the data required and its format. The application first would write the information to a segment of shared memory. The application then would issue a DATA command back to the macro program. The DATA command would contain a handle to a shared memory address. The macro program would need no additional information to process the data, since it originally specified the format. This scheme would let large amounts of data pass efficiently between applications and macro programs.

INITIATE:	a request to begin a conversation
TERMINATE:	end exchange
ACK:	response to a message
REQUEST:	requesting a given item
DATA	contains a requested data item
ADVISE	request a given item and automatic updating
UNADVISE	request end of automatic updating
POKE	contains an unsolicited data item
EXECUTE	request execution of indicated command

Figure 6: *The Dynamic Data Exchange command set.*

- The program would execute the DBMS application.
- The program would send a request to the DBMS to extract data from the corporate mainframe.
- The DBMS application would extract the data and return it to the program.
- The program would next execute the code to filter and format data to paste to a spreadsheet application.
- The program would execute the spreadsheet application.
- The program would request that the spreadsheet load an existing template.
- The program would send the data to the spreadsheet and request a recalculation.
- The program would request that the spreadsheet return a portion of the data.
- The program would reformat the data for inclusion in charting template for graphics comparison.
- The program would execute the graphics application.
- The program would manage the process of requests to extract and paste portions of both the spreadsheet data to the graphics application.
- The program would execute the presentation-graphics application.
- The program would send the same data to the presentation-graphics program to produce transparencies for the meeting.
- The program would execute the word-processing application and request that a partially prepared document be loaded.
- The program would manage the process of requests to extract and paste portions of both the spreadsheet data along with the graphics pictures to the document to be sent to each attendee.
- The program would request the attendee names from the document.
- The program would execute the scheduling application.
- The program would request a time for a meeting with the names extract and would also count the names and request an appropriate size room.
- The program would paste the date, time, and location of the meeting to the document.
- The program would execute the electronic-mail application.
- The program would request that the document be mailed to the list of names.

Figure 7: *The steps for an extended macro for performing an office-automation task within the proposed applications architecture.*

Examples of Uses

This proposed architecture is applicable to three major categories of programs: simple macros, data-filter programs, and office-automation rograms.

Simple macro programs would be similar to those currently being written. A program-creation tool could even implement a *record and play* function to aid in program creation. This architecture does not provide any significant benefits to this category of program. It mirrors the existing technology but is easier to use.

Data-filter programs would be a new, exciting result of having one macro program execute routines within multiple applications. A data-filter program could read the data from one application, then filter or reformat it as input for a second application, solving the data incompatibility problem within the current applications architecture. Applications such as project management, which generally do not have any way to receive or pass data, would be greatly enhanced.

Office-automation programs could benefit from this architecture as well. An example best illustrates the possibilities for office-automation macro programs (see figure 7). In this example, the regional sales data is located on a corporate mainframe. Each quarter, a meeting is held and the vice president of sales gives a presentation to a list of attendees. The sample macro program collects and analyzes data, prepares presentation materials, schedules a meeting time and location, and notifies attendees. The opportunities for office-automation programs built from the existing base of applications packages is limited only by the imagination. It would be an area of great potential for VARs and system integrators.

The Potential

This envisioned applications architecture eliminates the weaknesses of macro languages—too many of them, all different, and bound to a single application. It extends the strengths of traditional languages—variety and low-level access to system resources—to include the powerful routines inside each application. The ability to combine the power of routines from multiple applications is a significant opportunity worth pursuing. ■

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64180	199.50	199.50	995.00			500.00	2000.00
6501	199.50	199.50	995.00				
6502	199.50	199.50	995.00				
65c02	199.50	199.50	995.00				
65c816		299.50	1250.00				
6800,2,8	199.50	199.50	995.00	149.50	499.50		
6801,3	199.50	199.50	995.00	149.50	499.50		
6804	199.50	199.50	995.00				
6805	199.50	199.50	995.00				
6809	199.50	199.50	995.00	149.50	499.50		
68c11	199.50	199.50	995.00				
68000,8,10	299.50	299.50	1250.00				
68020		399.50	1500.00			700.00	2500.00
8400/c00	199.50	199.50	995.00				
80452		199.50	995.00				
8044/51	199.50	199.50	995.00	149.50	499.50		
80515		199.50	995.00				
8080	199.50	199.50	995.00	149.50	499.50		
8085	199.50	199.50	995.00	149.50	499.50		
8086/88	99.50	99.50	1250.00				
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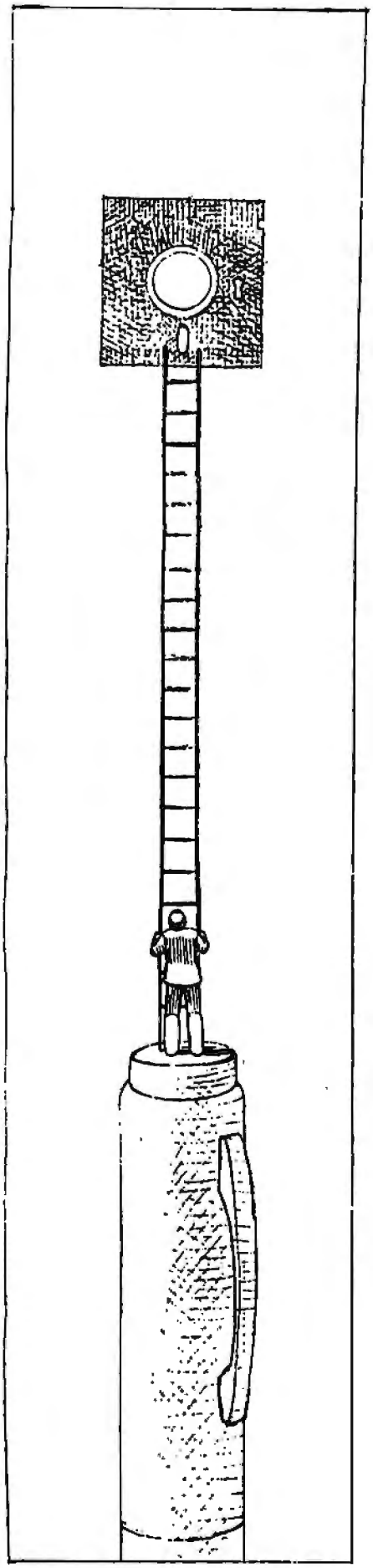

Illustration: Rob Colvin © 1987

The Application Program Interface

The SideKick Plus kernel, a proposed TSR standard

■ **Steven R. Boye and Philippe Kahn**

With Borland's 1984 release of SideKick—the first widely used terminate-and-stay-resident (TSR) program—it quickly became apparent that users wanted TSR programs for a wide range of desktop computing applications. Within the last three years, personal computer users have adopted a wide variety of TSR programs.

Borland has been working on a different approach to the design, implementation, and use of TSR programs. At the heart of this new approach is the application program interface (API). The first product to use this interface is SideKick Plus, a program that attempts to alleviate the compatibility and coexistence battles between TSR programs. This article explains the design of SideKick Plus and the API's role.

SideKick Plus: A TSR Operating System

SideKick Plus is an open-ended, resident operating system that manages all the applications in its environment. It comes with several applications similar to the original SideKick. The SideKick Plus kernel provides a resident environment in which you can use MS-DOS without reentrance conflicts. The open-ended architecture coupled with the availability of the API lets you program, install, and run your own applications in the SideKick Plus environment. SideKick Plus also supports a variety of keyboards, graphics standards, and processors.

Current versions of MS-DOS are not reentrant, preventing two different programs from invoking a single MS-DOS function call at the same time. The SideKick Plus kernel overcomes this problem and manages all reentrance requirements, together with all TSR activity.

If you write applications with the SideKick Plus API, you can use all its facilities including memory management (RAM, EMS, disk), window management, menu management, a TSR facility to activate/deactivate applications, a full-screen editor, a forms editor, database/file-handling facilities, an arithmetic package (BCD) and string package, printer facilities, and a full communications module including a data-communication script language.

Initially, SideKick Plus applications will run on the IBM PC family of computers and compatibles. The rationale for running all resident programs as SideKick Plus applications is to provide a streamlined, consistent, and integrated system.

Second, problems that arise from TSR memory requirements will disappear because the system loads with a limit on the amount of memory used for overlay and dynamic memory buffers. The SideKick Plus kernel handles all swapping of application code and data. Even if you use the smallest swap areas (the minimum area required for one module), you can still open all tasks simultaneously. The drawback of a small swap area is a reduction in program execution speed.

You can install SideKick Plus so that only the kernel remains resident while the system is inactive. When you activate SideKick Plus, the kernel will borrow memory from the current MS-DOS application and use it for its overlay and dynamic-memory buffers.

The SideKick Plus Architecture

SideKick Plus code is divided into small modules (see figure 1). Each application

continued

Steven R. Boye received his master of engineering in the computer science field from the Technical University of Denmark. He is now part of the Research and Development staff dedicated to SideKick Plus. Philippe Kahn is the president of Borland International.

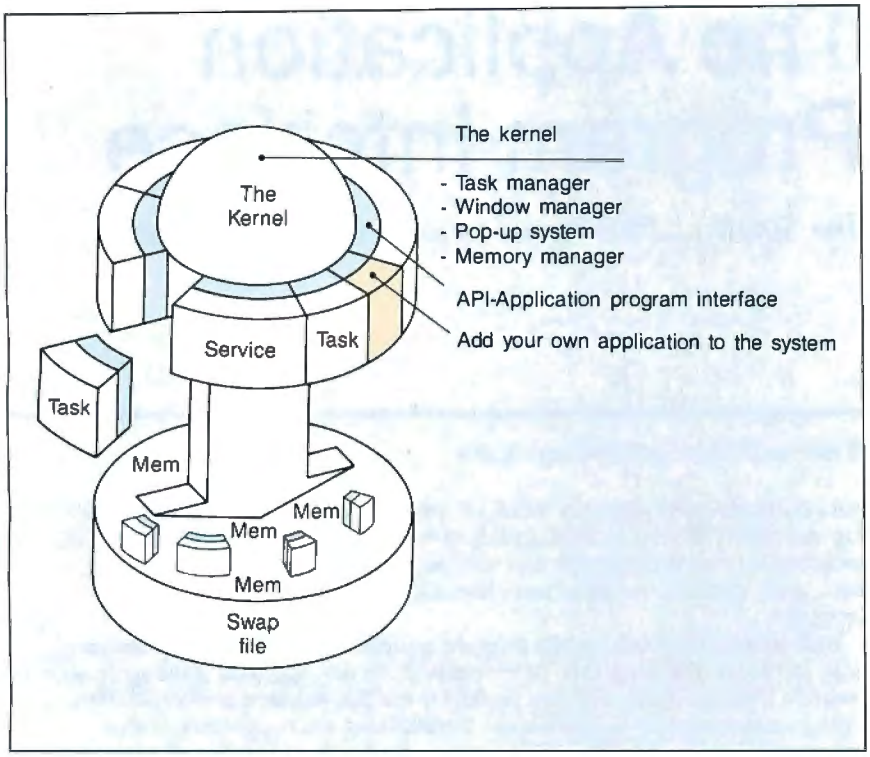

Figure 1: *Schematic drawing of a running SideKick Plus system. Tasks/services and the chunks of dynamic memory are pieces of data shipped between the swap file and memory. The code modules hook onto the kernel, and the memory blocks go into the resident dynamic-memory pool. When all SideKick Plus applications are inactive—while the user is running an MS-DOS application—SideKick Plus frees memory by swapping out all code and the dynamic-memory buffer. All swapping is done by the kernel and is invisible to the tasks and services.*

consists of one task module specific to that application and one or more general-purpose service modules. While executing, a task uses different services. The kernel is the core of the system, and all code is divided into three classes: kernel, tasks, and services.

The kernel is the central part of an installed SideKick Plus system. Its main job is to control and coordinate activities. It contains the task manager, memory manager, window manager, pop-up system, and other functions.

Tasks contain the various applications that appear in the SideKick opening menu, and each opens a window when invoked. Examples include the calculator and phone book. Services are general-purpose modules containing functions used by several tasks or services.

You can activate tasks, while tasks or services activate other services. Using the API developer's toolkit, programmers will be able to design both services and tasks.

You can execute your own customized version of the SideKick Plus system by building an SK.EXE file. An installation program does this by merging the code for the requested tasks, the necessary services, and the kernel. The size of the SK.EXE file you generate will therefore depend upon the number of applications installed.

Figure 2 shows the development of a module. First, a task/service profile is

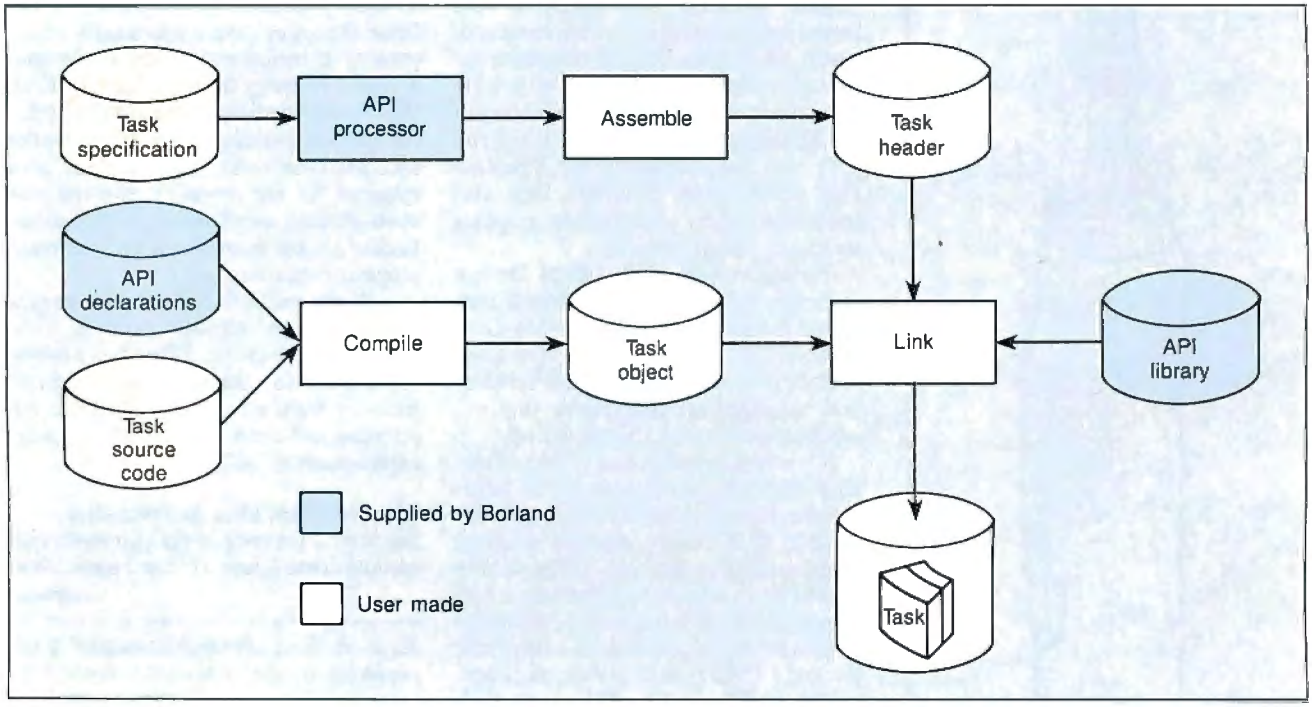

Figure 2: *A task programmer writes the source code for a task and a task/service description. The application program interface processor and assembler translate the description into a module header containing necessary data structures. This module is then linked together with the task object and API library, making a ready-to-install module.*

written, from which the API processor (APIP) can generate the necessary header file and data structures. This profile contains such information as services used, default function keys, and menu definitions. The resulting header file contains information describing the module entry points used by the kernel.

The application is written in a high-level language such as C or BASIC. An include file, with all the external declarations unique to the API, allows access to the kernel and services. Linking requires the API library that contains the access routines for the kernel and services.

Window Management

The window manager is central to the SideKick Plus kernel. Tasks normally display primary information in a main window. Other windows open when special operations are performed that don't logically belong in the main window.

The SideKick Plus time planner, for example, has four windows (see photo 1). In the photo, the calendar view is open with the schedule view on top. The appointment list for January 7 is open, and a user is currently attaching a note to the 10:00 appointment.

For the programmer writing an application in SideKick Plus, an opened window appears as a screen of its own. The C source code in listing 1 shows that SideKick Plus windows support *x,y* addressing and, if specified, will wrap text when reaching the right margin. Scrolling occurs automatically when you reach the last line in a window. [Editor's note: *The C source code for listing 1 is available on disk, in print, and on BIX. See the insert card following page 80 for details. Listings are also available on BYTEnet. See page 4.*]

The window manager repositions, recolors, and hides parts of windows. The programmer can decide whether or not the user should have control over the size of a window in some cases. The design philosophy of SideKick Plus is that, where possible, windows should be resizable. The only purpose in making a window of fixed size is to contain a structure of fixed size. In photo 1, the time planner's calendar and schedule cannot be resized, while the agenda and appointment list windows can be.

Menu System

SideKick Plus provides full menu-management facilities. Use of the menu system ensures that all the windows work smoothly together. In all applications, pressing the F10 key pops up a menu from which you can select different functions. In photo 2, the phone book is open, and pressing F10 has popped up the phone book's main menu. If the user had selected the address entry, the menu would have disappeared and an address window would have opened. By using the menu system in this way—press F10, select function, press Return, open new window—opening and shifting among windows is straightforward.

The last three lines on the screen always show the current function-key definitions and the message line of the active window. Function keys and shortcuts allow access to other windows or submenus without using the menus.

Anybody can define his or her own user interface for a SideKick Plus application. No longer do software vendors dictate the form or style of the menus or keys to activate a command. With the dynamic menu system in SideKick Plus, the application programmer defines the initial user interface and users can then tailor and change it until it behaves exactly as they like. Photo 2 shows how to do this. The bar is on the Speed entry and we

continued

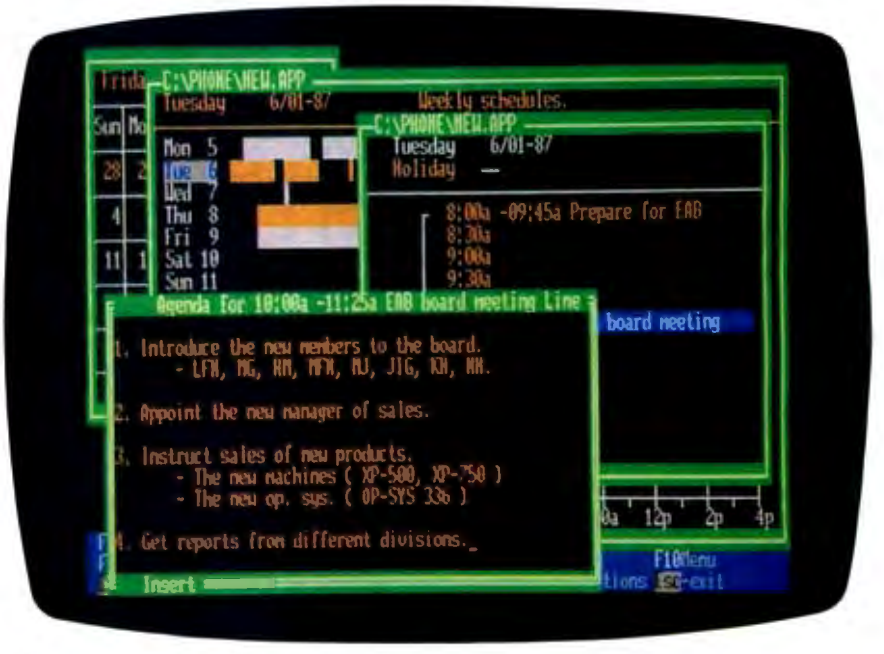

Photo 1: *A SideKick Plus application example.*

Photo 2: *An example of SideKick Plus's menu and windowing system.*

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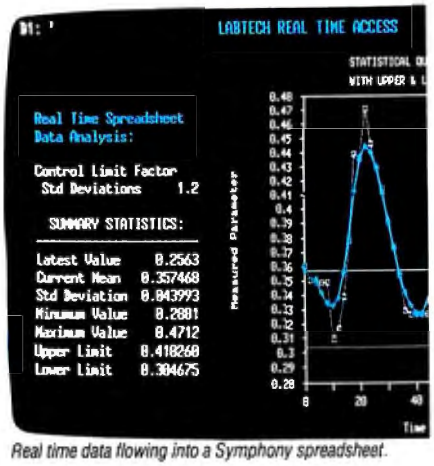

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The menu management system is much more than just a selection tool; you can also use it to enter and change values.

pressed Alt-Return. A new menu now opens, letting you change Speed entry's function key, shortcut, menu entry, or menu structure.

The menu system is more than just a selection tool; you can use it to enter and change values. The example in photo 2 shows how the communications parameters can be set to make data calls to an air-travel timesharing computer. From the programmer's viewpoint, the menu system requires only a description of the menus for the APIP, which then generates all the necessary data structures.

Full Memory Management

As outlined earlier, the kernel supports memory management. Its two different uses are to swap tasks and services and to give tasks access to dynamic memory. The task manager controls the overlaying of task and services, activates tasks, and acts as a channel for service requests from the API. Internally, the SideKick Plus kernel works with a dynamic memory buffer whose size you determine during installation.

Running an executable file prompts the task manager to load the necessary tasks and services into memory and swap files. When a request to execute a service or task occurs, the task manager checks to see if the module is in memory. If it is not, the task manager loads it from the swap file. By using this memory management technique, a SideKick Plus system occupies a relatively small amount of memory compared with the number of open and active tasks.

Overlaying of all tasks with a minimum memory buffer sufficient to accommodate the largest application will cause SideKick Plus to swap when it switches tasks (unless the active tasks are collectively smaller than the overlay). The memory manager supports three varieties of swap devices, EMS (Above Board), RAM disk, and hard disk.

Tasks use the dynamic memory manager when they require large amounts of memory. Dynamic memory has three different states: free, claimed, and released. When a task or service requests a block of memory, that memory is claimed—meaning that the task is resident and accessible. If you do not require the task for a temporary period, it can be released and swapped to disk. If you must access the memory block at a later time, the task can reclaim memory and be swapped back into memory if necessary.

After use, the memory block is freed. Memory is swapped out only when the space available in the memory manager's buffer is not large enough to accommodate space in a newly claimed block. All large uninitialized data structures used by tasks should be allocated in dynamic memory. That way, they can be swapped out when the task becomes inactive, thereby freeing memory.

Because a particular task can work with more than one dynamic memory block and each block is expandable to 64K bytes, each task can easily work with large amounts of data. For obvious reasons, the programmer must be careful not to have too much memory reclaimed at any time.

Listing 1 illustrates the use of dynamic memory. The code shows part of a task. The three procedures are task hooks, called by the kernel under certain conditions.

The procedure `OpenProc` is called when the task activates the first time. `OpenProc` opens a window. The procedure goes on to establish where in the window text can appear, initializes the function keys and menu system, and finally allocates 8K bytes of dynamic memory to its buffer.

The procedure `EntryProc` contains the main loop within the task, which polls the `ReadChar` routine for a keystroke. The `CloseProc` procedure frees the buffer.

The Editor

The editor is a useful service module. In addition to its use by the notepad task to provide up to nine separate notepads, it has many other practical purposes. It can attach notes to appointments in the time planner. It can attach notes to phone book entries and edit communication programs executed when dialing remote computer systems. Also, the editor can capture results in the calculator, much as an accountant's calculator outputs to paper tape. The tape is edited and saved as a text file.

From a programmer's viewpoint, the editor service module is easy to use. Once it receives a dynamic-memory data segment or a filename, it executes. Like many of the other heavily used services in SideKick Plus, the editor service is reentrant, so it allows for multiple editor windows to be open simultaneously.

This situation is possible in the note-

Listing 1: *C source code demonstrating the use of SideKick Plus dynamic memory.*

```
int         BufferHandle;       /* Handle to dynamic memory text buffer */
char        far * Buffer        /* The physical buffer, wherever the memory
                                   manager put it. */

#define     BUFFERSIZE          512         /* 512 paragraphs = 8k */

void        OpenProc( )         /* Called when task is activated */
{
            WinOpen( MyWindow );
            GotoXY( 2, 0 );
            SetColor( Frame );
            WriteString("This text will appear in the top of the frame.");
            SetColor( Normal );
            WinChangeScope( 1, 1, 1, 1);
            SetKeys( MyTasksKeys );
            DynMem_Get( BUFFERSIZE, &BufferHandle, &Buffer);
            BufferNoPara = BUFFERSIZE;
}
void        EntryProc( )        /* The task executes by running this loop
                                   continuously */
{
            void      (* Handler) (int);
            int       Parameter;

            GotoXY( 0,0 );
            WriteString("Hello, this is the first line inside the frame");
            while (True)
            {
                  DynMem_Release(BufferHandle);  /*In case of task
                      interrupt */
                  C = ReadChar( &Handler, &Parameter );
                  DynMem_ReClaim(BufferHandle, &Buffer);

                  if (C == Nil) /* Pop-up menu, function key, command key */
                        *(Handler)(Parameter);

                  else
                  { /* Normal keystrokes */
                        WriteChar(C);
                        if (C == CR)
                              WriteChar(LF);
                  }
            }
}

void        CloseProc( )        /* Called when task is deactivated */
{
            DynMem_Free( BufferHandle );
}
```

pad task, where nine notepads can be open, one on top of another. This is one of the benefits of dynamic memory management. Running out of memory is not a problem in cases where multiple editor windows are open at the same time. Expansion of the active editor text swaps out memory belonging to one of the inactive editors.

The File-Management System

The file-management service module used in SideKick Plus is evident throughout the system. Each time you specify a filename containing wild cards, the file window opens and lets you browse through your directories. You can then either select a file or press Escape.

Furthermore, you have access to all the file manager's facilities, including functions such as directory management, file search, and sorting. The file manager is both a service and a task.

Data Communication

Data communication plays a major role in the SideKick Plus phone book and communications tasks. When dialing a remote computer, the phone book task will open a communications window and optionally execute a script program. Capture to file, script learn mode, and file transfer are some of the most frequently used features.

Among the other available services is a modem manager that supports dialing from a variety of modems. An interrupt-driven serial port driver/manager maintains independent input and output queues. Access to each queue is provided in several ways: scan for available data, read/write character/string, flush, and status. You can dynamically reconfigure the port on the fly (i.e., you can change speed, character size, parity, echo, etc., whenever you choose). A script interpreter accepts an editor-created script file as input and executes it. A log file for diagnostics and exceptions is maintained. A file-transfer protocol manager enables the task to transmit or receive symbolic or binary files, optionally under protocol control (e.g., XON/XOFF or Xmodem).

Simplicity

SideKick Plus provides a complete TSR operating environment with a flexible and open-ended architecture. Soon programmers will be able to write more useful applications, and everyday users will have the means to create simple, elegant pop-up utilities. ■

ACKNOWLEDGMENTS

The authors wish to acknowledge the contributions of Jeffrey Goldberg and Henrik Maegaard.

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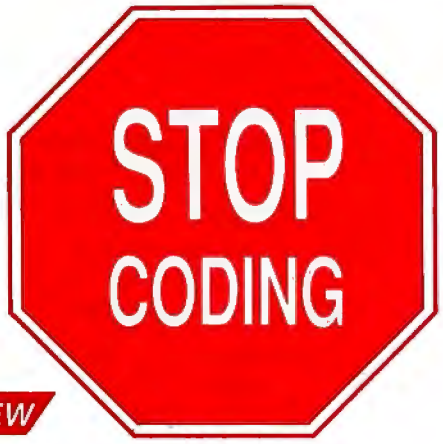

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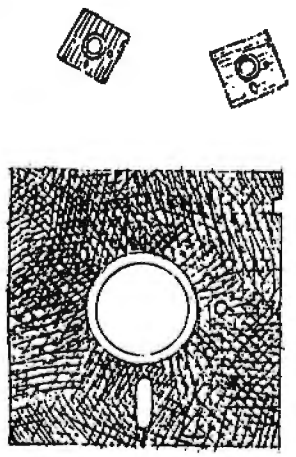
The Network-Model DBMS

A powerful alternative to the relational-model database management system



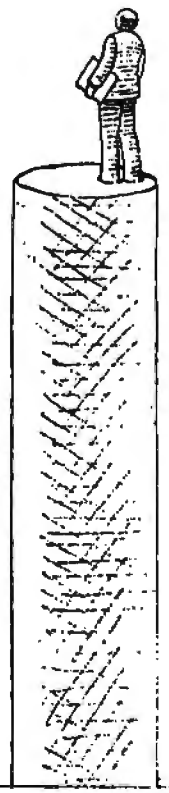


Illustration: Rob Colvin © 1987

■ **David Kruglinski**

Almost all microcomputer database management systems are either file managers or relational database managers. However, a relatively unknown type of database, called the network-model DBMS, has significant capabilities over the others. This article introduces the network-model DBMS and shows how it can solve problems that don't fit the familiar relational model.

First, a word about terminology: Don't confuse the network-model DBMS with the local area network of interconnected computers. The DBMS network refers to interconnected data records. It's unfortunate that these two uses of the term "network" conflict, but the database people did claim the word first. To further complicate the issue, network-model DBMSs can be installed on LANs.

The Need for More Powerful DBMSs

DBMSs were first used on large mainframe computers to implement important business-oriented systems in a minimum of time with maximum accuracy and flexibility. Because highly skilled professional programmers manned large corporate computers, DBMS developers concentrated on power rather than ease of programming, and power meant a network-model database or a variation thereof.

The first users of microcomputers were not programmers; therefore, a need existed for easy-to-use DBMS products. PFS:File, dBASE II, and their successors filled this need very well, making it possible to create simple, one-of-a-kind systems for everyday business record-keeping. These popular file managers and relational DBMSs will continue to improve and find new uses in the office.

Now consider the big-name, all-purpose, industry-specific accounting programs designed for PCs. Few of these products are based on the popular relational DBMSs; instead, they use brute-force techniques of disk-file handling. Why don't they use dBASE or R:base? Some of them were developed on minicomputers before the existence of microcomputer DBMSs, but, generally, the popular database products don't have the muscle to handle complex business applications.

With the arrival of the 80386-based microcomputers, businesses are looking to personal computers to solve problems with high-volume data processing that were formerly reserved for minicomputers and mainframes. Interestingly, applications developers are returning to the roots of database technology—back to the network-oriented mainframe DBMS world.

Actually, network-oriented DBMS products for microcomputers have existed since 1979, and several successful, nationally distributed accounting software products incorporate them. Now, more network DBMS products are showing up and this is a boon for serious software developers. Finally they have a range of high-performance network-model DBMSs to choose from that are suitable for developing major applications.

Relational versus Network-Model

A relational DBMS is so named not because it relates one file to another, but because it uses a mathematical construct called a *relation*. A relation is nothing more than a table, or "flat file," with rows (records) and columns (fields).

Relations can be linked together on the basis of a common field. Suppose you have a customer relation and an invoice relation laid out like the one in table 1.

continued

David Kruglinski is a principal in a computer systems firm and a consultant to software developers. His address is c/o Tenon Software, 1980 112th Ave. NE #250, Bellevue, WA 98004.

Note that Cust# is the common field joining the two relations. If a program were processing the invoice relation row by row, it could look up the customer in the customer relation as needed in order to produce a report like that in table 2.

Another program could process the customer rows and find all the associated invoices for each. The relational DBMS depends on indexes for its speed. The customer relation is indexed by the key field Cust#, and the invoice relation is indexed both by Cust# and by Invoice. The index allows quick access to each record.

The relational DBMS isn't too far removed from old data-processing environments with keyed files. The main added feature is the data dictionary built into the file structure. This data dictionary describes all the columns (fields) so that programs can find them without knowing the record's precise layout. If you add a new field, the programs using existing fields don't change.

Products like dBASE III have added more useful features, such as full-screen editors, easy-to-use programming languages, and query and report processors. Taken together, these features let a microcomputer user quickly assemble simple but useful data-processing applications. The main attraction is that you can change the system easily. You can add and delete fields; you can also establish new relationships merely by associating common key fields in different tables.

If you programmed the customer/invoice application in dBASE III, you would need two data files and three index files. For a major accounting application, you would need as many as 50 data files and over 100 index files, and you would have to include common key fields in all related records. If you changed the value of a key field in one relation, you would have to be certain to make the same change in all of the relations you wanted to connect.

Consider the common situation of an invoice header record and its associated detail-line items. A relational database forces a programmer to identify each line item with a unique index number to preserve the data-entry sequence. Typically, items are numbered 10, 20, 30, and so on. You can insert nine more line items before you fill the slots between 10 and 20, but then you have a problem. Now you will see how the network model gets around many of the relational system's limitations.

The network-model database uses records and fields that correspond to the relational model's rows and columns. The difference is in the way records are linked together. In place of related key fields is a construct called a *set*, a relationship between an owner record and a member record, and that relationship includes the member record's sort order.

Figure 1 illustrates the customer-invoice example in the context of the network model. The invoice records are attached to their customer records. The Cust# field no longer needs to remain in the invoice record. Each invoice can have line items attached through another set. Thus, the invoice line-item records can be linked to their header record in the same order in which they were entered. You can insert new details anywhere.

The network model can support simple single-file systems with records simultaneously available in multiple sort orders, and it can handle complex systems involving dozens of record types and hundreds of interconnecting sets. With one of these large network-model databases, you can define simultaneous access to all records in all sort and selection orders. An equivalent dBASE III application would require hundreds of separate disk files, not all of which could be open at any one time.

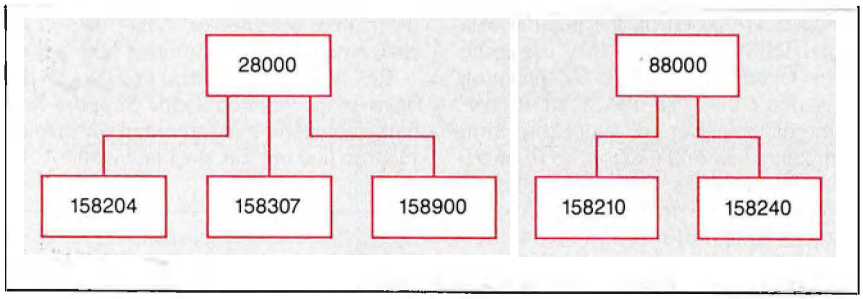
Despite the network model's power, some applications adapt more naturally to the relational model. If you do not know your reporting needs from the start, or if you must change the system often, the relational model makes more sense. Some developers use a product like dBASE III as a prototyping tool. When the end user is satisfied with the screens and system flow, the developer recodes using a network-model DBMS. To choose the correct programming environment for a given project, the developer must be familiar with both the network and relational models.

Table 1: *A customer relation and its invoice relation.*

CUSTOMER RELATION		INVOICE RELATION			
Cust#	**Name**	**Invoice**	**Cust#**	**Date**	**Amount**
28000	Addison Supply	158204	28000	080186	$22.43
88000	Bird Electri	158307	28000	081286	$678.00
		158900	28000	081386	$50.00
		158240	88000	080486	$2323.40
		158210	88000	080286	$18.57

Table 2: *Records assembled through the customer number field.*

Invoice	Cust#	Date	Amount	Customer Name
158204	28000	080186	$22.43	Addison Supply
158307	28000	081286	$678.00	Addison Supply
158900	28000	081386	$50.00	Addison Supply
158210	88000	080286	$18.57	Bird Electric
158240	88000	080486	$2323.40	Bird Electric



Performance versus Convenience

Historically, most industry-specific accounting and record-keeping programs have evolved from a custom application built on contract for one client. If the program works, the developer tries to "go national." Unfortunately, the file-handling tools that work best for quick-and-dirty applications are not appropriate for high-quality products in the mass market. Other software developers have taken a different approach. They've secured venture capital and spent millions developing high-quality products. Many of these companies have chosen a network-model

continued

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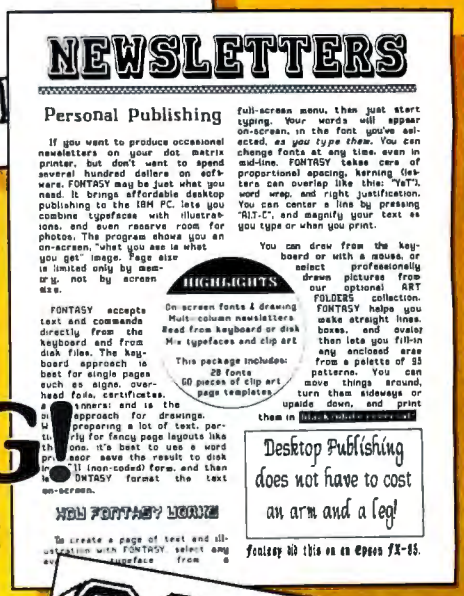

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All the available network-model DBMSs require the use of a standard programming language such as C.

database manager for the job.

All available network-model DBMSs require the use of a standard programming language such as C. No interactive, database-specific language like dBASE's exists, nor is there automatic screen generation and reporting as with R:base. Forget about pull-down menus and help screens; this is real programmer territory.

A trade-off exists between DBMS performance and ease of programming. The choice of the more powerful network model makes programming more expensive and development cycles longer, but the situation is improving.

Network DBMS vendors are introducing query languages, report writers, screen generators, and other tools. Perhaps one day it will be just as quick to develop an efficient network-model application as it is to develop a relational-model application.

Available Products

Two major network-model DBMSs are available for IBM PC-compatible microcomputers. I'll use actual examples from these products to give a feel for network-model DBMS programming, but keep in mind that this article is not a product comparison or review.

MDBS III from Micro Data Base Systems (P.O. Box 248, Lafayette, IN 47902) is the current leader of the network-model DBMSs. The product runs on MS-DOS, Unix, networks, and some other environments, and it supports C, FORTRAN, Pascal, COBOL, and BASIC. It's a good product, but a single-user MS-DOS license costs over $10,000 with all the support modules. The royalty fee for a run-time license starts at $250 and winds downward with quantity.

Typically, a software house purchases the complete developer's package and then creates applications for specific customers. Solomon III is a popular accounting package based on MDBS III; a user base of over 10,000 makes its publisher, TLB Inc., MDBS's largest customer.

New to the market is db_VISTA from Raima Corporation (3055 112th Ave. NE, Bellevue, WA 98004), a powerful network-model DBMS linkable to C. This product might not have all the MDBS III features, but its low price makes it accessible to a much wider audience. The single-user library-only version is $195, and the multiuser version with source code is only $990. You pay no royalties for programs compiled with the db_VISTA libraries. In addition to the standard single-user MS-DOS version, others exist for LANs, Unix/Xenix, and other environments. A linkable query module is available, and a database restructure utility is promised.

A Network-Model DBMS at Work

A major Toronto recording firm rents studio time at $250 per hour. It needed a quick method of locating a sound effect from a tape library of 8000 selections. What resulted was a db_VISTA-based system that has a lot in common with online information-retrieval utilities such as Dow Jones and Dialog. Thus, it is a good model for a variety of useful applications.

The sound-effects database system has one large file of sound-effect records, each with three keywords contained in the effect's title (e.g., computer, programmer, screaming). The user types in one, two, or three keywords to match, and the program retrieves the records containing all the specified keywords. Figure 2 shows a sample inquiry screen. Of course, provisions exist for adding, deleting, and editing records, and for listing them to the printer.

Listing 1 shows the database schema in db_VISTA's format. Note the three records, `effect`, `word`, and `intersect`. The keyword `intersect` is a dummy record that I will explain later. Figure 3 shows a diagram of the schema relationships, with records shown as boxes and sets shown as connecting lines.

There is one `effect` record for each of the 8000 sound effects and one `word` record for each unique keyword. The database also contains three indexes: one for the description, one for the tape reel ID, and one for the keyword. If a keyword is found through the index, the db__VISTA DBMS can find the attached `effect` records by navigating through the database structure, which includes the `intersect` record. If you specify more than one keyword, the program can sequentially reject all records that don't contain the extra keywords.

Look again at figure 3. The `effect` record is the owner of the `intersect` record through the `effect_list` set, and the `word` record is the owner of `intersect` through the `word_list` set. In db__VISTA, an owner can have many members, but each member can have only one owner. This is a one-to-many set, and that's why the `intersect` record is necessary in this example, letting one effect have several keywords and the keyword be linked to many effects.

How is the database structured on disk? It has two distinct DOS fixed-length data files, one for `effect` and the other for `word`, and one B-tree index file for all the indexes. The data files contain pointers linking set owners to set members. Several record types can be contained in a

```
--Ramware Designs Inc.----------------------------SFX-Library--Date:86/09/12

Effect:  Computer programmer screaming
Description:  Programmer screaming as computer erases all data files (sounds
              of hammer in background).
Duration mm / s[00:08]    Medium: Cart              Format: Stereo
Effect quality:           Above average
Other comments:           Encoded in Dolby A
--OPTIONS:----------------------------------------------------------------
S Word Search             D Delete                  G Sign Out Effect
X Extended Search         E Edit                    R Sign In Effect
N Next Record             M More Detail             H Help
P Previous Record         L List Record             ESC Exit
   [ ]
-------------------------------------------------------------------------
```

Figure 2: *Data-entry screen for sound-effect system.*

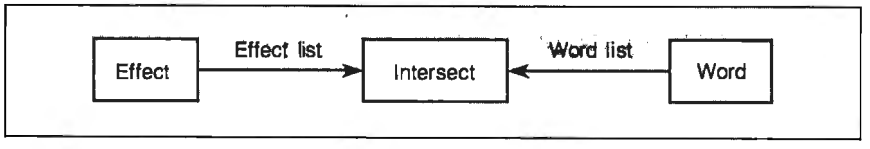

Figure 3: *Sound-effect database schema diagram.*

Listing 1: *The db__VISTA database schema.*

```
database sfx
{

 data file "sfx1.dat" contains effect;
 data file "sfx2.dat" contains word, intersect;

 keyfile "sfx1.key" contains reelid, fxdescrip, keyword;

 record effect {
  unique key char fxdescrip[67];                    /* descr. of effect */
  key char reelid[26];          /* reel id # where effect resides */
  char dur_min[3];              /* length of effect minutes       */
  char dur_sec[3];              /*      "       "      seconds     */
  char libr[12];                /* library name                   */
  char loc_hrs[3];              /* location of effect hours       */
  char loc_min[3];              /*      "       "      minutes     */
  char loc_sec[3];              /*      "       "      seconds     */
  char medium[5];               /* medium tape, cart or disk      */
  char time_hrs[3];             /* timecode location hours        */
  char time_min[3];             /*      "       "      minutes     */
  char time_sec[3];             /*      "       "      seconds     */
  char time_frs[3];             /*      "       "      frames      */
  char format1[7];              /* format 1, mono or stereo       */
  char cutno[3];                /* cut no on media                */
  char outcode[5];              /* sign-out person's id code      */
  char outdate[9];              /* sign-out date                  */
  char detail1[61];             /* detail description line 2      */
  char detail2[61];             /* detail description line 2      */
  char quality[58];             /* quality of effect              */
  char comment1[58];            /* comment line 1                 */
  char comment2[58];            /* comment line 1                 */
  char keyword1[16];            /* keyword index #1               */
  char keyword2[16];            /* keyword index #2               */
  char keyword3[16];            /* keyword index #3               */
 }

record word {
  unique key char keyword[16];     /* unique keyword */
}

record intersect {                /* dummy record -- no fields */
}

 set effect_list {
  order first;
  owner effect;
  member intersect;
 }

 set word_list {
  order first;
  owner word;
  member intersect;
 }
}
```

single data file, but each will occupy the space required by the largest; therefore, it makes sense to keep dissimilar-size records in separate files.

The programmer creates the schema with a text editor, then processes it with the db__VISTA database definition language processor (DDLP) to produce the skeleton data and index files, as well as some header files for inclusion in the C programs.

Network-Model Programming

All access to the db__VISTA database is through C function calls supplied in a library. Here is a sample sequence of statements needed to find a keyword in the

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word file and thence retrieve the associated effect records:

```
d_keyfind(KEYWORD,users_keyword);
if(db_status == S_NOTFOUND)
 printf("keyword not found
         in database");
else {
 printf("Keyword: %s",
         users_keyword);
 d_setor(WORD_LIST)
 for(d_findfm(WORD_LIST);
    db_status == S_OKAY;
    d_findnm(WORD_LIST)) {
  d_findco(EFFECT_LIST);
  d_recread(&effect));
  print_fields(&effect);
 }
}
```

Here's a summary of the db__VISTA functions used in the preceding program: `d_keyfind` finds a `word` record by key and makes that record the current record; `d_setor` sets the current owner of the `word_list` set to the current (recently found) record; `d_findfm` finds the first member of the `word_list` set; `d_findnm` finds the next member of the `word_list` set; `d_findco` finds the current owner of the `effect_list` set; and `d_recread` reads the current `effect` record from the database.

The sound-effects example is complex enough to show the network model's advantage over the relational model but simple enough to be clear. The application would be inefficient to program using a relational DBMS because the sound effect's unique 67-character key, `fx-descrip`, would be included in each keyword record, forcing two B-tree indexed lookups for each keyword retrieval.

A More Complex Application

A major office telephone system manufacturer uses a db__VISTA database to control configuration of telephone systems with as many as a thousand telephones and a hundred trunks. The systems engineer runs the application on a portable personal computer at the customer's site. The actual database has 22 record types, 42 sets, and 15 indexes.

Figure 4 shows an abbreviated database schema that might make sense to someone who has used a large office telephone system. The real schema would be comprehensible only to telephone engineers.

Central to the schema is the extension record. Telephone extensions are associated with both trunks and individual stations (phones). An extension rings on a station at a specified line number. In addition, stations have feature tables, and trunks are associated in trunk groups. Some records are connected with several sets. The intercom set contains only those line members that are intercom lines, the extension-line set contains regular extensions, and so on.

Since telephone systems constantly change as a company reorganizes and expands, the configuration program must allow for maximum flexibility. Take the extension number, for instance. When the extension number changes, all references to it must be updated. This would be difficult in a relational system because the extension number would occur in over 20 different records. The network model solves that problem because the extension number is stored in one place only—the extension record—and the extension record is physically linked to all other associated records.

Phone systems evolve as companies constantly change, therefore a configuration program must be flexible.

Note that all the sets shown in figure 4 determine two-way relationships. The relational DBMS could duplicate those two-way links only if each record contained the unique key for each associated record. Including these extra keys would further increase redundancy, making it harder to make changes to the data.

Other Network-Model Applications

The telephone application is a medium-complexity network example. The Solomon III accounting system, using MDBS III, is considerably more complex, with 68 record types and 170 indexes. At the other end of the scale is a product called Nametags Plus from Peopleware of Bellevue, WA. This simple db__VISTA application uses a single record type—a name-and-address record. The program, written in C, includes a tightly integrated copy of the Fancy Font utility and can produce high-quality name tags and certificates on a dot-matrix printer.

Peopleware chose db__VISTA for several reasons. The company's main product line consists of top-of-the-line conference-reservation software based on MDBS III. MDBS III was not appropriate for the inexpensive Nametags Plus because of the royalty structure. The db__VISTA DBMS offered the familiar network data model and the C language flexibility necessary for screen management and integration with Fancy Font.

When MDBS III was the only network-model DBMS available, principal users were major software developers, the Department of Defense, and large corporations with important custom programming needs. Raima's db__VISTA has widened the market with its low cost. As Nametags Plus demonstrates, a network-model DBMS can serve well for even the most straightforward file-management projects. As more products like MDBS III and db__VISTA become available and more ease-of-use features are added, the network-model DBMS might become established as a product category in its own right. ■

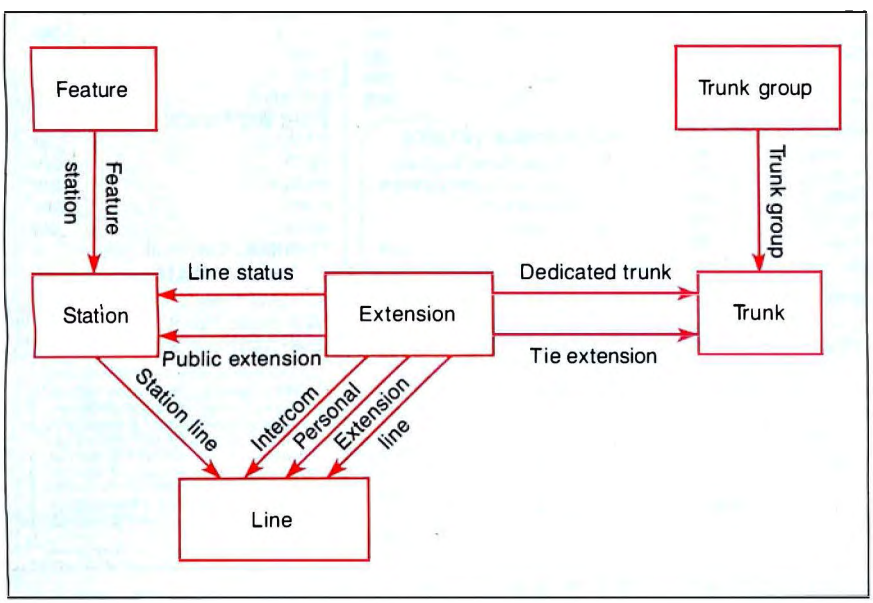

Figure 4: *Telephone schema.*

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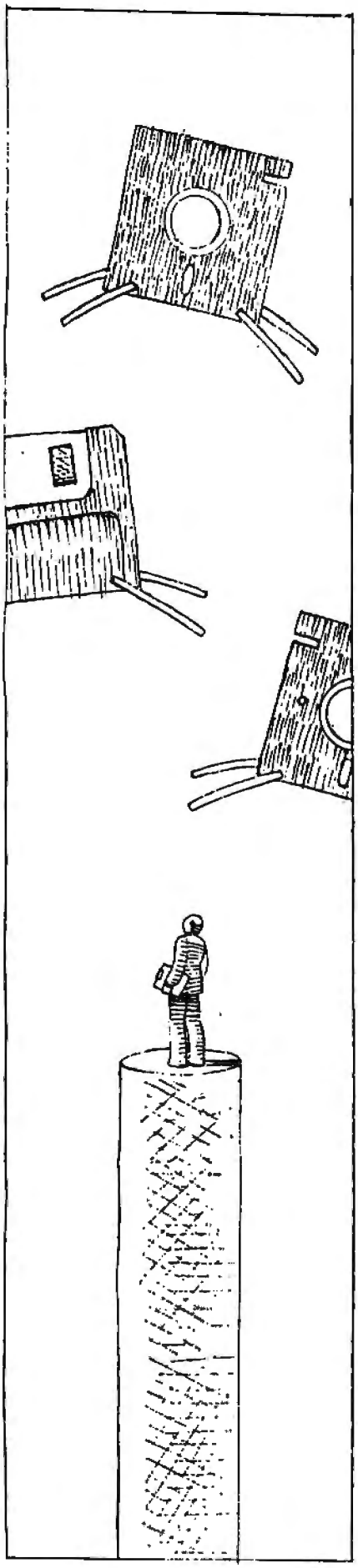

Illustration: Rob Colvin © 1987

Dark Horse Applications

A handful of unusual or unknown programs for MS-DOS computers

■ Ezra Shapiro

The greatest irony of computer software is that a successful program isn't necessarily a good one. The fact that a particular program boasts tremendous sales figures does not mean that it is the best in its category or even especially outstanding. Likewise, an excellent product might cause barely a ripple in the marketplace.

While it's common to blame the size of a manufacturer's advertising budget, that's not the only factor involved when a good product drifts into obscurity. Some software is ahead of its time. Other programs are too similar to existing products to be noticed, even if they incorporate significant improvements. And a few products simply baffle reviewers.

For more than a year and a half, I've been writing BYTE's "Applications Only" column. On average, I receive about 30 software products a month, and I write about four of them. I've been surprised at how many of the packages are well-designed, solid, and useful; I encounter relatively few bad programs. So when I was asked to come up with a list of little-known applications for this issue, I had a huge collection available. I picked out a few favorites; my evaluations follow.

A Better Mousetrap

Bruce Tonkin was a veteran user of WordStar 3.3, but he was frustrated with its shortcomings. His solution? Write a better version in BASIC. The result was My Word!, an inexpensive word processor that starts with the WordStar command set and adds a wide selection of advanced features. The current version even adds a good spelling checker.

When I first saw the program about two years ago, I was not impressed. It emulated WordStar, but I didn't think it was a slick, professional product. However, in the intervening months, Tonkin has strengthened and refined the program to the point that it is the equal of many far more expensive word processors on the market. The current release, version 2.0, is written in QuickBASIC 2.0 with some routines in macro assembler, and it really sings.

To begin, the program can do just about everything that WordStar 3.3 can do, with some major exceptions. First, My Word! can handle files up to only about 50K bytes, as opposed to WordStar, which is disk-based. The program doesn't scroll the display horizontally for lines longer than the screen width; you have to reformat. My Word! doesn't make automatic backups of files and doesn't let you set and go to the 10 position markers that WordStar allows. The program has no block move—you have to copy a block, then delete the original—and it does not display file directories. My Word! doesn't look like WordStar, either; Tonkin prefers a clean screen. If you want help or status information, you have to press a function key. Finally, My Word! works with pure ASCII characters, so you'll have to run a simple conversion utility before editing old WordStar files.

What does My Word! have that WordStar 3.3 doesn't? Plenty. An undelete command for words, lines, or blocks. Ten definable macro commands, each up to 255 characters long. Graphics characters. Definable cursor shape. The ability to sort tables in ascending or descending order. Math functions. Formula evaluation. A built-in mail merge function, with IF/ENDIF nested conditional branching. A label-printing mode. Nested linking of files on output. And on and on.

My Word! is as fast as, or faster than, WordStar for all operations. The docu-

continued

Ezra Shapiro is a consulting editor for BYTE, where his "Applications Only" column appears monthly. He can be reached at P.O. Box 170040, San Francisco, CA 94117.

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mentation is complete and well-indexed. Bruce Tonkin supports the product fiercely, and he's extremely loyal to his customers.

My Word! is a quality product and a real bargain.

New Tricks

Two reasonably priced programs from Airus employ a novel technology to provide a handy safety net that doesn't get in your way when you feel confident enough to work without it. Détente, a $75 memory-resident shell for MS-DOS, and Write Now, a $150 word processor, use as-you-type spelling checking to catch mistakes before they cause problems.

Most shell programs for MS-DOS are designed to insulate you from the operating system; almost all of them give you an "easy-to-use" interface that protects you from cryptic MS-DOS commands. But, like overprotective parents who prevent their children from learning how to cope with life, these products can lull you into a false sense of security. Sooner or later, you're going to have to perform an operation that requires dealing with MS-DOS in the raw, and if you've been sheltered by your shell, you're going to be lost.

In contrast, Détente doesn't try to do everything for you; it merely nudges you in the right direction when you type a command. It's the only MS-DOS aid I've used that isn't more trouble than it's worth.

The first time you load the program, it builds an internal list of your directories and the executable files in your MS-DOS path (the list is updated whenever you make changes). Thereafter, every time you try to enter an illegal command, Détente will spot the mistake and warn you. If you turn on all the program's bells and whistles, it will highlight the error, beep at you, and present you with a selection of acceptable alternatives in a pop-up window. Détente bases its presentation of choices on spelling, but if you like you can view all the possibilities. You can scroll down the list and select the correct command or directory name, thus pasting it into the command line.

What I like about this program is its configurability. In its strictest mode, it won't let you complete a command it can't identify; it will stop you and demand that you pick a legal phrase from the list of choices. If you like, it will even complete typing a command as soon as you've entered enough letters to eliminate any ambiguity about your choice. Or you can turn off all the warning features and merely use Détente's command editor and command history stack (which lets you recall earlier commands) when you need them.

Inquiry 71

Write Now is a word processor that applies the same philosophy to text editing. The program is somewhat limited, however. I wouldn't use it to prepare any project that requires extremely complicated formatting, like an academic paper with embedded typesetting codes, but it's fine for correspondence, simple reports, and most everyday word-processing tasks. Maximum file size is 64K bytes, and you don't get the sophisticated layout and style options available in more extensive programs, but Write Now has all the basics you'd expect to find in a word processor: ruler lines, mail merge, headers, footers, page numbers, and so on. You perform block operations with a quick cut and paste. You can activate commands through a series of function-key menus that appear along the lower edge of the screen, or you can shortcut the menus by entering short control-character sequences.

Write Now comes with a moderately sized dictionary with which you can correct the spelling in an entire document, or you can set it for as-you-type checking. In the latter mode, it behaves in much the same fashion as Détente; warnings can be as mild as a gentle beep or as fierce as complete refusal to let you enter a word not in the dictionary. The word-completion feature can let you type in a kind of shorthand. Write Now will finish words as soon as any ambiguity vanishes, and you can save yourself many keystrokes if you can learn to adjust to the program's rhythm.

Both Détente and Write Now are configurable; you never feel railroaded into features you don't need or want. Both come with thorough, well-written documentation. Both are excellent products that you might not hear about from your local software dealer.

Items Discussed

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Write Now $150
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Portland, OR 97223
(503) 620-7000

Finance 10 ..... $149
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Analyst's Toolbox

Finance 10 is Progressive Software's memory-resident collection of 10 tools for financial analysis, including loan amortization, lease/purchase analysis, ACRS depreciation, present/future value, personal worth, IRA growth, bond yield, internal rate of return, simple statistics (mean, median, and standard deviation), and financial manager's rate of return.

Configuration of the product is quite simple: Each tool is a separate module that's linked to an overall menu. You can install any or all of the tools into the framework. The result is a pop-up utility that covers only the functions you need.

The phrase "memory-resident utility" brings to mind an abbreviated piece of software that's nowhere near as powerful as a stand-alone program. Not so with Finance 10—the modules are all complete, full-featured workhorses. Although some of the more straightforward tools, such as the statistics calculator, require only one screen, many of the modules use a long series of linked screens. A good example is the personal financial statement, which uses separate schedules for different sorts of assets and liabilities.

There's no tool in the package that you can't build (or in many cases, buy) as a spreadsheet template, but Finance 10's modules are laid out intelligently and constructed for easy data entry. And you sure can't load Lotus 1-2-3 as a pop-up if you're working in WordPerfect without getting into some ugly multitasking problems. If you regularly perform one or more of the calculations covered by the product, Finance 10 is a convenient solution.

Although the package claims that Finance 10 was "designed by a CPA for the financial community," I found the modules so self-explanatory that even a mere mortal like myself could use them effectively without consulting the top-rate documentation. I didn't discover any major conflicts with other terminate-and-stay-resident products (although my testing wasn't comprehensive), and I found Finance 10's import and export capabilities more than adequate to deal with moving the data in and out of other software.

Finance 10 is certainly not for everyone, nor is it as flexible as a good spreadsheet, but what it does it does well. It merits wider attention than it's been getting.

A Neat Calculator

I once described SimplSoft's It Figures as a minispreadsheet with only three columns and 20 rows. That's a helpful explanation insofar as It Figures lets you work with numbers organized in a grid, but it misses the program's real power and utility. Although It Figures looks somewhat like a spreadsheet, it's much more a calculator that lets you accomplish serious computation without all the fuss and bother of a major-league spreadsheet.

The program gives you a data-entry screen of 20 lines (a status line at the top and a function-key menu at the bottom occupy the rest of the display). Each line is divided into three areas. The first is reserved for formulas, constants, and/or raw data; it's here that you build your calculation. The second area shows a running total, the interim result of your calculation. Think of it as the equivalent of the tape from a printing calculator. The third area is simply a space for remarks or line labels. You can use It Figures to perform any top-down computation.

Sounds easy, doesn't it? But don't think that the program's simplicity indicates lack of power; you can set global variables for all your worksheets or local variables for single worksheets, perform macro functions like standard deviation, and chain worksheets for long and involved calculations. To illustrate the product's potential, SimplSoft has included 57 sample worksheets in the package, ranging from loan interest to Ohm's law to the Pythagorean theorem to a full IRS 1040 form.

The program is a breeze to use, and you can get the hang of it by checking out a couple of sample worksheets. The concept is so obvious that you probably won't need to look at the short but excellent manual. If you get stuck, thorough on-line help is available.

It Figures is a wonderful tool that does what it's supposed to do quickly and efficiently. It's not designed to replace the massive number-crunching power of a spreadsheet, but it's a great shortcut for simpler operations. For its low price, you can't go wrong. ■

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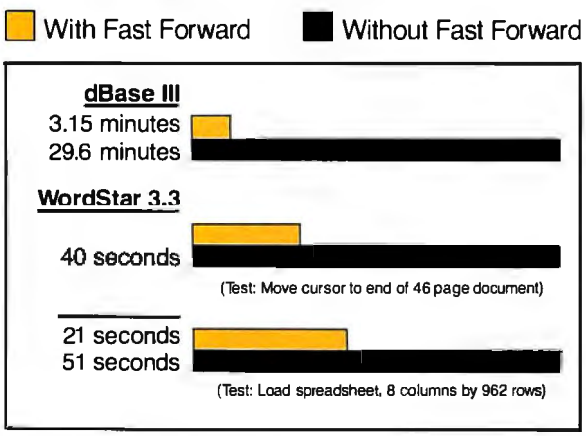

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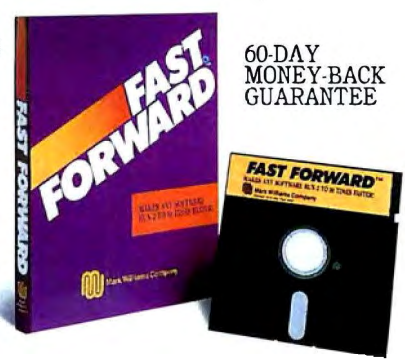

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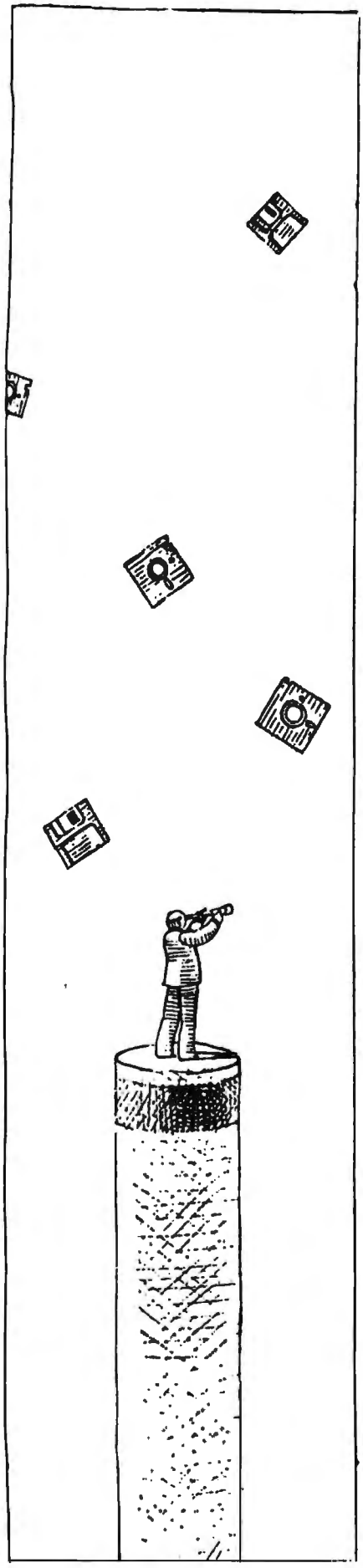

Illustration: Rob Colvin © 1987

The Promise of Application Software

Trends for the future of productivity programs

■ **Oliver L. Picher, Cynthia R. Lubrano, and Rochelle Theophano**

It is becoming increasingly clear that we are seeing the birth of a new generation of personal computer hardware. More and more Intel 80386- and Motorola 68020-based computer systems are being introduced all the time. Better-quality, cheaper, and more easily available graphics technologies are being developed at every turn. Sometime in the near future, we may also begin seeing LANs that are truly easy to use for the average personal computer user. Does all this mean that we will see a new generation of software, or are we merely going to do the same things faster, in living color, and with more people?

There is some truth to the old maxim that "the hardware drives the software." If these new microprocessors, graphics coprocessors, and LANs really offer a quantum leap in hardware capabilities, then a similar leap in software capabilities is almost sure to follow. Think for a moment of the processing speed of the 80386—at 3 to 4 million instructions per second, it is almost six times faster than the older 8088. Imagine if your car could suddenly drive six times faster; think of where you could go and what you could do.

But before we leap into our atomic-powered antigravity vehicles to meet for lunch in Paris—where we'll speculate on tomorrow's software trends—let's stop and think about the software of the present.

Most of us use software because we have a specific job we want to get done. When we sit down at our word processors, we do so because we need to write something, not because we think the thesaurus is nifty. We want results, and we want the software to help us get there. For all the great new technologies becoming available, if they don't help us get our work done, they are worthless. This, then, is our second maxim: Hardware may drive software, but software answers the needs of the user. Software has to earn its keep.

A Lesson from the Past

Following this maxim, it is easy to see why advances in software have as much to do with changes in how people use computers as they do with changes in technology. For example, look at what has happened with word-processing software over the past few years. In the early 1980s, personal computers were known only to those adventuresome souls who were willing to tinker with the technology. The software then available reflected this hands-on approach. The earliest word-processing programs, such as WordStar, were little more than program editors with a few text-formatting functions added on.

After IBM introduced its PC, microcomputers became more common. The price, flexibility, and capability of these machines made them attractive alternatives to the dedicated word-processing systems that secretaries and clerical workers commonly used. A whole generation of personal computer word-processing programs followed that met the needs of these users by emulating the dedicated systems already in use. MultiMate, OfficeWriter, and Samna are the three best-known programs.

Then a curious thing happened. The so-called knowledge workers—those who had once dictated the words that the secretaries then transcribed—discovered word processing. A new wave of pro-

continued

Oliver L. Picher, Cynthia R. Lubrano, and Rochelle Theophano are on the staff of Datapro Reports on Microcomputers, *where they are responsible for hands-on evaluation of database, graphics, word-processing, and project-management software. They can be reached at Datapro Research Corporation, 1805 Underwood Blvd., Delran, NJ 08075.*

Within a year, all high-end word-processing programs will support improved laser-generated output.

grams resulted, with new features geared to the needs of this new group. These programs emphasized on-screen display of different text modes and have come to be known as WYSIWYG (what-you-see-is-what-you-get) programs. Thesauri, spelling checkers, and outline processors are just the latest in a long series of features designed to attract these new users. New functions are made possible by the availability of cheap RAM, cheap disk storage, and cheap graphics display systems, but the functions are there primarily because users want them.

Whither Word Processing?

Some of the features we may see in tomorrow's word processors will show the influence of desktop publishing, features made possible by new advances in graphics and in laser printer technology. The key question: Does desktop publishing represent a new attitude toward word processing, or is it just another feature of the month?

Within a year, all high-end word-processing programs will support improved laser-generated output. In this sense, desktop publishing is really an extension of our present use of word-processing software.

Most people don't care about fancy output. If they want something more sophisticated, they'll send text to the in-house paste-up specialist. There will still be a need for separate paste-up software, like PageMaker and ReadySetGo, which has become so popular. Depending on the volume of the text and the need for publishing-quality output, people will either look to better quality in today's generalized word-processing programs or they will use specialized systems that handle cradle-to-grave text editing, typesetting, and paste-up. With these "document-control" systems, the use of LANs will become more important.

While generalized word-processing programs will continue to prosper, specialization will become increasingly important. The overall market for word-processing software is now large enough, and competitive enough, that it could diversify into niches of specialized needs.

Manuscript, Lotus's new engineering and scientific word processor, is a case in point. The program was designed from the ground up to handle technical documents, which differ a great deal from ordinary business communications. Manuscript may be only the first of many such programs, because tremendous needs exist for similar programs in legal, insurance, and publishing environments. This will be especially true when LANs come into common use and people begin looking for document control rather than plain word processing. People will expect a document-control program to match the current flow of documents in their offices.

The Three Trends

Word-processing programs, like all of today's software, are being shaped by several different factors, but three basic trends are worth close examination. The first is the availability of *high-quality graphics*, which is turning even text-based applications like word processing into ones that make extensive use of such graphics-intensive features as bit-mapped character displays, windows, and in-text charts. The second trend is *increasing connectivity*, specifically, LANs, microcomputer-to-mainframe gateways, public information networks, and departmental computing. This trend isn't so apparent in word-processing software yet, but it will have a profound effect on other applications.

The last trend, *specialization*, is more ephemeral and more controversial. This trend goes directly against the prevailing current of the microcomputer software industry, where the most successful programs have always been the most generalized; the big sellers—Lotus 1-2-3, dBASE, and WordPerfect—are programs that can meet a variety of needs. Still, people use software for a job, so they want software that will match their needs as closely as possible.

Survey after survey shows that personal computers have penetrated into only a few industries and that vast new markets in manufacturing, government, and retailing remain relatively untapped. Many of these markets need custom-tailored tools that will stretch the imagination of the software vendors. Some specialization is fine, but too much specialization means that the program will find itself boxed into a limited market.

The Tao of Databases

Database software fits squarely into the movement toward more specialized software. Database programs have always served as a general framework for the development of customized applications. They are the paradigm for our future software program—the general program that can be customized easily. The problem, however, is that using these programs hasn't been as easy as it should be. Programs like dBASE offer plenty of power, but you need to reach a certain level of proficiency with dBASE before the "customizability" of the database works as it should. Consequently, the average user of database programs has always been more technically proficient than, say, the average word-processing user. The reason dBASE has become as popular as it has is because it established a strong base of support among third-party application developers, people likely to develop a custom application for bowling-alley management or to recommend to a father, mother, or brother-in-law that they buy dBASE III.

The latest trend in database software is away from power for power's sake. R:base System V and Paradox are emphasizing accessible power. R:base provides a complete set of development tools to round out the development of database structures, menus, entry forms, and reports. These tools are designed so that the average computer user can produce a sophisticated, customized database application in a relatively short amount of time. In a similar vein, Paradox provides a smooth blend of macro recording, forms-driven queries, and a sophisticated programming language.

The Dream of Artificial Intelligence

More than any other application, database management systems stand to be transformed by the use of artificial intelligence techniques. Paradox is one minor example of how this technology can be used. Paradox lets users define their queries in a form on-screen, independent of any concerns about index structures or query syntax. The program then interprets the request and generates its own retrieval program, optimized to make the best use of the database structure. As for future uses, perhaps someday you'll be able to buy a "third-party consultant in a box," a program that would help you customize your own bowling-alley management system.

The next step in applying AI technology to database management would be to develop a natural language database-description system that could understand the implicit, syntactical relationships between different data items.

In addition to natural language, there is also a tendency toward increased use of

continued

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As scanners and optical disks become more prevalent, graphics will be seen as an integral part of a data record.

visual user interfaces in database programs. Query-by-forms systems are just one small example. The market for database programs is filled with programs that attempt to use the graphics orientation of the Macintosh. Reflex for the Macintosh, for example, lets users draw connecting lines on-screen to indicate the relationship between different files. Odesta Helix uses a sophisticated series of "tiles" and icons to represent the logical flow of what might normally be considered a program.

Graphics in the Database

In general, the new graphics technologies hold great promise for database software. Not only will graphics help to make database programs more visual and more intuitive to use, but they can help in the analysis of the data. Today's database programs can handle up to 1 or 2 billion records, and no better way exists to monitor databases of this size than with a graphic representation. This is something akin to Lotus 1-2-3 merging spreadsheets and graphics together; it won't be nearly as revolutionary, but it will be one more step in rounding out database management software into a complete application development system.

Another use of graphics, of course, is as a field type. As scanners and optical disks become more prevalent, graphics are no longer going to be seen as just pretty pictures but as an integral part of a data record. This capability is quite common on Macintosh databases.

Data, Data, Who's Got the Data?

Connectivity is another important issue for database programs. It is long past time for the development of a good LAN database, since databases are usually developed, maintained, and used by groups, not individuals. But connectivity is only an evolutionary change. The more significant changes will come as the bridge between microcomputers and mainframe computers becomes stronger. Suddenly, issues like data compatibility, distributed processing, and security will become paramount. This will change the face of both microcomputer and mainframe software, and, although everyone assumes that the mainframe software vendors are going to overwhelm the personal computer database vendors, the vendors of personal computer databases have a strong background in innovative user interfaces and enough new ideas to represent a serious threat to some of the lower-level mainframe database programs. No matter what happens, the database program of two years from now will probably, at some level, be compatible with IBM's Structured Query Language. In just over three years SQL has become a virtual standard in the mainframe and minicomputer markets, and it could be a key factor in integrating the mainframe and microcomputer database markets.

Project Management

Project management is another area that was once the exclusive province of mainframe software but that is now undergoing rapid changes brought about by increasing interest in advanced graphics, interconnectivity, and specialization.

For two decades, project management was solely a mainframe-based operation, mostly used for extensive defense and civil-engineering projects. The marriage of microcomputers and project management software has proven tremendously popular. With the inception of personal computer–based project management programs, complex techniques were taken out of the hands of specialists and placed into the hands of anyone with access to a microcomputer. Because project management systems were no longer anchored to a mainframe, they became very flexible and transportable.

Vendors are adding features to make their software capable of handling larger and more complex schedules, but most of them are concentrating on three areas—graphics and high-quality output, connectivity, and overall flexibility.

Graphics Is a Perfect Fit

Since project management frequently involves the coordination of time, people, and costs, communication is essential. Graphics offers the ideal way for communicating scheduling and resource information. For example, instead of paging through detailed text and numeric data, you can view a Gantt chart to see exactly when a task is scheduled. Furthermore, you can turn to a Pert chart to view the relationships between certain tasks. Resource histograms, cost, and actual-versus-planned charts are also becoming commonplace.

Tomorrow's project management sys-

continued

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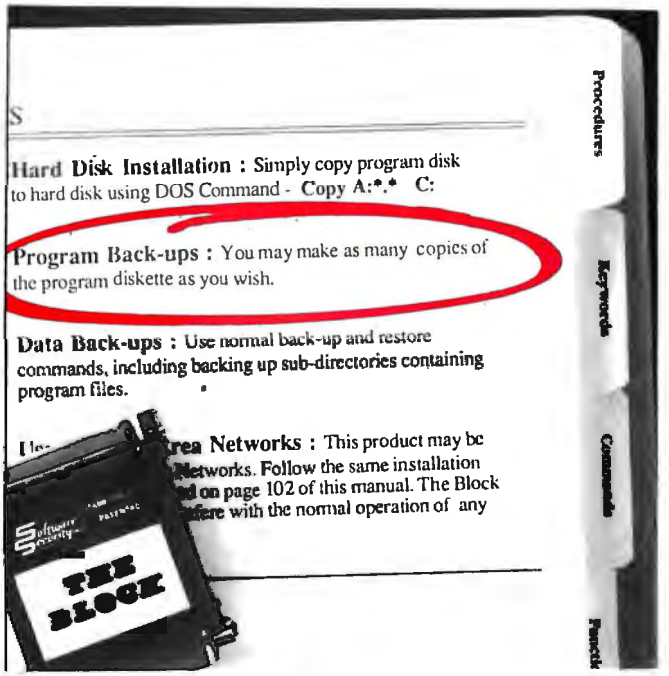
Inventor and entrepreneur, Dick Erett, explains his company's view on the protection of intellectual property.



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tems should also include many features found in graphics programs, including plotter, film recorder, and laser printer support; a variety of fonts; and extensive customization and formatting features.

Working in Harmony

Connectivity has also become an issue in the project management software industry. Direct interfaces between their personal computer-based project management programs and mainframe-oriented systems will be needed. Microsoft Corporation recently developed a software utility that links its very popular Microsoft Project with high-end Primavera Project Planner. This gateway lets users unite simple-to-use, low-end functions with sophisticated and versatile, high-end functions.

Do It My Way

Project management software has grown so much that it now stretches over a broad range of professions. The application has traditionally appealed to those in the engineering, scientific, research and development, and construction industries. Now, however, customers include medical, educational, and publishing professionals. In fact, Qwiknet, from Project Software & Development, is being used to help plan the 1988 Winter Olympic Games to be held in Calgary, Alberta, Canada. Although most users agree that a certain nucleus of features should be included in all project management systems, they tend to want their software to be specific to their company's needs. How can project management software that is used for the petroleum industry be adapted to work in an educational environment?

Project management software has already been customized to a moderate degree. Primavera Systems offers Finest Hour, a project management program developed for the plant and utility environments, including the power and petrochemical industries. Omicron has created Plan/Trax for use in engineering, architectural, and construction projects. MicroDOD, from Earth Data Corporation, complies with Department of Defense reporting standards. These are just a few, but look for more of this type of specialized project management software to be available within the next several years.

Spreadsheets

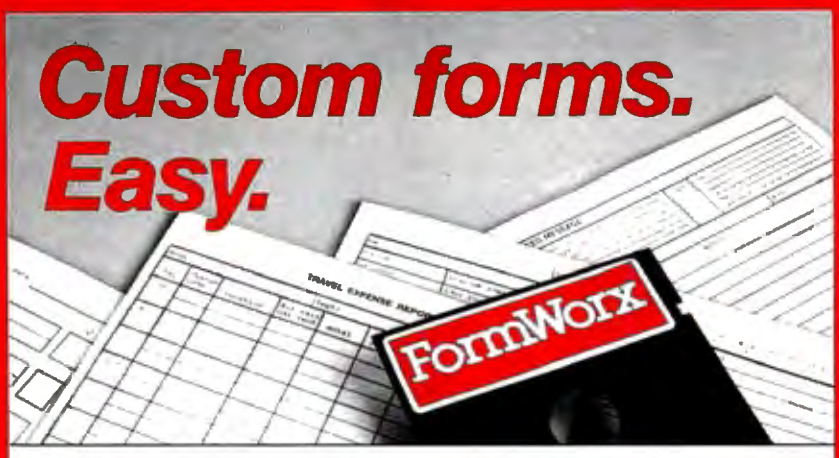
There has always been a unique synergy between the personal computer and the spreadsheet. The quick response and real-time processing of the computer make it a natural fit.

In the past year and a half, Lotus has introduced a microcomputer-to-mainframe data bridge, a stock quote system that broadcasts information over the FM radio band, a CD-ROM database of financial information, a data acquisition program, and an electronic mail package. It is clear that Lotus sees that its growth lies not in providing spreadsheets to new customers but in enhancing the value of the spreadsheets already owned by existing customers.

For Lotus, the ultimate goal is to provide people with information to feed its spreadsheet. Information is the world's most short-lived renewable resource, and people are willing to pay a great deal, and continue paying, to get it. Ultimately, the spreadsheet should be seen as simply being a filter that lets users analyze data from a variety of different sources. (Incidentally, this statement applies equally well to database programs.)

Once this vast quantity of data has passed through your spreadsheet, then you have a variety of output options. The new graphics technologies could be used to produce camera-ready charts and re-

continued



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ports on laser printers, laser slide systems, and even videotext systems. As the 640K-byte limit is broken in DOS, we may see these capabilities brought within the Lotus 1-2-3 umbrella as add-on utilities. Lotus has already set the groundwork for this step by publishing the specifications for hooking add-on programs into 1-2-3; third-party suppliers have jumped at the opportunity to capitalize on the large installed base of 1-2-3, and everything from communications programs to relational databases can be used within 1-2-3.

Specialization and AI

Standardization makes it easy to speak of the future of Lotus 1-2-3 in concrete terms. However, if the next generation of personal computers creates a window of opportunity for a new spreadsheet standard, then what would we like to see in the spreadsheets of the future?

First, we'd like to shake loose the idea that a spreadsheet program has to be in the form of a spreadsheet. The row-and-column structure was a real innovation, but we shouldn't let the tool's structure stand in the way of our approach to a problem.

Cell-based formulas are great in some circumstances, but it is time to talk of the broader objective of spreadsheet programs. First, not everyone uses them for financial calculations. We make extensive use of spreadsheets at Datapro while analyzing the test results of different programs. The spreadsheet works for us, but some rule-based AI program might be more to the point.

Those who do use spreadsheets for financial problems probably want to move beyond simple what-if analysis into the goal-seeking functions found in many high-order financial modeling programs. Instead of playing with different variables to see the individual effect on the bottom line, you want to set the bottom line and let the computer play with the variables until it gets the desired end result. Ultimately, spreadsheet/financial planning systems should become more than mere calculating wizards. If they are to be used for planning, they should provide a structure that supports good planning, providing advice as well as accurate internal rates of return.

Welcome to the Future

We are in for some exciting times. The new hardware technologies will open up vast new capabilities in terms of speed, display, output, and information access. For all this, however, we must remember that the ultimate test is the user, who truly does know what is best. That is what the personal computer is all about. ■

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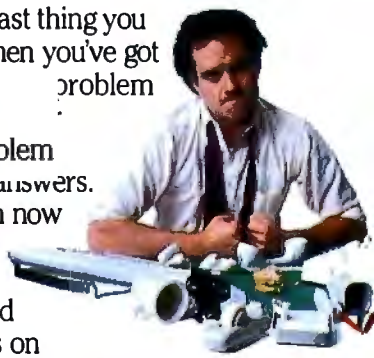

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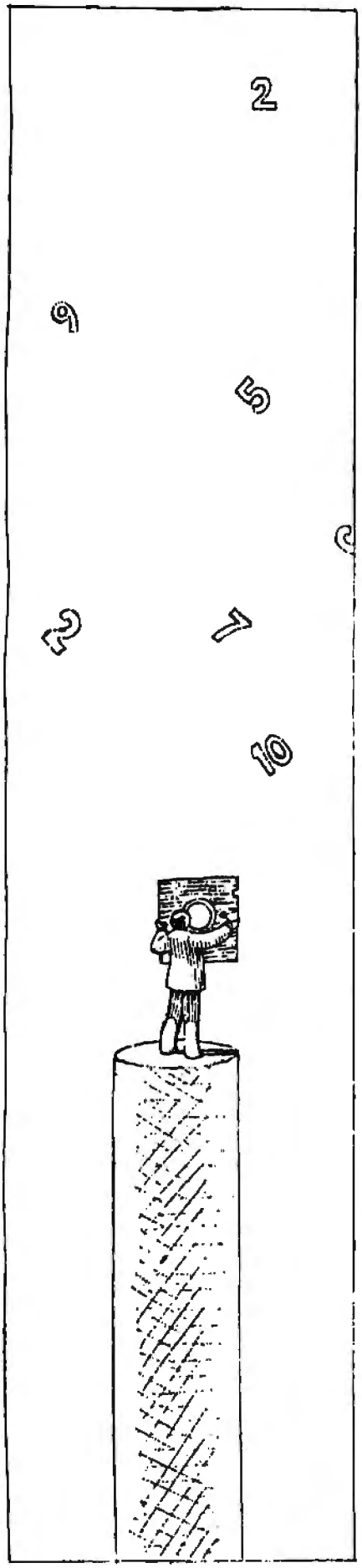

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Designing Modern Accounting Software

An analysis of key features determining the cost and quality of accounting software

■ Gary W. Hedge

Financial accounting software, traditionally expensive, is now available over a much wider price range—even reaching into the under-$100 category. I will analyze some of the technical features that distinguish one accounting system from another. In addition to helping potential buyers determine which package would be best for their business, I will show how the choice of an accounting system can concern the auditor, the IRS, the financial controller, and the end user/operator.

An Open Design

Traditionally, an organization's accounting function is served by three main software packages: accounts payable (A/P), which records moneys owed by the user; accounts receivable (A/R), which records moneys owed to the user; both of these feed into the general ledger (G/L), which balances all transactions and provides an overall picture of the organization's finances, plus payroll (see figure 1). In the days of manual bookkeeping, the same figures had to be laboriously entered in several journals. Even the most basic automated accounting system will at least "post" summarized data to all the files that need it.

Despite this rudimentary level of integration, not all accounting systems offer a truly open design. A minimal package will typically consist of the key requirements for the three areas of A/P, A/R, and G/L, and perhaps a minipayroll, but often nothing else. Most such packages have been designed to run under low-end hardware configurations (128K or even 64K bytes) and to consume minimum disk space. To achieve this minimum system requirement, these packages may eliminate files and fields that allow flexibility, substituting hard-coded, specific structures instead.

A number of key questions will help you find out if you can expand or upgrade a system over time. For one thing, does the software have an upward growth path? To what extent can you adapt each package to your own needs by purchasing modules that can stand alone or work together? Figure 2 illustrates how a family of applications might be built up, each package interfacing or interacting as necessary with every other package on the system and all being accessible from a common starting point.

Another hallmark of an open design is source code availability. Software developers who have grown up in the minicomputer data-processing tradition encourage you to make modifications to the products by allowing you (or the software supplier) access to the source code. This is rarely the case with low-end products.

The willingness to provide and support source code modification places burdens on the original software designer. The source code must be structured for ease of maintainability and modification—even, occasionally, at the cost of efficiency. In contrast, smaller systems will use whatever programming tricks are available to pack the code into the minimum amount of memory, making future enhancements much more difficult and field modifications by the customer out of the question.

Multiuser Capability

Permitting more than one terminal to access data creates new problems, namely, record locking and exclusive file usage—so that two people cannot update the same record simultaneously (see the text box "Two-Read Record Locking in Multiuser Systems")—and security. More reports and proof of all changes will be necessary to prove the accuracy of the data. These audit trails are a key concern in the design

continued

Gary W. Hedge is vice president of software engineering for MCBA Inc. (425 West Broadway, Glendale, CA 91204-1269).

of accounting software at all levels of sophistication. The extra programming required goes a long way to explaining the higher cost of multiuser products.

In the main, I will describe applications in a single-user environment. But in a firm where several employees update the accounts, you will be grateful for the greater levels of password protection found in a multiuser product, even if the system is running on a single workstation. One such feature is the ability to limit each operator's access to particular screens and reports.

File Handling

A good clue to the sophistication of an accounting system is the ease with which you can access records. For instance, some systems require each record to be identified with a single key or number; you can access the record only by typing in this key or number. The program searches the file sequentially until it finds the right number. This is fine for small data files, but as your files grow over time, deterioration of speed becomes noticeable.

More sophisticated approaches are incorporated into many accounting packages. The multikey indexed sequential-access method, for example, lets you access records by name, number, or other key field. You can still access the records sequentially, but, under ISAM, one or more sorted indexes point to the record's address, thereby letting the computer go straight to the information. Obvious choices for the index would be vendor or customer name. You then need to type in only the first few letters of the name, far easier than remembering the account number.

Another method is to build the system on a relational database. In theory at least, you can locate any field by reference to any other field. This increases the ease of access and flexibility of ad hoc reporting. A good relational database also lets you add fields to a record without affecting the existing data. However, the greatly increased level of indexing tends to make database-designed systems slow. Also, security problems can exist: It is harder to block access to the data in relational databases than in ISAM files. Therefore, someone could make unauthorized changes that are nearly impossible to detect.

A combination of file storage and access methods might be the best solution. Relational databases are good for storing and retrieving historical data, while multikey ISAM-accessed sequential records, which permit greater speed and control over data, are more appropriate for the more active transactions in the accounting system.

Are you forced to buy all the accounting functions as a set? This is a sign that the software is designed to require a fixed number of files. But government users, for example, might not need A/R. A more flexible system generally permits each module to function alone. This is not so simple as it seems. First, it requires an installation program that sets up either an integrated or stand-alone environment. Second, the package needs the flexibility to later be upgraded to an integrated system. Finally, some packages might need auxiliary files when running by themselves.

On-line versus Batch Processing

Microcomputer users take on-line update of files for granted, but accounting often requires a more complex approach. Automatic posting of *all* data across the system in real time is not always a good idea, even though some packages advertise that as a feature. A better approach uses a combination of batch processing and on-line processing.

Routine update of the master file, like a vendor's change of address, will be on-line, as will any transaction involving inventory—a business needs to know exactly what quantities it has in stock at any one time. Posting of financial data from A/P and A/R to the G/L, on the other hand, might be better left as a batch process. This follows the basic rule in accounting that you don't alter the G/L without leaving a history of the changes.

An on-line system must have a means to correct honest errors. Some systems will force you to make a reverse entry so that both the error and the correction show up on the audit trail; some weaker systems will simply let you get at the data and erase the mistake. Auditors and the IRS consider the latter approach vulnerable to falsified records.

You might think that with a completely on-line G/L system, you can always see how your business is faring at any time. The value of this "instant snapshot" is limited, however, by the fact that a company's bottom line is affected by periodic accounting adjustments to the G/L, like depreciation and capitalization, that do not appear in day-to-day inquiries.

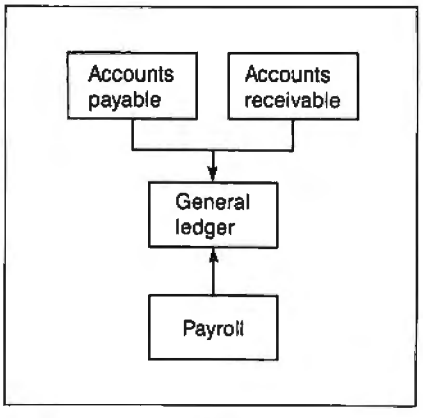

Figure 1: *Basic interactions between the four financial applications packages.*

Under a batch system, updates to A/P and A/R go into a transaction file, which you can print and check for errors before posting in a batch to G/L. After that, operators can no longer get at the data without leaving a trail. Apart from the increased security, the system is appropriate to any organization where one manager has control over A/P, another over A/R, and a third over G/L. This is common in all but the smallest companies.

By transferring data from A/P or A/R to the G/L, the manager is saying, "I have approved all the transactions in this batch. I am now handing over authority of this data to G/L." And at the moment the batch is posted, the better systems will automatically generate a register proving what was posted, which is spooled to the printer, forcing creation of a hard copy.

Codes or Numbers

Professional-quality accounting software derives much of its flexibility from the use of codes rather than fixed numbers. An example is in payroll, where a narrow-application product might give you a choice of one set of tax-withholding rates. A more sophisticated system lets you put in a code rather than a number. The program then looks up the meaning of the code in a control file that contains the tax tables of all the states. As a result, one payroll system can pay employees working in any number of states.

Another example—of great significance to network users—involves filenames. Rather than force you to accept the program's filenames, a state-of-the-art package will have a pathname file that lets you pick your own data filenames. The pathname will not only tell the program under which name to look for the required data, but where to find it. You can therefore organize your files in any directory or subdirectory structure and place them on any drive on the system.

Fields of Data

One index of the power of an accounting system is the number of data fields in the master files. In A/P, for example, low-end packages on average have fewer than 12 predefined data fields; larger systems have three times that number, and some of the fields are user-defined.

This measure is relevant first for reports—it's difficult to produce a report analyzing sales staff performance if the

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system makes no provision for recording who is responsible for each sale—and second for ease of use. For example, when processing a customer order, a good larger system will optionally insert the usual shipping address or terms of payment recorded in the customer file. If the master file contains plenty of data, the use of "default" entries will speed up processing of invoices and reports.

Consequences of Design Choices

To the IRS: The government doesn't pass judgment on particular computer systems. There is no approved standard for, say, audit-trail generation in the same way there is a COBOL standard. But the IRS will be suspicious of an automated system that lets you tamper with transactions in the G/L and will appreciate one

continued

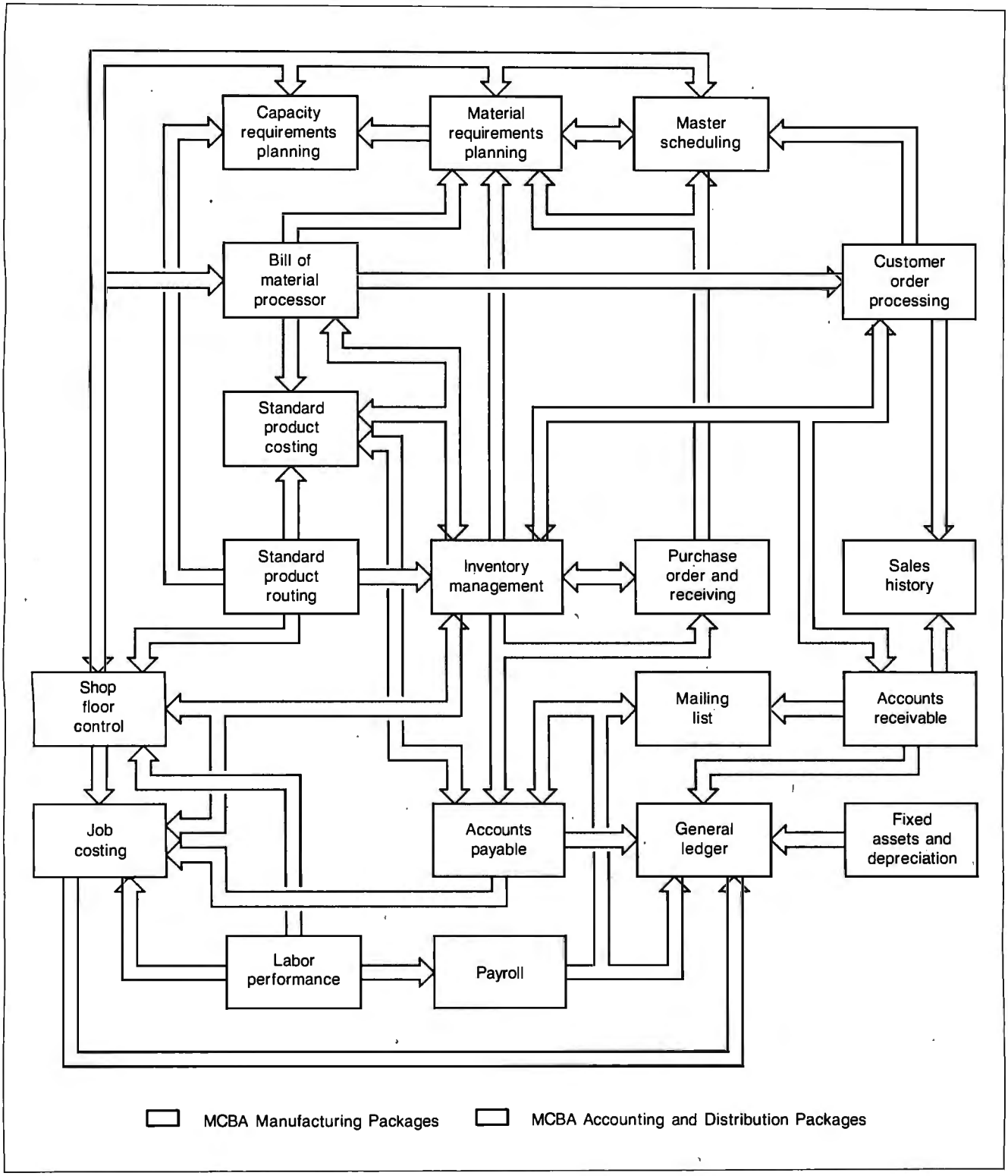
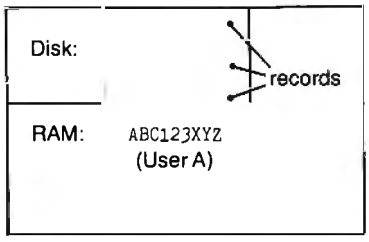


Figure 2: *The various modules in a full manufacturing, accounting, and distribution system—in this case, MCBA's.*

Two-Read Record Locking in Multiuser Systems

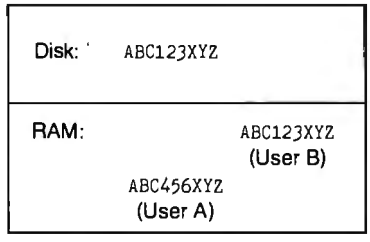
1. User A runs a program that reads some data from disk, making a temporary copy of it in his program's data-storage area in RAM so that he can change it.



Data ABC123XYZ exists on disk.

User A's program has a copy of the data in RAM.

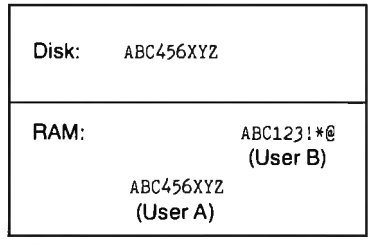
2. While User A changes, for example, 123 to 456 in his copy of the data in RAM, User B accesses the same record, making a *second* copy in her program's temporary data-storage area in RAM. (If record locking were in use, User A's program could have marked the record as "in use" and User B's program would have refused to make a second copy, thereby preventing User B from seeing the data.)



Original data ABC123XYZ still exists on disk.

Now, User B *also* has a copy of the original data, but User A has changed his copy.

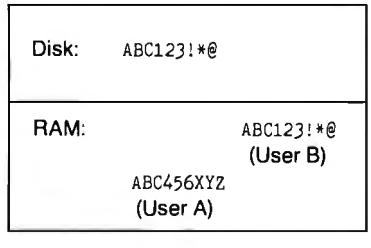
3. User A's program writes the changed data, copying it from User A's temporary storage area in RAM to the disk, replacing the original data. Meanwhile, User B is changing, for example, XYZ to !*@ in the second copy of the original data temporarily stored in RAM.



Data on disk now contains User A's change.

User B has made a different change in her copy of the original data in RAM.

4. User B's program copies the data with her changes from User B's temporary data-storage area in RAM to the disk, replacing the original data modified by User A's change. User A's change is overwritten and destroyed.



Data on disk now contains User B's change, but User A's change is permanently lost.

User B has succeeded in getting her change recorded on disk, but has inadvertently overwritten User A's change.

Figure A: *How data is lost in a multiuser application without record locking.*

To qualify as multiuser, software must employ some mechanism for preventing two or more users from updating the same piece of data at one time. For word-processing and spreadsheet applications, it is acceptable for an entire file (i.e., a document or a spreadsheet) to be exclusively used by one user at a time. However, the data in an accounting or information-processing system is typically divided into discrete and independent records in each file. To lock the whole file would be unsatisfactory, as only one user at a time could access the data.

Every good multiuser accounting package will let multiple users access the same data file concurrently but will employ record locking to ensure that a user's changes are correctly stored on the disk and not inadvertently wiped out by another user changing the same record at the same time.

The danger of inadvertently overwriting an updated record comes about because computer programs do not operate directly on data as it is stored on the disk. Instead, the program copies data from the disk to a temporary storage area in the computer's main memory (RAM). The program then operates on its own temporary copy of the data and, when finished, writes it back to the disk. Figure A illustrates the dangers of this method in disk-based data-processing computers.

The Simple Solution

Multiuser operating systems (and MS-DOS 3.1 and higher for networks) contain a record-locking facility that enables applications software developers to mark a record as "in use" when a program intends to change it. If all programs then check for this "in use" flag when accessing data, the program can either wait until the record is not in use or let the user go on to process some other record.

Applications developers traditionally wrote software using the following steps: Lock the record the user wants to change; leave the record locked while the user thinks about what changes to make and types in those changes at the keyboard; update the record with the user's changes; and unlock the record so that other users can now access it.

Although foolproof in theory, in practice this solution bogs down the system

because users may get partway through changing a record and then get distracted by a telephone call, lunch hour, or going home for the night.

During all that time, the record is locked and inaccessible to other users. In some file management systems, a locked record not only prevents other users from changing the record but even prevents them from reading the contents of the record. This can tie up any reports that need to be run, and you might also have an angry customer on the line, unable to get information about his or her account.

The Preferred Solution

The optimum strategy is to lock records for only the minimum time necessary to maintain data integrity. This means eliminating the thinking time (or lunch break) taken by the operator updating a record. If the program is locking records for only the split second needed for the computer to perform the updates, and records are never locked for the comparatively long time it takes a user to think and type in changes, then users will rarely encounter a locked record—and, if they do, the program can have a built-in loop that will repeatedly attempt to access a locked record until it becomes free. The user will seldom notice any delay.

The two-read record-locking technique is one way to achieve this ideal. The following steps summarize the technique as it is implemented by MCBA in some packages (see figure B).

When a user wishes to update a record, the program reads the record but does not lock it. The program stores the copy of the original data record as Copy #1. Since the record is not locked, other users are free to access the data record. After the user has entered changes from the keyboard, the program stores the data record as changed by the user as Copy #2 in the program's temporary storage area in RAM. The program compares the data in Copy #1 to the data in Copy #2. If the values are the same, no update to the disk is necessary because nothing has changed. If the values of the data in Copy #1 and Copy #2 are different, the user has made changes. The program rereads the original data record from disk and locks it. It stores this newly read value of the record in its temporary data storage area in RAM as Copy #3.

The program then compares the value of the data in Copy #3 to Copy #1 to see if any other user has changed that data record while the first user was changing it. If Copy #3 and Copy #1 are the same, the program writes Copy #2, which is the data record changed by the user, to the disk and unlocks the record. However, if the newly read Copy #3 and the originally read Copy #1 are different, the program needs to intelligently merge the changes made by the user and the changes made by other users to create a correctly updated data record so that no one's change is overwritten.

Data fields that accumulate numerical figures, like inventory quantity or year-to-date sales, must be merged so that the new sum reflects both the user's change and changes made by other users during that same period of time. In the worst case, like inventory quantity on hand, another user could decrease the quantity so low that the quantity the first user wanted to have is no longer available. In that case, the program must give the user a message that after he or she first looked at the record, another user took the inventory.

From the users' point of view, two-read record locking permits the simultaneous update of a record by two or more users, without corruption of data. Users will normally never receive a "record-locked" message. This obviously enhances the users' productivity and reduces CPU overhead, since programs are almost never waiting for other users to complete changes.

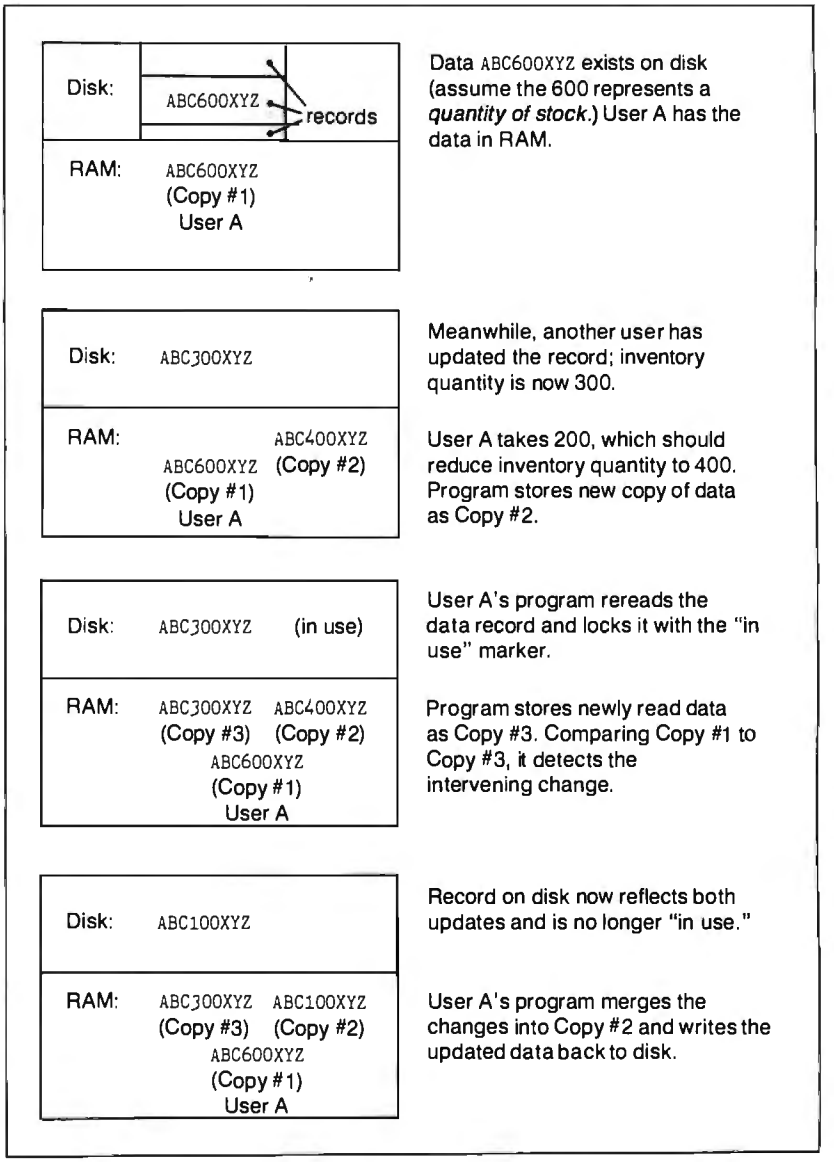


Figure B: *Two-read record locking.*

that includes a detailed history of the organization's accounts. A good low-end product will pass the first test but might have trouble with the second.

The IRS likes to see evidence that you are in some way keeping tabs on the data flowing through the system. For example, one system provides easily read totals of each batch so the bookkeeper can handwrite into a ledger. This human involvement pleases the IRS and also reassures the operator (who can do a few simple sums to confirm that the books do indeed balance) that the computer is keeping track of everything properly.

To the auditor: A minimum degree of audit-trail generation is expected in all serious accounting software. However, some features are generally restricted to the more expensive systems. Before settling on a system, you should be sure that it produces documentation that is adequate for your needs and for your auditor's needs.

For example, find out whether the system requires that batch totals balance before the batch is accepted for posting to master files. Cross-referencing of files is another important feature, since it affords greater data validation. A small system that lacks this feature might, for example, let you delete a vendor, even while that vendor has invoices outstanding. This will certainly lead to confusion, and possibly fraud, since the computer might generate a check leaving the payee line blank (because it has been unable to find any name in the vendor file).

To continue with the check-handling example, in a full-featured package, the same data used to generate checks will also update vendor history. It's impossible to issue a check for one amount and enter a different figure in the vendor's file. If the check is voided for any reason, you can enter the voided check number with an explanation (the check forms may have jammed in the printer). You can thus account for every check, a boon both to you and the auditor.

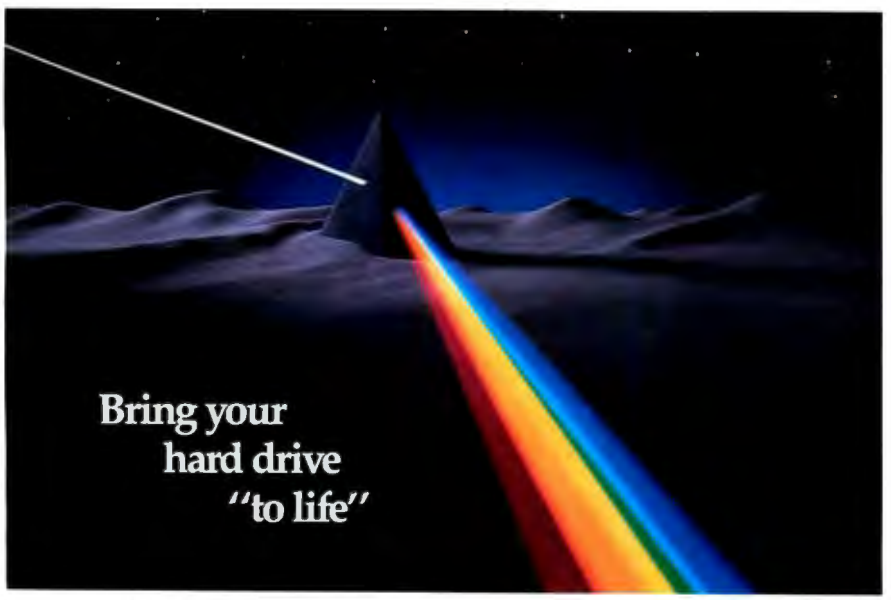
To the controller: It's hard to predict the different ways a controller might want data reported, but some packages limit you to a set of prepared report formats. Virtually all financial packages print out a balance sheet, a summary of year-to-date income, and other essential reports. But the user who is looking for something more—an analysis of product sales per geographic region, perhaps, will be out of luck.

More powerful packages will have a built-in or optional report writer, letting the controller customize any number of financial statements, summarize accounts in any sequence and any subtotaling, include text and notes, compare month-by-month results with calculated variance, and so on.

To the end user: The end user, above all, will notice the difference between minimal and full-featured software, purely in time and effort needed to enter data or generate forms. I have already given several examples. Another one is partial payment of invoices. Some packages force you to generate two invoices, one for the amount you're prepared to pay, the other for the balance. This is obviously time-consuming and confusing to the auditor. A good system will handle partial payments without difficulty.

Conclusions

Low-end packages are fine for very small businesses. However, an organization with a turnover exceeding $500,000, with several people entering data, is well-advised to spend the extra money now to set itself on a path that allows for the integration of additional software and for complete transfer of data when hardware is upgraded. The software designer aiming at this market will do well to emphasize the same concerns. ■



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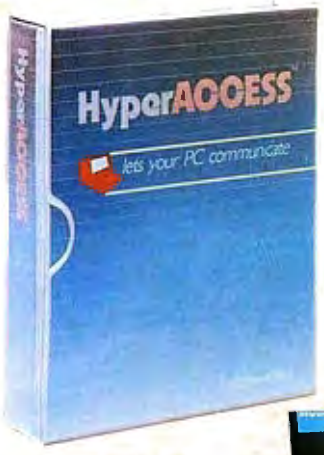

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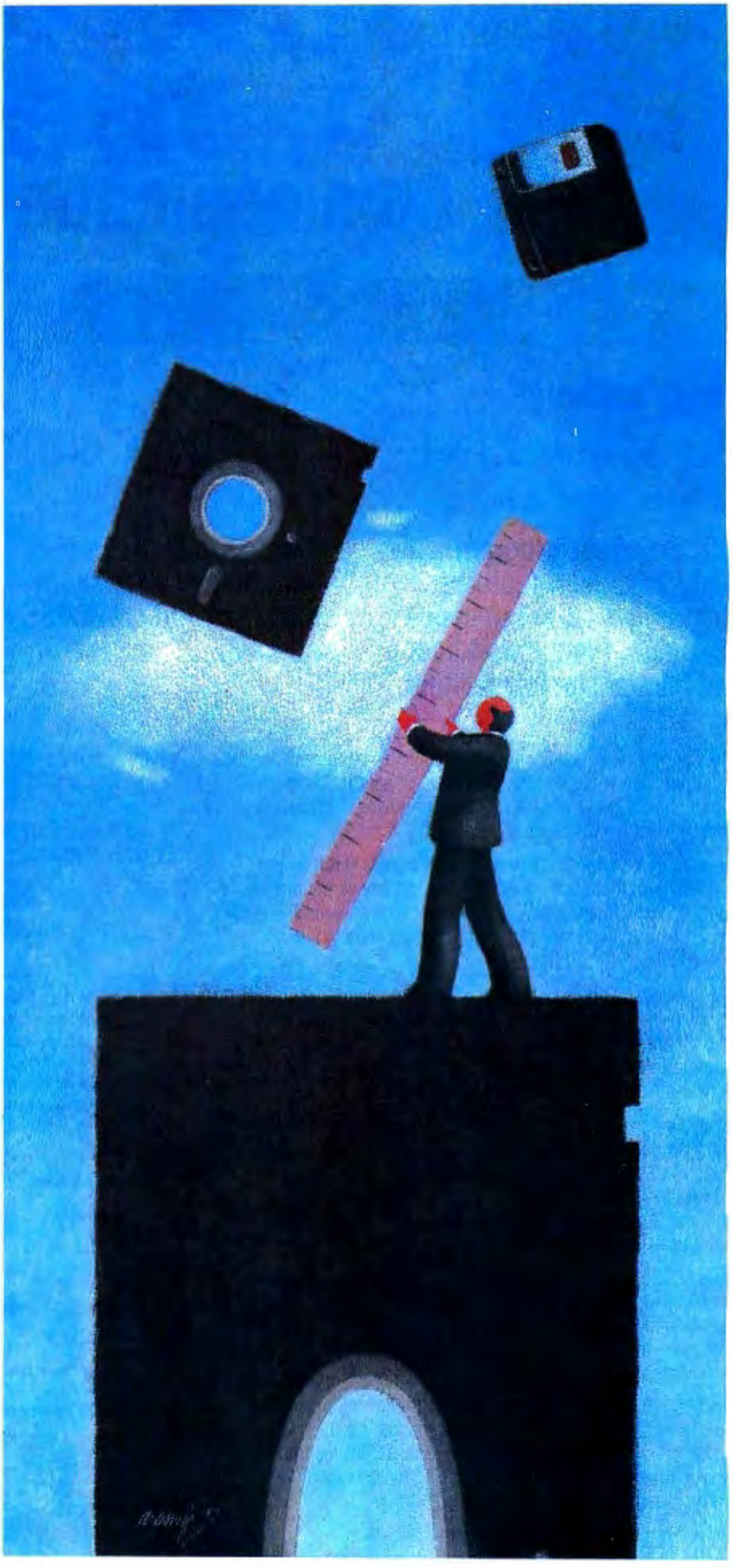

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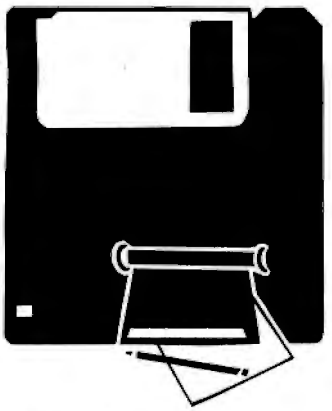
STATE OF THE ART



Word Processors

The top seven—three for the Macintosh and four for the IBM PC

WriteNow
MindWrite
Word for the Macintosh
Manuscript
WordPerfect
Word for the PC
Nota Bene

■ **Phillip Robinson**

What constitutes "state of the art" in any software? Speed? Power? Ease of learning? Compatibility of standards? To choose seven state-of-the-art word-processing packages, I looked for programs that combine a full complement of editing options with some outstanding new feature or virtue. (For a comparison of the features and performances of these seven word processors, see the text box, "Comparing Capabilities" on page 56.) My choices for the top three Macintosh word processors are T/Maker's WriteNow version 1.0 ($175), MindWork Software's MindWrite version 1.0 ($295), and Microsoft Word for the Macintosh version 3.0 ($395). My choices for the top four MS-DOS word processors are Lotus Manuscript version 1.0 ($495), WordPerfect's WordPerfect version 4.2 ($495), Microsoft Word for the PC version 3.1 ($450), and Dragonfly Software's Nota Bene version 2.0 ($495). Many other fine programs are available, and, for some particular application, one of them might be better than my top seven.

The Current Trends

One of the most obvious trends in word processing is the injection of desktop-publishing features into both old and new word processors. These features are likely to include merging graphics into documents, controlling type style and size, controlling character positioning by such processes as microjustification, and driving laser printers. The combination of word processing and desktop publishing is sometimes called *document processing*.

The second trend is the combination of word processors with other applications in integrated business-oriented packages. These can handle almost any sort of writing short of a full book or an academic paper. The word processors often benefit from the easy transfer of data between text documents and the other application in the package. For example, a combination word processor and database is useful if you spend much time writing about database results. Combining word processing with a spreadsheet is helpful if you need to incorporate spreadsheet tables or charts into business proposals.

Another trend is the use of RAM-resident notepads for simple writing, such as jotting down a note, preparing a paragraph to send on-line, or capturing text to merge with another document. Also, word processors are always striving to be as WYSIWYG (what you see is what you get) as possible. Most of us understand more from a picture than from a page of special codes. With WYSIWYG you see a graphic page break instead of a page-break symbol, superscript characters raised to their appropriate positions instead of highlighted or tagged, and so on. Spelling checkers are now built into most word processors, as well. Their dictionaries may differ, but you can customize most of them with words from your own situation and specialty.

The State of the Art

Two abilities I consider important are outline processing and windowing. A word processor with an integrated outline processor lets you set up an outline structure with various levels of headings and subheadings and then manipulate it, putting text and sometimes graphics within the subheadings. You can move subheadings to other positions within the outline, increase or decrease their values within the hierarchy, and display or hide them beneath a superior heading. Stand-alone outline or idea processors, like ThinkTank and MaxThink, pioneered this concept. Living VideoText's MORE is an outline processor for the Macintosh with some word-processing features that let

continued

Phillip Robinson is a contributing editor for BYTE and editor of Desktop Engineering News *and* The Architect's PC *(P.O. Box 40180, Berkeley, CA 94704).*

Comparing Capabilities

BYTE chose three methods to measure the abilities, ease of use, and speed of the seven word processors. The results of the first method are shown in the table of features (see table A), which provides a comparative listing of what the word processors can do, what they need to do it, what documentation they come with, and how much they cost. The table doesn't contain an inclusive listing; it covers mainly the features discussed in the article.

Defining Ease of Use

A second method, ease of use, is measured in keystrokes and was conducted in two parts. BYTE performed the first part, and the software companies performed the second part.

BYTE used the standard BYTE 4000-word file for testing word processors. This document has 40 numbered 100-word paragraphs, each paragraph containing 10 copies of the sentence, "One two three four five six seven eight nine ten." We counted the number of keystrokes required to load the file from disk (the Load test), search for all occurrences of the word "eight" and replace those occurrences with the word "octo" (the Replace test), reformat the entire document with a new right margin at 60 characters (the Reformat test), and save the resulting file as an ASCII document on disk (the Save test).

For the second part of the ease-of-use test, BYTE sent another document to each of the software companies involved. This document contained three paragraphs consisting of a set of directions for editing the document (a reflexive edit, that is, a self-modifying document). The software companies agreed to perform the specified edits and count the keystrokes required (without using macros).

The assumption behind these ease-of-use benchmarks is that the fewer keystrokes it takes to specify a given operation, the easier the word processor is to use. But what constitutes a keystroke? And how does the Macintosh mouse fit into such a count? (We didn't use the mouse potential of the IBM PC programs.) Is a click equal to a keystroke?

We decided that each key held down—

continued

Table A: *A comparative summary of features for the seven word processors.*

	WriteNow 1.0	MindWrite 1.0
Requirements	Macintosh 128, 512, 512KE, Plus, or XL; if upgraded ROM, System 3.2, Finder 5.3, and either ImageWriter 2.3 or LaserWriter 3.1 are more convenient to use	Macintosh 512K and external drive, or (recommended) 512KE, Plus, SE or II
Documentation	175-page user's manual	248-page user's manual
Price	$175	$295
Integrated outline processor	No	Yes
Windows	Number limited only by amount of memory	Number limited only by amount of memory; >1 allowed per document
Columns	Maximum of 4 at once; allows snaking (newspaper-style) columns	No
Footnotes	Yes	Yes
Integrated graphics	On-screen integrated graphics	On-screen integrated graphics
Spelling checker	50,000 words	No
Thesaurus	No	No
Mail merge	No	No
Laser-printer support	Yes; also PostScript device support	Yes; also PostScript device support
List generators	No	Table of contents
Undelete	Yes	Yes
Redline (mark text)	No	Yes
Word count	No	Yes
Sorting	No	Yes
Macros	No	No
Glossary	No	No
In-text math	No	No
Auto-hyphenation	No	No
Extra features	Sample WriteNow application; special backup options; powerful headers and footers; precise line-spacing control; soft hyphenation; on-screen column editing	Text gathering; accumulating clipboard; ability to rearrange text with mouse

Word for the Macintosh 3.0	Manuscript 1.0	WordPerfect 4.2	Word for the PC 3.1	Nota Bene 2.0
Macintosh 512K, 512KE, or Plus	IBM PC, XT, AT, or compatible with 512K bytes of RAM (640K bytes recommended) and a hard disk; Document Preview needs Hercules card and CGA or EGA monitor; DOS 2.0 or higher	IBM PC, XT, AT, or compatible with 256K bytes of RAM and two floppy disk drives; MS-DOS 2.0 or higher; also runs on IBM 3270, DEC Rainbow 100, and others	IBM PC, XT, AT, or compatible with 256K bytes of RAM (216K bytes available to user) and two disk drives; DOS 2.0 or higher	IBM PC, XT, AT, or compatible with 256K bytes of RAM with MS-DOS 2.x; 384K bytes for auto-hyphenation, concurrent text-base use, or MS-DOS 3.0 or higher; two floppy disks
458-page reference; 151-page tutorial	169-page tutorial; 370-page reference	698-page user's manual	430-page tutorial and user's guide; 288-page reference; 96-page printer-use manual	1000+-page reference
$395	$495	$495	$450	$495
Yes	Yes	Outlining feature	Yes	Some outlining features
Number limited only by amount of memory; >1 allowed per document	Maximum of 2; only 1 per document	Maximum of 2; >1 per document	Maximum of 8; >8 per document	Maximum of 9; >1 per document
No maximum; allows snaking columns	Depends on printer size, memory size; 70 columns, 3 characters per column	Maximum of 24 columns; allows snaking columns	Maximum of 10 columns; allows snaking columns	Maximum of 8 columns; allows snaking columns
Footnotes and endnotes	Footnotes and endnotes	Footnotes and endnotes	Footnotes and endnotes	Footnotes and endnotes
On-screen integrated graphics	Integrates on printer; draws lines and boxes	Draws lines and boxes	No	Box graphics
80,000 words	100,000 words	115,000 words	80,000 words	No
No	No	10,000 head words	Yes	No
Yes	Yes	Yes	Yes	Yes
Yes; also PostScript device support	Yes; also PostScript device support	Yes; also PostScript device support	Yes; also PostScript device support	Yes; also PostScript device support
Table of contents; index	Table of contents; index; table of tables, table of figures; other lists	Table of contents; index; table of authorities up to 16 sections; other lists	Table of contents; index	Table of contents; index; other lists
Yes	No	Yes	Yes	Yes
No	Yes	Yes	No	No
No	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
No	Yes	Yes	No	Yes
Yes	No	No	Yes	Yes
Yes	No	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Two-level menu system (short menus or full, more powerful menus); DCA translation; page preview; data exchange; automatic date and time stamping	Cross-referencing; sizing and positioning equations in text; integration with Lotus 1-2-3 and Symphony PIC files into text	Powerful merge features; statistical typing; hidden comment feature; preview feature; document summary	Mouse support; style sheets; shows most character types on-screen; computer-based training; automatic paragraph renumbering	Text base; bibliography function; academic style sheets

Table B: *BYTE's ease-of-use benchmark results. (Figures are in number of keystrokes.)*

	Load	Replace	Reformat	Save
WriteNow 1.0	18	14	8	21
MindWrite 1.0	9	14	7	6
Word for the Macintosh 3.0	5	14	12	10
Manuscript 1.0	18	14	53	21
WordPerfect 4.2	17	15	9	17
Word for the PC 3.1	16	15	12	7
Nota Bene 2.0	15	18	7	38

Table C: *The software companies' ease-of-use benchmark results. (Figures are in number of keystrokes.)*

WriteNow 1.0	188
MindWrite 1.0	140
Word for the Macintosh 3.0	119
Manuscript 1.0	179
WordPerfect 4.2	220
Word for the PC 3.1	192
Nota Bene 2.0	169

Table D: *BYTE's speed benchmark results. (Figures are times given in seconds.)*

	Load	Replace	Reformat	Save
WriteNow 1.0	124.5	46.7	1	104.5
MindWrite 1.0	10.8	76	2.4	5.3
Word for the Macintosh 3.0	2.4	21.3	2.5	10.3
Manuscript 1.0	9.8	53.3	3.7	17.1
WordPerfect 4.2	12.4	13.5	1.4	26.6
Word for the PC 3.1	6.2	82.5	1.8	41.5
Nota Bene 2.0	2.7	17	0.6	9.4

Macintosh benchmarks were performed on a 512K-byte Macintosh with a 128K-byte ROM. All used Finder 5.3 and System 3.2. IBM PC benchmarks were performed on an IBM PC with 512K bytes of RAM and two floppy disk drives running MS-DOS 2.0, except for Manuscript, which used a hard disk and MS-DOS 3.1, and Nota Bene, which ran under MS-DOS 3.1.

including the Alt, Control, and Shift keys—and each "down" click of the mouse button or drag of the mouse would count as a keystroke. Then, while making the counts, we tried to find the path with the fewest keystrokes. The results are useful but not absolute. For instance, they don't account for the time it takes to move your hand from the keyboard to the mouse. They also don't account for the quick selection from dialog boxes that the mouse makes possible, selection that would require a number of keystrokes in a mouseless environment. They don't account for experience; for example, experienced control-key-combination typers might be able to press a three-key combination in less time than it takes to move the fingers to the programmable function keys for a single keystroke there. By definition, we ignored the effect of using macros, but WordPerfect and Nota Bene have macro abilities that let them combine many keystrokes into one or just a few keystrokes. This is a considerable time-saver, as it removes the time it takes to respond to visual stimuli.

How Easy Are They to Use?

With one exception, there isn't much difference in ease of use for BYTE's first three tests between the seven word processors, even between Macintosh and IBM PC programs (see table B). The exception is that Manuscript required 53 keystrokes to perform the Reformat test. Excluding Manuscript, only Word for the Macintosh and Word for the PC required more than the average of 9 keystrokes; each of them needed 12. For the Load test, Word for the Macintosh needed only 5 keystrokes, significantly less than the average of 14, and MindWrite needed only 9.

The Save test, however, is another story because of the need to translate the file into ASCII. It can involve conversion from the file and control-character format of the word processor to the format of a plain ASCII file. MindWrite and Word for the PC offer this option from the standard menu, and therefore require few keystrokes, while Nota Bene requires a long, explicitly typed command to perform the translation.

The results of the tests run by the software companies (see table C) show that on average the Macintosh programs require fewer keystrokes than the IBM PC programs. But familiarity with a program's commands and a predilection for function keys or Control-key combinations are also important. Because of the Macintosh's mouse and its keyboard's lack of a Control key and programmable function keys, comparing Macintosh to

you put text or graphics within an outline.

It is much easier to organize a document—and to intelligently modify that organization—when you can "back up" to see the forest without looking at the trees. You should check on what a company means when it claims to have outline processing in its word processor. The ability to create an outline within a document and automatically renumber it after a change is not the same as the ability to tuck text and graphics into that outline.

Windows are an important element in a state-of-the-art word processor. They let you see more than one document or location within a document at one time. This more closely approximates the process of writing with pen and paper, with many different pages strewn across a desk, available for quick inspection and comparison. In fact, microcomputers can offer even more document visibility now that some packages with outline processors, such as Word 3.0 for the Macintosh,

IBM PC keystrokes directly is like comparing apples and blueberries.

How Fast Are They?

For the speed benchmark, BYTE timed the four editing tests—Load, Replace, Reformat, and Save—for which we had counted keystrokes. Speed numbers are more directly comparable than keystroke counts, but they still hide some complexity. The timings range widely from test to test and from package to package (see table D). The Load test required only 2.4 seconds with Word for the Macintosh and 2.7 seconds with Nota Bene, but 124.5 seconds with WriteNow. The Replace test ranged from 13.5 seconds with WordPerfect to 82.5 seconds for Word for the PC. The Reformat test took very little time with all the packages, the maximum being 3.7 seconds for Manuscript. The Save test ranged from 5.3 seconds (MindWrite) to 104.5 seconds (WriteNow).

The best performance on the Save test was by MindWrite, which required only 6 keystrokes to initiate the test and 5.3 seconds to perform it. Overall, the worst performance on this test was by WriteNow, which needed 21 keystrokes to start the Save and 104.5 seconds to accomplish it. While Nota Bene required more keystrokes (38) to specify the Save, at 9.4 seconds it performed the actual operation more quickly than did most of those that required fewer keystrokes; for example, Word for the PC required only 7 keystrokes to initiate the Save test, but it took 41.5 seconds to accomplish the test because it uses an external routine to convert files to ASCII. The process of leaving the main program and returning to it takes time. If you are editing several documents and can postpone the save-and-convert-to-ASCII operation until you are finished, doing it in a batch job will be quicker.

According to our tests, Word for the Macintosh 3.0 is the fastest of the three Macintosh packages, followed by MindWrite 1.0 and then WriteNow 1.0. Similarly, Nota Bene 2.0 ranks as the fastest of the four IBM PC packages, followed by WordPerfect 4.2, Manuscript 1.0, and finally, Word for the PC 3.1.

let you see the same document at different levels of detail in multiple windows at the same time. Packages for the Macintosh often exceed their MS-DOS counterparts in this ability since the Macintosh was built on a windowing interface.

The ability to put text into columns is also an important feature. Some packages, such as WriteNow, allow both parallel and snaking columns and display them on the screen. (Snaking columns are sometimes called newspaper-style columns: A single story can run to the bottom of one column and then continue at the top of the next.) Nota Bene can handle multiple columns in different languages side by side, with some words wrapping left to right and others right to left, depending on which is appropriate to the language. Manuscript makes it easy to resize, move, and swap columns.

Most lengthy documents and many memos and letters contain both text and graphics. One key feature of all Macintosh word processors has been their ability to inject charts, pictures, and the like into a document. This ability is beginning to appear in MS-DOS word processors as well. However, MS-DOS systems still lag behind; they can rarely show anything but rudimentary graphics on the screen with the text. You can instruct some products, such as Manuscript, to lay in the pictures when printing. The ability to draw lines and boxes on the screen is also important. Surprisingly, more MS-DOS than Macintosh systems have this facility.

Many state-of-the-art word processors can generate a table of contents, index, or some other organizing list. Some require special marks near the words that you want included, but others can take their cues directly from the document's internal organization.

Many also offer footnotes, endnotes (so-called when the footnotes are collected at the end of the document), and a bewildering array of numbering options to handle the requirements of academic work. Users sometimes purchase packages like Nota Bene more on the strength of their footnoting abilities than on any other single feature.

Similarly, headers and footers are more powerful than before. With many programs, you can make them as long as you like, format them in a style different from the document's, attach or not attach them to various pages (such as alternating headers between facing pages) and even add graphics to them.

Retrieving database records and copying appropriate information from them into documents at print time is not new. This mail-merge—so-called because of its use in individualizing single letters sent to multiple addressees—or file-merge ability is enhanced in state-of-the-art software, allowing complex manipulations that rival a database manager's reporting function. A few programs, such as Samna Word IV, even let you build a database within the word processor.

Many word processors now contain macros that let you retrieve an entire phrase or line of text with a single key or combination. Others, such as Word for the PC, have a glossary function that lets you keep common phrases and their abbreviations in a separate file; you use the abbreviation, and the program translates it into the real thing. For example, instead of typing National Security Council many times, you put it in the glossary and type NSC. With the addition of complex formatting codes and merge facilities, macros can go far beyond just storing phrases: They can capture commands. WordPerfect has this ability.

A Crowd of Features

Many other features approach state-of-the-art behavior. Automatic backup, the ability to set a timer to back up your editing changes to disk, is one. Revision marking is another: The ability to mark or find changes between various versions of a document makes it easier to trace editing changes. My state-of-the-art list also includes undo functions (such as in the newest release of WordStar), proportional spacing, decimal tabs, alternate character sets (for foreign languages and scientific documents), superscripts and subscripts, in-text math (calculating four-function arithmetic from numbers in the text), complex search and replace (which can specify cases, work forward or backward, and handle wild cards), typewriter mode (which lets you type directly to the printer), mouse support (in MS-DOS word processors), context-sensitive help, and network compatibility.

Reading and writing in other file formats is also critical in word processing, where so many formats exist. Some translations are thorough, leading to "editable" documents that include the editing marks, such as footnotes, centering commands, underlining, and the like, in the output document. Others simply read the characters in the text. Some programs can handle only their own format and ASCII files. Others, such as OfficeWriter V and MultiMate, excel at reading files from an "older brother"—in their case, Wang dedicated word processors.

More and more state-of-the-art packages are acquiring various import and export utilities, some as built-in menu choices—my preference—and some as external conversion programs. IBM DCA (document-content architecture) in the RFT (revisable-form text) or FFT (final-form text) format is a popular translation, as are ASCII (plain text), WordStar, Navy DIF (also called GSA), WordPerfect, and other formats. Macintosh word processors often offer Word, MacWrite, and ASCII translations.

A need also exists to read databases,

continued

spreadsheets, and graphs whose data, numbers, and charts can be included in word-processing documents. For example, MultiMate can read Lotus 1-2-3 .WKS files or VisiCalc DIF files. Macintosh word processors can import almost any sort of graphic by moving it from its original application to the scrapbook and then to the word processor.

Some word processors come with a disk full of specialized drivers to support 100 or more different printers. Lately, this list is likely to include laser-printer and PostScript drivers.

One exception to this trend is IBM's DisplayWrite 4. Although the program has a wide variety of features, including a spelling checker, footnotes, macros, on-line help, in-text math, mail merge, mouse support, network support, line drawings, a notepad, and an option for voice-note recording, it supports only nine printers, all from IBM, plus the option of building your own printer-function table.

More than a dozen MS-DOS word processors offer nearly everything you could want in the way of features, including alternate character sets, footnotes, columns, on-line tutorials, and mail merge. Only a fine line exists between my state-of-the-art list and close competitors. For example, products like VolksWriter 3 can handle almost any editing task; in fact, if VolksWriter 3 had an integrated outline processor, it probably would have made my list. However, my top seven exemplify the powerful new state-of-the-art features I have listed. I didn't find comparable power in any CP/M, Amiga, Atari, or Apple II word processors, although some came close. For example, WordPerfect has a version for the Apple II line which has many of the same features that are in the MS-DOS version.

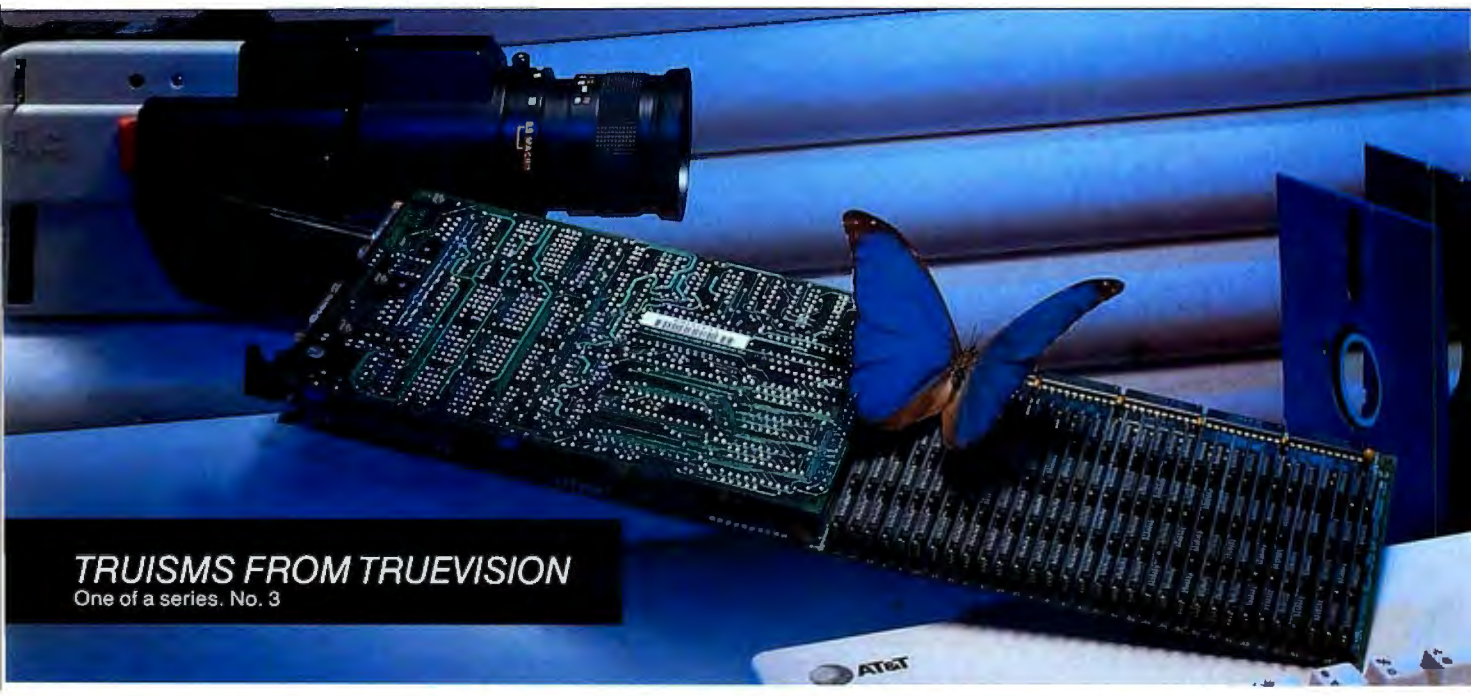
For the Macintosh

Word processing on the Macintosh differs from that on MS-DOS machines. The Macintosh's pull-down menus and mouse bypass the tangle of command keys and function keys on which MS-DOS software depends, so its mousing requirements deter some writers. The Macintosh's bit-mapped display lets a variety of typefaces—styles and sizes—appear on the screen; it lets you integrate text and graphics on the screen as well.

In the past, word processors for MS-DOS machines have actually offered more features than those for the Macintosh; however, the two are converging. New software for the Macintosh offers outline processors, spelling checkers, customizable footnotes, and other features of state-of-the-art MS-DOS word processors. And the high-resolution displays on MS-DOS machines—generated by such cards as the IBM Enhanced Graphics Adapter (EGA) and Hercules Graphics Card Plus—display a variety of types and page layouts on the screen, approaching the Macintosh graphics ability. Still, there are differences between the two: The MS-DOS software leads in sheer number of features, and the Macintosh word processors are ahead in display ability and ease of use.

WriteNow 1.0

T/Maker's WriteNow competes with Microsoft Word for the Macintosh as the most complete Macintosh word processor. WriteNow's particular strengths are its columns, footnotes, headers, and footers. It lets you open any number of documents at one time in separate windows, limited only by memory. It also allows multiple-column editing of up to four columns of text or graphics per page. WriteNow is missing some state-of-the-art features, including outline processing, table-of-contents and index genera-



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tion, mail-merge capability, a thesaurus, context-sensitive help, and multiple windows on the same document.

The rulers used for margins, tabs, and so on, differ from other Macintosh word processors; they sit in separate windows, and you can manipulate them with cut-and-paste commands. The built-in spelling checker comes with a 50,000-word, customizable dictionary that includes plurals, past tenses, and similar forms as separate entries. The superscript and subscript features offer more control than in most word processors. Repeated application will continue to move them higher and lower, so you can have, for example, superscripts to superscripts. You can preset the font, headers, footers, page size, and so on, for new documents—essentially a style-sheet feature. Search-and-replace commands can work forward, backward, or wrap around the document on words, spaces, tabs, returns, and wild cards.

WriteNow offers automatically numbered footnotes, and each column on a page can have its own footnotes. A footnote can be of any length and can contain both graphics and text, including page number, time, and date. If there is enough room below the relevant page or column, the entire footnote is printed on that page; otherwise, it spills over into the footnote region of the next page or column.

WriteNow has the best header and footer features for the Macintosh, including page numbers, document or chapter titles, and graphics. It allows as many different headers and footers in a document as you want—one of each to a page—and alternating odd and even page settings. Headers and footers can occupy a single line or up to one-fourth of the page's height. You edit them in a separate window, but the `page view` command shows the entire page layout, including graphics, footnotes, headers, footers, page breaks, and margins.

The package also offers a thorough integration of graphics (with a sizing and scaling option), an `undo` command, a command that shows all nonprinting characters, hanging indents, and alternating binding margins for two-sided printing. WriteNow has a wealth of saving and backup features: You can work with your edited file, the saved copy, or the backup. One unique feature is its `save/compact` command, which reclaims the unused space that editing injects into a document's data structure. This can be as much as 20 percent of the document's size, to a maximum of 25K bytes.

A separate program called Translator contains WriteNow's import and export facilities. It can transform Word for the Macintosh 1.05, MacWrite, and ASCII files into WriteNow files; it can also convert WriteNow files into ASCII files and translate to and from Interchange files (text-only files with user-readable formatting information embedded in them).

WriteNow is not copy-protected. T/Maker encourages you to distribute copies of Sample WriteNow, a program on one of the WriteNow disks, to anyone who wishes to try WriteNow before buying it. The two programs are the same except that any document printed with Sample WriteNow has a message at the top and bottom of each page stating that it was created with Sample WriteNow.

MindWrite 1.0

While integrated outlining and flexible windows are MindWrite's key features, it doesn't skimp on others. MindWrite's outliner uses double-clicking to expand and contract sections, making its conventions easier to learn than Word for the Macintosh's special outlining buttons

continued

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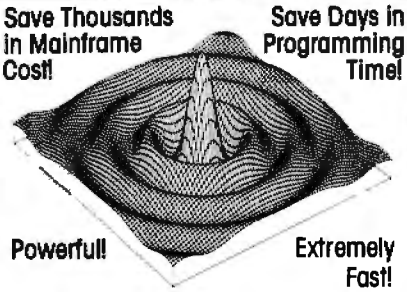

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and commands. To move an outline section, you use the mouse to grab—a hand icon "pinches" the heading—and drag the material to its new position where it is automatically renumbered. MindWrite can hide graphics within outlines as just another collapsed paragraph.

You can also generate a table of contents directly from the document. A single command gathers the document's headings and stores them in a new, separate table-of-contents document.

MindWrite has a mark option. Each time you create or change a paragraph, MindWrite invisibly stamps it with the current date and time. You can use those stamps to mark selected paragraphs, such as all paragraphs that have changed since a certain date or since the last save. The program marks such selections with a vertical bar on the screen so you can review or print them independently.

The package's standard search-and-replace feature has a variety of options, including forward or backward search, wild card matching, and nonprinting character search and replace. MindWrite can find all occurrences of a text that you specify; it can then select them and gather copies of all the paragraphs or headings (and their subheadings) that contain that text into a new document.

To format documents or sections of documents, MindWrite uses multilevel rulers that you can change, globally or by level, and use when setting and saving preferences in style sheets.

You can open multiple windows in MindWrite (the number is limited only by the amount of memory in the system), and those windows can view multiple documents or multiple parts of the same document. Zoom buttons and a Windows menu help you manage the windows. Due to the expansion and collapse of outlines and the ability to open several windows on the same document, you can simultaneously view a document in different levels of detail. Any text change in one window will affect all the others, but you won't see the change until you bring another window to the front.

MindWrite has a pop-up window for counting words in a selected section or in the entire document. This handy built-in utility counts characters, words, paragraphs, and the average word length.

One unique feature of MindWrite is its accumulating clipboard. All text cut in a session is saved on the clipboard, with each section separated from the others by lines of equal signs. The last section saved is automatically selected and is the one used in a paste operation, unless you open the clipboard and change the selection. This creates as complete an undo facility as you could want and can make editing much less frustrating. You can also save the clipboard contents to and restore them from a disk.

For import and export functions, MindWrite can read MacWrite, ThinkTank, and ASCII files and can save to MacWrite and ASCII files. You don't have to leave the editor for these functions as you do in WriteNow; you can read and write directly from a dialog box. When you want to depart from MindWrite, a menu option lets you stop the program and start another application without returning to Finder. In addition to importing graphics from such applications as MacPaint and MacDraw, MindWrite can resize pictures by adjusting their length and width or by shrinking or stretching them proportionally, and it can return them to their original size.

Unlike WriteNow, the package offers only a single header and footer per document. It also has automatic footnote renumbering, but it doesn't have the footnoting flexibility of WriteNow and Word for the Macintosh.

MindWrite's intuitive, integrated, outline processor and flexible windows make it my favorite Macintosh word processor for day-to-day work. MindWrite lacks a number of important functions, however, such as true column editing, mail merge, a spelling checker, a thesaurus, and an index generator.

Word for the Macintosh 3.0

The Macintosh version of Word 3.0 is packed with features. Although it lacks such elements as footnotes for columns and an accumulating clipboard, it allows embedded PostScript commands and contains a glossary function, automatic index generation, and the ability to perform math in the document.

Word is the first major revision since version 1.05, and it incorporates a number of features that first appeared in PC versions of Word: style sheets, a spelling checker, automatic index and table-of-contents generation, and outline processing. However, Word doesn't have dynamic repagination. That is, when you have done some editing and want to see where the page breaks will fall, you have to specifically choose a pagination option on one of the menus. A page `preview` command lets you see what the printed page will look like.

You can perform some math in the document, sort items, and insert graphics. Word 3.0 has a mail-merge feature and on-line help, as well as an undo feature. Superscripts and subscripts are available to a single level each. You can open multiple windows on one or more documents, and document length is limited only by disk space. The Windows

menu lets you manipulate windows rather than simply clicking them into activity and then dragging them out of the way.

Style sheets let you specify and save document formats. For instance, you can use them to specify titles in a certain position, style, and size; subtitles with another set of characteristics; text with yet another; and so on. Using them transforms document modification from a search-and-modify mission into a batch operation. If you want to change the font of the subtitles, you don't have to find each subtitle, select it, choose the new font, and then move on to the next subtitle. Instead, you just change the specification in the style sheet and all the subtitles change at once.

The outline processor differs significantly from the outlining conventions established by ThinkTank. Instead of double-clicking to expand or collapse text, you use special icons at the top of the screen. Also, you cannot drag a section to a new position; you must cut and paste it. Word has an integrated outline processor, not merely an outline-renumbering tool. With its multiple windows, you can see several levels of detail in a document at once.

You must insert special codes in Word documents if you want to handle math or mark text for inclusion in an index or table of contents. This necessity makes Word less intuitive than some of the other Macintosh word processors. The program comes with as much documentation as an MS-DOS word processor does.

Word for the Macintosh provides footnote and endnote tools that let you decide where you want your notes to appear, what numbering scheme to use, and how to print the notes. It offers multiple-column printing and the ability to link several files together to print or to generate a global index or table of contents. You can number lines in the left margin (especially useful for legal writing), include nonprinting text in the document, automatically hyphenate text, and draw lines and boxes. The program can also drive some daisy-wheel printers.

Word can perform a number of import and export functions from within the program. It can directly open and translate a Word for the Macintosh 1.05, MacWrite, ASCII, Word for the PC 3.0, DCA, or RTF (Microsoft's rich text format) file; it can also save to those formats. Switcher comes on the disks with Word for the Macintosh 3.0 and will be useful if you have enough system memory to set up multiple applications.

The MS-DOS Arena

There are many more word processors in the MS-DOS arena than there are for the Macintosh, making my final cut here difficult. Two products I liked, OfficeWriter V and Samna Word IV, didn't have a particular state-of-the-art feature, but they do offer lots of power and long lists of features, more than most people will ever use. Other close contenders include VolksWriter 3, XyWrite 3, MultiMate's Advantage!, and WordStar Professional 4.0. In the end, I chose Manuscript for its integrated graphics and outlining; WordPerfect for its completeness, portability, and macros; Word for the PC for its integrated outliner and completeness; and Nota Bene for its text base, footnoting, and panoply of academic functions.

Manuscript 1.0

Manuscript is definitely a state-of-the-art product. Lotus bills it as a technical word processor because so many of its features tailor it to creating scientific and technical articles and reports; these features are also useful for other word-processing tasks. In my opinion, its integrated outline processor, ability to represent complex scientific equations, and ability to merge graphics and text are its three best features. In performing these tasks, Manuscript uses a top-of-the-screen menu line, pop-down menu boxes, dialog boxes, and typed backslash commands similar to those in Lotus 1-2-3. Its outline processor is full-fledged, letting you create blocks of text in a hierarchy and then collapse or expand those blocks by level or by section, working completely within the word processor.

Manuscript can display any number of fonts on the screen and print Greek letters and mathematical and scientific symbols. It can show some of these on the appropriate graphics displays; others, including imported graphics, you can specify only for printing. A Hercules Graphics Card Plus, for instance, can show bold, underline, italic, superscript, subscript, and strike-through. To specify imported graphics or equations for printing, you must type backslash command lines within the document. A `document preview` mode allows a full-screen view of what the final page will look like as long as you have a display capable of showing bit-mapped graphics. The Manuscript editor, however, uses text-oriented graphics to provide an acceptable speed.

Manuscript can accept graphics files from several different sources: Lotus 1-2-3 charts, .PIC files, bit-mapped images, and scanned or digitized images. You can set aside blocks of space for these images when using the editor. Although you can't see the actual image on the screen, you can integrate it onto the same page or in side-by-side columns

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with text when you print the document. This ability requires a printer that can handle the image, and Manuscript can drive a variety of printers, including laser and PostScript devices.

Manuscript also contains a two-sided printing feature, a mail-merge capability, a context-sensitive help feature, a spelling checker (with a 100,000-word customizable dictionary), macro and merge facilities, and a host of other features, including extensive footnoting and endnoting. It lacks a thesaurus and can open only two windows on the screen at one time.

For columns and tables, Manuscript is the most powerful of my top seven word processors. It has a special editor that lets you adjust column widths and attributes, swap columns with other columns, specify their borders, and so on. It lets you easily create a table of contents, list of figures, index, and almost any other supporting list, directly from a document. You can inject cross-references to keep track of other positions in the document to which you're referring. And Manuscript has separate pop-up style-description forms for each type of list.

You can import ASCII, DCA, and ThinkTank files and export ASCII and DCA files. You can compare two documents and automatically generate a final document that has the insertions, deletions, and revisions marked. For technical documentation, Manuscript is hard to beat. However, due to its use of virtual disk memory that is set up to expect a hard disk, you can't run it on a floppy-based system.

WordPerfect 4.2

WordPerfect has a long list of word-processing features. If it had an integrated outline processor and more windowing flexibility, it would stand alone at the top of the heap. A version for the Macintosh is in the works, but it isn't available as I write this review.

In portability, WordPerfect far surpasses Word for the PC, its closest competitor in this respect; WordPerfect runs on a huge variety of machines. It is currently available on MS-DOS machines, the Apple II series, and some minicomputers, and WordPerfect Corporation is busy porting it to everything from the Macintosh to IBM mainframes. It even comes with a toll-free phone number for technical assistance.

WordPerfect has a mail-merge function, a built-in spelling checker with a 115,000-word customizable dictionary, and a thesaurus. It can do in-text math, sort lines or paragraphs, capture and handle macros, drive a myriad of printers (including laser and PostScript printers), and work with up to 24 columns of text or figures in either of two styles: snaking newspaper columns or tabular columns. WordPerfect has an undelete feature, a document-summary page, line numbering, an on-line tutorial, and a `document preview` function. The commands that perform most of these functions are implanted in the document and can be hidden or displayed for direct editing.

You can specify blocks of text that you wish to protect from editing; center blocks vertically on a page; employ headers and footers (including on alternating pages); draw lines; use overstrike, strikeout, and redline (vertical bars) markings; and automatically renumber outlines. Compiling a table of contents and an index is a simple matter of marking the desired passages and striking some function keys. The footnoting feature allows both footnotes and endnotes and many options for numbering and positioning those notes. "Widow" and "orphan" control alleviates the problem of stranded text at

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the end or beginning of a page.

WordPerfect's macro facility is extensive, and it lets you chain macros and include commands for repetition and conditional execution. Its sorting feature can work on up to nine keywords. The manual contains a section called "Flights of Fancy" that suggests some complex operations you can direct by combining the mail-merge and macro features.

The program has a timed backup feature—you specify the length of time—that periodically and automatically saves your work to WordPerfect files. The import and export facility can read and write WordStar, MultiMate, DCA FFT, DCA RFT, Navy DIF, and ASCII files.

Word for the PC 3.1

Word is a state-of-the-art product on both the IBM PC and the Macintosh. For the PC, version 3.1 contains a great many features, but it isn't as easy to learn as WordPerfect is. Many writers choose Word particularly for print control: It works with many printers and offers many printing options, two of which are laser and PostScript printing.

Word's built-in outline processor can collapse and expand sections of documents and automatically renumber an outline when you move a section. It also has a more powerful windowing capability than Manuscript has—you can open multiple documents in separate windows and move text between them with a cut-and-paste feature.

With Word for the PC, Microsoft includes a powerful on-disk tutorial called "Learning Microsoft Word." Word also has voluminous manuals that are surprisingly easy to read.

Word's style-sheet feature lets you capture a range of formatting commands so you can automatically apply them to future documents. This feature can speed up the creation of a series of similar documents. Instead of choosing each section and applying formatting commands to it, you can build a template of formatting commands and apply it to an entire document at once.

Word has mail-merge, glossary, and footnoting abilities and can create indexes and tables of contents. It has a built-in spelling checker and thesaurus, and it can show boldface, italic, underline, superscript, subscript, small caps, and double underline all on the screen. It more closely approaches WYSIWYG than most other MS-DOS programs. Besides performing basic math operations within the document, Word for the PC can also select and manipulate columns, sort lists of numbers, and work with a mouse.

Nota Bene 2.0

Nota Bene appears on this list for three reasons. First, it has so many academic-writing features that the MLA (Modern Language Association) has endorsed its use—the first program so honored. Second, it has a built-in text-searching function that lets it handle reams and reams of notes. Third, it has so many features that I'm still finding new powers and potentials buried in the encyclopedic manual although I've been using Nota Bene for some time.

Nota Bene is based on two previous programs, XyWrite 3.1 and FYI 3000 Plus. Dragonfly licensed those programs, modified them substantially, and combined them into Nota Bene. XyWrite itself is a formidable word processor that I nearly included on this list. FYI 3000 Plus is a free-form text-retrieval program that lets you search through disks full of information for the exact text that you want. Together, their features make Nota Bene ideal if you collect lots of notes and then write papers or books.

Nota Bene's search feature can find all the occurrences of a specified text on a disk. This feature lets you make huge

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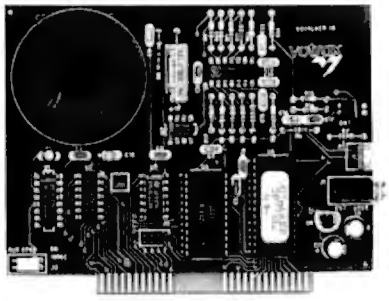

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note bases on a disk and then automatically search them, even employing Boolean expressions to pinpoint what you want more accurately.

The text-base manager in Nota Bene lets you index quotes, outlines, or any sort of text files for rapid retrieval. It accepts Boolean expressions to search through 750 to 1000 pages of notes in a single floppy text base or 50,000 pages on a hard disk, in as many as eight subdirectories, each with five sub-subdirectories. You can make every word a key if you limit files to four pages per document, or you can make up to 500 keywords per entry. You can reindex and extend text bases over multiple disks. Therefore, from within your word processor, you can search for related material by content and then read it directly without leaving the word-processing program.

Nota Bene can turn out many different types of lists on a document. It can make a table of contents up to five levels deep, generate an index, and make one or two bibliographies per document.

It has lots of standard functions like undelete, windows (up to nine), list sorting, four-function math, macros, context-sensitive help, box graphics, widow and orphan control, on-screen underlining and boldfacing, and mail merge. It also has style sheets like those in Word for the PC for saving document formats.

With its academic emphasis, it's no surprise that Nota Bene also has some predefined style sheets for MLA, Chicago Manual of Style, and other standard styles. And it has a file-comparison feature for delineating the differences between documents.

For foreign-language use, Nota Bene has multilingual keyboard layouts with access to all western European language characters and specific layouts for Britain, France, Germany, Italy, and Spain. For high-resolution displays, there will soon be Nota Bene versions that handle biblical and modern Hebrew (with right-to-left wordwrap), classical Greek, Cyrillic, old and middle English, eastern European, and transliterated eastern and Asian languages. Dragonfly Software has demonstrated Nota Bene running multiple columns with different languages side by side in different columns, some of which read, and therefore wrap, from right to left and some from left to right. For printing such complex texts, version 2.0 contains improved laser-printer support, including the use of a virtually unlimited number of fonts per document and variable vertical line spacing.

Finally, Nota Bene offers all the footnotes and endnotes a scholar could want. It lets you specify the numbering system for multiple-level footnotes of any length, which it can then keep on the appropriate page, collect at the end, or change back and forth. A cross-referencing facility automatically updates any comments you insert aimed at particular passages in a document to the latest positions of those passages.

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Looking Ahead

Although I didn't find any word processors that reached my state-of-the-art criteria for either the Atari ST line or the Commodore Amiga, such programs might soon appear. Word processors originally written for the Macintosh will probably come first, because the Atari STs and the Amigas have similar windowing tools, processor speeds, and bit-mapped displays.

In the MS-DOS world, the pace won't slacken either. Borland, for example, has recently announced (but at this writing, has not yet released) Sprint, a word processor that is said to contain a programming language, file and command compatibility with many other word processors, and automatic timed backup. Proximity Technology has also announced a grammar checker that is said to locate subject-verb disagreements in a sentence, as well as case errors.

A fascinating program called Guide points toward one aspect of the future for Macintosh word or document processors. Guide is a "hypertext" tool that lets you put new meaning and relationships into a document. By making links between parts of the text (or graphics) and other parts, attaching pop-up notes to portions of the text, and building a hierarchy of document sections that can collapse or expand much like an outline, you can create a more meaningful document that can only be read on a computer, not on paper.

Other products will continue to add desktop-publishing capabilities to show more types of characters on-screen, integrate text and graphics, and lay the characters out in a larger variety of ways.

Making the Right Choice

What would the perfect word processor be? That depends on the person and the application. Mine would combine the best features mentioned in this review with the ability to build hypertext structures that include video and sound and have the ability to cut and paste material from a CD-ROM reference. I also want a program that can take advantage of larger screens—I want that soon. I need a minimum of a 19-inch display that can show several pages at once, including multiple windows from the same file with outline processing and integrated graphics tools. The spelling checker should be joined by a grammar checker, and this program should be able to read and write any file format. And, finally, I don't want to have to read an 800-page manual to find cryptic text commands that I must inject into a manuscript to access these features.

What is the perfect word processor for you? Don't choose one merely because it is given the state-of-the-art nod in this or any other review. Look at its actual list of features and at the compatibilities it has with your current system and files. Your choice should be based on your own needs, desires, and abilities, not someone else's. ■

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■ **Rich Malloy**

Electronic spreadsheets are one of the most ingenious software developments; they combine a straightforward, output-oriented user interface with the computer's ability to calculate and display numbers. Spreadsheets have been adapted for business reports, modeling, and forecasting. Some are used as small database managers and graphics generators, and some can even be used for such nonbusiness applications as electronic circuit simulation.

Objectives

The first and foremost spreadsheet feature I'll cover is performance, in terms of speed and accuracy. Next I'll look at capabilities, such as ancillary functions and macro commands, and compatibility issues, such as support for numeric coprocessors and networking. I'll also examine the structural capabilities of the spreadsheet (i.e., the ability to create multidimensional worksheets or to link worksheets). Next is the all-important user interface: How do you interact with the spreadsheet, and what does its output look like? I'll also examine two other details that might impact your plans to use these products—price and program size. See tables 1 and 2 for complete lists of the program's features.

I used the popular version 1A of Lotus 1-2-3 as a rough basis for comparison of spreadsheet features. Although this version is out of date, it is still in wide use. Many of these spreadsheet programs' features are functions of the underlying hardware and operating systems (e.g., the icons and menus used to control Macintosh spreadsheets). For a more detailed description of the tests I used to evaluate the programs, see the text box "Benchmarking Spreadsheets" on page 72.

1-2-3 version 2.01

Lotus Development's 1-2-3 version 2.01 for the IBM PC ($495) is sold only as a copy-protected program. This package supports an 8087 coprocessor and expanded memory but has no networking or multidimensional support. Although the 2.01 package is slower than the original 1.0 version in all but one benchmark (the Scroll Right test), it is still one of the fastest IBM PC–compatible spreadsheets available.

Version 2.01 incorporates 42 macro commands and 89 functions ranging from the simple absolute value to the complex sum-of-the-years depreciation. In fact, many of the nongraphics functions of the BASICA programming language are supported in some way by either 1-2-3 macro commands or functions, making it possible to write comprehensive 1-2-3 programs.

The authors of 1-2-3 practically invented context-sensitive help screens, and these continue to be an important part of the program. Unfortunately, 1-2-3 cannot record keystroke sequences into a single macro keystroke. Version 2.01 can invert and multiply matrices, but it's rather limited in its ability to link worksheets together.

The 1-2-3 user's manuals consist of three perfect-bound volumes. These are smaller, lighter, and easier to use than three-ring binders. I did not like the manuals' insistence on referring to generic key labels instead of actual key names, however. For example, one of the manuals explains how to execute a macro by using the Macro key, but it doesn't say what key on the keyboard is the Macro key. That indispensable information appears on a small card. It is also in the Help file, if you can figure out where the Help key is. This information should appear prominently in one of the manuals.

Many of 1-2-3's shortcomings are partially solved by the add-on product HAL. But even with its shortcomings, 1-2-3's

continued

Rich Malloy is a senior technical editor for BYTE. He can be reached at BYTE/McGraw-Hill, 1221 Avenue of the Americas, New York, NY 10020.

fast spreadsheet capabilities, together with its database, graphics, and rudimentary text-processing features, endow the product with a high degree of functionality. The program's value is also enhanced by its large user base and its sizable number of add-ons, macros, and user textbooks. The HAL accessing program extends 1-2-3's functionality even further.

HAL 2.01

Lotus Development's HAL version 2.01 ($150) is an accessory program for 1-2-3 versions 1A, 2, and 2.01, but it provides so many extra features that it deserves mention as a separate program.

HAL does not impede user access to all the regular 1-2-3 facilities; it sits between the user and 1-2-3 and translates user requests into 1-2-3 instructions. For instance, HAL would translate `total this` into a series of macro instructions that would check each of the cells near the current cell pointer and insert a sum formula below each column of values. HAL can also do a few tasks that were previously not possible with macros, the most notable of which is Undo. Undo lets you cancel any HAL request, but not normal 1-2-3 instructions. The Undo capability is only one instruction level deep, and using it reduces the memory availability by more than one-half because it must keep a copy of the last state of the spreadsheet in memory.

When you turn on Undo in a 512K-byte IBM PC, only 66K bytes are available for use. When you turn off Undo, 166K bytes are available. When you use 1-2-3 2.01 without HAL, 302K bytes are available. I had to turn off the Undo facility for both benchmarks that I used because they can't run in 66K bytes of RAM.

HAL's benchmark results can be misleading, since the speed with which it executes a request depends on how you word the request. HAL performs simple 1-2-3 requests with the same efficiency as 1-2-3. To give you an idea of how HAL interprets requests, I varied the Arithmetic Recalculation test so that it would be more HAL-like. The test worksheet consists of 2500 cells, all of which are a function of one input cell. Normally, I change the value of the input cell from 2 to 1 and measure the recalculation time. For the test on HAL, I merely placed the cell pointer on the input cell and entered the HAL request `decrease by 50 percent`.

HAL's execution time in this test was significantly longer than the time required to translate the request into a series of 1-2-3 commands. Instead of merely changing the value of the single input cell, HAL apparently checked each of the 2500 contiguous cells to find any value cells that needed halving. HAL also performed rather slowly on the Insert Row test.

HAL does not have any more functions with the @ prefix than 1-2-3 has, but it can execute macros of combined HAL requests and 1-2-3 instructions. These two types of instructions cannot be on the same line of the worksheet, however. Since HAL has 307 words with which you can begin a request, it effectively adds 307 macro commands to 1-2-3, giving a whopping total of 349 possible macro commands. However, many of these requests are synonyms of each other.

HAL makes creating macros easier because it can record requests and insert them into cell ranges. Unfortunately, it

Table 1: *Spreadsheet prices and company information.*

Spreadsheet	Versions	Hardware	Company	List price	Manual(s)
1-2-3	2.01	IBM PC; 256K	Lotus Development Corp. 55 Cambridge Pkwy. Cambridge, MA 02142 (617) 577-8500	$495	551 pages
HAL	2.01	IBM PC; 512K	Lotus Development Corp. 55 Cambridge Pkwy. Cambridge, MA 02142 (617) 577-8500	$150	178 pages
Boeing CALC	3.0	IBM XT, AT; 386K and hard disk	Boeing Computer Services Microsoftware Products P.O. Box 24346 Mail Stop 7W-05 Seattle, WA 98124-0346 (800) 362-4555	$399; LAN: $799	380 pages
Excel	1.03	Mac; 512K	Microsoft Corp. 16011 Northeast 36th Way P.O. Box 97017 Redmond, WA 98073-9717 (206) 882-8080	$395	572 pages
Multiplan	3.01	IBM PC; 256K	Microsoft Corp. 16011 Northeast 36th Way P.O Box 97017 Redmond, WA 98073-9717 (206) 882-8080	$195	516 pages
Silk	1.0	IBM PC; 512K	Daybreak Technologies 2271 205th St., Suite 104 Torrance, CA 90501 (213) 212-3030	$298	292 pages
SuperCalc4	1.0	IBM PC; 256K	Computer Associates Int'l Inc. Micro Products Division 2195 Fortune Dr. San Jose, CA 95131 (408) 432-1727	$495	650 pages
Trapeze	1.0	Mac; 512K	Data Tailor 1300 South University Dr., Suite 409 Fort Worth, TX 76107 (817) 332-8944	$295	208 pages
VP-Planner	1.3	IBM PC; 256K	Paperback Software International 2830 Ninth St. Berkeley, CA 94710 (415) 644-2116	$99.95	500 pages

cannot record regular 1-2-3 keystrokes. Another feature of HAL not available to 1-2-3 users is the ability to audit spreadsheets. HAL can create a table of all formulas used or all cells that are dependent or precedent to a particular cell. However, in the list of dependent cells, the range names are converted to cell addresses.

HAL's best feature is its ability to do complex 1-2-3 tasks easily. HAL makes it easy for you to create a graph or find entries in a database that satisfy certain criteria. Both of these operations can take a considerable amount of time using the old 1-2-3 command interface.

HAL's ability to link 1-2-3 spreadsheets is really no more powerful than Lotus's current `Combine` instruction. HAL merely creates an auto-executing macro that combines values in ranges from other worksheets to ranges in the present worksheet. While I was testing this, I got a curious error message stating that the combined length of the linked range name and the filename could not exceed 13 characters.

HAL's user's manual is good, but it could use a phrase dictionary showing how all its words are used. HAL's help feature is context-sensitive, but slow for large worksheets.

Users might expect too much of HAL. You can easily give HAL a request that it will either not understand or misinterpret. Nevertheless, this program is impressive and will undoubtedly be popular. Note that its price, combined with the cost of 1-2-3, make the combination package the most expensive of the spreadsheets reviewed in this article ($645).

Boeing CALC 3.0

Boeing CALC 3.0 for the IBM PC ($399; LAN version: $799) from Boeing Computer Services has many of 1-2-3's features but is designed for much larger and complex worksheets. Most prominent is its ability to do three-dimensional *workpads*, which are delineated by rows, columns, and pages.

This program can handle tremendous worksheets: up to 16,000 rows, 16,000 columns, and 16,000 pages. Since the program has virtual-memory capability, physical memory size is not a limiting factor, and you do not need expanded-memory boards. A hard disk is a must for this application.

Virtual memory has its price, usually in terms of performance. In the benchmark tests, Boeing CALC was one of the slowest programs, even though it was running on a computer equipped with a hard disk. Other shortcomings of the program are its lack of graphics, lack of 8087 coprocessor support, and, surprisingly, its inability to bestow names on ranges of cells.

Those limitations notwithstanding, this program has some impressive capabilities for large, complex worksheets. For example, the `Worksheet` selection on the 1-2-3-style menu has been replaced by `Workpad`, denoting the fact that each worksheet is but a page in a three-dimensional pad. You can access all cells not only by column and row numbers, but by page numbers as well. With this interface, it is easy to set up a series of worksheets and consolidate them into a summary worksheet. With the networking version of this program, you can assign users access to certain pages of a workpad, setting the stage for a powerful multiuser capability.

HAL's best feature is its ability to easily perform complex Lotus 1-2-3 tasks, such as graphs and database searches.

Boeing CALC supports 89 functions. The function names do not require an @ character, as 1-2-3 functions do. The program supports a rudimentary form of macro; it can save keystrokes into a file, but it lacks any special macro commands. As for compatibility, Boeing CALC can read and write 1-2-3 files directly.

continued

Table 2: *Features of the nine spreadsheets reviewed.*

Feature	1-2-3	1-2-3 HAL/	Boeing CALC	Excel	Multi-plan	Silk	Super-Calc4	Tra-peze	VP-Plan
Computer	IBM PC	IBM PC	IBM PC	Mac	IBM PC	IBM PC	IBM PC	Mac	IBM PC
Functions	89	89	89	114	77	81	92	127	59
Macro commands	42	349	0	29	13	44	46	0	9
Networking	No	No	Yes	No	P	No	No	No	No
Arithmetic coprocessor	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No
Expanded memory	Yes	Yes	*	N/A	No	Yes	Yes	N/A	No
Multidimensional	No	No	Yes	No	No	No	No	No	Yes
Linkage	P	Yes	Yes	Yes	Yes	P	P	Yes	P
Database	Yes	Yes	No	Yes	P	Yes	Yes	No	Yes
Natural language	No	Yes	No	No	No	No	No	No	No
Undo	No	Yes	No	Yes	No	No	No	Yes	No
Record macros	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Contextual help	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Live help	No	No	No	No	No	Yes	No	No	No
Auditing	P	Yes	No	Yes	Yes	Yes	P	No	P
Graphics	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Cross-compatibility	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Non-copy-protected	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* = virtual memory
P = partial support

Although Boeing CALC's user interface is much like 1-2-3's, it has minor idiosyncrasies. One is that the Point mode is not automatic. In 1-2-3, if you want to write a formula that accesses the value of a certain cell, you can simply point to it (i.e., move the cell pointer to it). In Boeing CALC, you must first press F9.

Excel 1.03

Some people call Microsoft's Excel ($395) the 1-2-3 of the Macintosh world. With its large number of features and formidable power, Excel has a justifiable claim as the best spreadsheet for any machine.

In the benchmark tests, Excel was clearly the fastest of all nine programs, especially when compared with the IBM PC-compatible spreadsheets. Only in the Scroll test was its speed exceeded by a number of Macintosh and IBM PC programs. Excel usually seems even faster than it is because it can do recalculations in the background, and it avoids recalculating cells that do not require it.

The only items that Excel lacks are special networking features and multidimensional worksheet support. Excel has a total of 114 functions; the program has 29 macro commands and an additional 87 that are the equivalents of keyboard commands. You can feed the functions single values or arrays, and you can even add your own special functions using the macro commands. You can easily record, store, and play back macros with any worksheet.

Although Excel cannot work with multidimensional worksheets, it can display several worksheets on the screen at once. You can reference ranges of cells on other worksheets by using a simple notation that includes the names of the worksheets and their ranges. Like the other Macintosh spreadsheets, Excel makes full use of the Macintosh interface, featuring pull-down menus and scrolling windows.

Auditing is one area in which Multiplan, Excel's sister program for the IBM PC, has it beat. Unlike Multiplan, Excel cannot display lists of formulas and dependent cells, but it can display the worksheet, showing formulas instead of values. Excel can read and write files in 1-2-3 and SYLK (symbolic linked file format) formats. Version 1.03 of Excel supports the Macintosh 68881 math coprocessor and is not copy-protected.

Multiplan 3.01

Microsoft claims that Multiplan version 3.01 ($195) is the fastest spreadsheet available for the IBM PC, a claim that I will not dispute. On the four benchmark tests, it was the fastest IBM PC program in the Savage, Scroll Right, and Insert Row benchmarks and just 20 percent slower than the fastest in the Arithmetic Recalculation test. The only problem I noticed was floating-point accuracy in the Savage benchmark. Multiplan scored the largest error rate: approximately 10^{-4} after 1000 iterations. Most other programs had an error rate of only 10^{-8}.

Multiplan has two features that create an even greater illusion of speed. The first is the ability to do calculations in the background like its sister program, Excel. You can still move the cursor and edit while the calculation is going on. In a very long calculation, such as the Savage test, you can even scroll down the 1000-row column and watch the wave of recalculations taking place. This background-calculation feature, however, might cause a problem for extremely long calculations because you can't be sure when a value has finally been recalculated.

The second feature that enhances the perception of Multiplan's speed is its ability to select and recalculate only those cells that require it. This feature is sorely needed in other spreadsheets.

One of the best features of Multiplan is its ability to link spreadsheets. To link a cell in one spreadsheet to a cell in another, you select the `Xternal` menu choice and fill in the names of the appropriate cell and spreadsheet. To verify your linkages, you set up a window on the screen corresponding to each spreadsheet.

Multiplan 3.01 also has some handy auditing features. When you display formulas, the program automatically expands cell widths to encompass the widths of the formulas. It can also generate all the precedent cells of a given cell (i.e., all the cells that serve as input to a given cell formula).

While it is certainly state of the art, Multiplan has some deficiencies: It lacks expanded memory and 8087 arithmetic coprocessor support. Although instructions are included for setting up the program on a network, it has no special network-oriented features. The program also lacks graphics capabilities, and its database functionality is limited. But it can read and write files in SYLK, 1-2-3,

Benchmarking Spreadsheets

The Savage benchmark, as described in "The 8087/80287 Performance Curve" by Stephen S. Fried in BYTE's *Inside the IBM PCs* (Fall 1985, page 70), is ideal for testing a program's ability to handle floating-point calculations.

The Savage benchmark involves three function pairs: tangent and arctangent, exponent and natural log, and square root and square, all of which should combine with each other to form an identity function. In addition, the operand of the function is varied from 1 to 1000. The Savage benchmark used in these tests consisted of 1000 rows of a single cell containing the following:

```
tan(arctan(exp(ln(sqrt((prev__
 cell)^2)))))+1
```

`Prev__cell` refers to the cell immediately above. The initial value of `prev__cell` is 1. After 1000 iterations, the value of 1001 is subtracted from the resulting output to obtain the error, which is compounded during each iteration.

I also used three other tests based on an expanded version of the simple worksheet used in previous BYTE spreadsheet reviews. The worksheet consists of 100 columns and 25 rows, where each cell is the product of 1.001 times the cell to its left. The cells in the first column are the products of the last cells of the previous row times 1.001. The value of the cell in the first row of the first column is 1.

The first test on this worksheet was a simple recalculation. The second was the Scroll Right test, which measured how long it would take to scroll from the upper-left cell to the top cell of the rightmost column (column 100). The third test measured how long it takes to insert a row at the top of the 100-column by 25-row worksheet with the automatic recalculation turned off.

I performed each speed test three times on a plain 512K-byte IBM PC and a 512K-byte Macintosh and averaged the results. No special programs were resident in the background of each system, and I ran each spreadsheet in its standard configuration. Note that I did not test the programs on a PC AT-style IBM PC; based on past experience, I'd estimate that users of those machines can expect times to be approximately one-third of those for the standard PC.

These tests were designed to measure the performance of the programs in some common spreadsheet operations. Like all benchmark tests, they should be interpreted relative to other data.

or dBASE II formats; you might use other programs to provide some of the missing capabilities.

Multiplan uses 77 functions but only 13 macro commands. You can record a macro, but only one. You must then rename the recorded macro before you record another. The function names are quite readable and do not require the @ prefix used by 1-2-3. Macro programs can be hard to read, as the macro commands and key labels consist of an apostrophe followed by two letters.

Multiplan uses Microsoft's own menu interface, which is similar to that of Microsoft Word and all other Microsoft IBM PC applications software. I find some aspects of this interface illogical. For example, the left and right cursor keys can control the movement of the cell pointer only. This requires some unusual command-key usage; to move the cursor in the command menu, you must use the space bar or the Backspace key. To move the cursor in the command-parameter window, you use the Tab and Shift-Tab keys. When you want to edit a cell's contents, you have to use F9 and F10.

Pressing the left or right arrow key while editing a cell's contents (an understandable mistake, since many programs use the arrow keys for editing) will terminate the editing process and move the cell pointer. Since moving the cell pointer is never desirable during the editing of a cell's contents, the function of the left and right arrow keys should be restricted to moving the cursor during this process.

Multiplan's Help function does not use the F1 key; instead, you must choose `Help` from the menu or press Alt-H. The Multiplan user's manual, like that of 1-2-3, uses generic key labels. To find out what the actual key referred to is, you must look up the generic key in a key table. The use of generic key labels is not totally unacceptable because you can configure Multiplan to run on a wide range of MS-DOS computers and terminals. But, since most people will use it on an IBM-style keyboard, there is just cause to include both the generic and the IBM key names whenever keys are mentioned in the manual.

Another nice feature of Multiplan is the amount of usable memory left over after you load the benchmark files. After you load the 100- by 25-cell spreadsheet, 84 percent of memory is still available on a 512K-byte machine. After I loaded the Savage test, 87 percent was left available. Multiplan obviously stores its worksheets compactly. Finally, at a price of only $195, Multiplan represents a good value.

Silk 1.0

Silk version 1.0 for the IBM PC and compatibles ($298) from Daybreak Technologies is similar to 1-2-3 and is well-suited for time-based worksheet applications. Silk is based on a row/column design but also uses special columns and rows, called time periods and data fields, respectively. In a typical example, you might set up 12 time periods, one for each month. You can then consolidate them into quarterly or yearly summaries without having to write and copy the individual sum formulas for each line. More importantly, you can later insert other columns between the time periods without affecting the sums.

Data fields are special rows of cells to which you can attach formatting, validation, and prompting information. You can restore a data field's contents after you have accidentally or deliberately written over it.

In performance, Silk was usually second to last or last in the benchmark tests. In the Arithmetic Recalculation test, however, it finished in second place

continued

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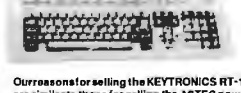

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Table 3: *Results of the spreadsheet benchmark tests. All times are in seconds.*

Spreadsheet	Savage	Arithmetic Recalculation	Scroll Right	Insert Row
1-2-3	160.2	8.9	173.2	4.4
1-2-3/HAL	161.8	18.9	173.9	6.5
Boeing CALC	547.0	20.5	48.0	10.4
Excel	34.3	4.4	51.8	3.8
Multiplan	114.7	11.6	20.3	3.5
Silk	222.3	9.9	190.3	13.0
SuperCalc4	164.0	13.2	36.4	6.7
Trapeze	196.7*	N/A	N/A	N/A
VP-Planner	148.0	12.8	22.7	29.2

* = estimated time

among the IBM PC programs.

Silk stores global constants in a pop-up table, called a form. In fact, many command parameters, such as range names, global constants, and parameters for graphics and printing (e.g., page length and margins), are stored in variations of this form. Silk uses a special mode called FMENU to let you edit the information in these windows. This mode is sometimes awkward; you cannot simply press Escape to get out of it, as you can from almost every other mode. Instead, you must first access FMENU and choose `Quit`. In spite of this drawback, forms make it easy to save, reuse, and change parameters.

Although Silk's user interface is roughly similar to that of 1-2-3, it can't read 1-2-3 files directly and can't execute most 1-2-3 macros. You first have to translate DIF and 1-2-3 files using a Silk utility. Despite the similarity between the names, Silk can't read Multiplan-compatible SYLK files.

Silk has a rather rich set of macro commands that are surrounded in brackets ([ ]) rather than the more traditional braces ({ }). Silk also has a good set of functions with fairly readable names, which do not include the @ character.

Silk lets you include comments in formulas. This capability is enhanced by a feature called PEDIT mode, which is actually a long version of 1-2-3's EDIT mode. With PEDIT, you can insert up to 2000 characters in a single cell. This could be helpful for annotating spreadsheets. Unfortunately, Silk does not include a `Range Justify` command for formatting text.

Silk incorporates a live help feature. Once you call it, the Help window automatically updates itself as you move from one situation to another. Daybreak Technologies recommends that beginning users engage this feature continuously. This feature slows the system down and reduces the viewable area of a worksheet by one-half, however.

To safeguard against data loss due to a power failure or some other accident, you can configure Silk to keep a keylog file on disk. Silk stores the information on each key you press on the default disk. Should a power failure occur, you can return to your worksheet as it was just before the failure by executing the keylog file. Be careful when you modify and save a file, however, since the keylog will expect the original file, not the new saved version. You would probably most often use the keylog feature for recording macros. Silk also has an instruction for uploading a keylog file into a range of cells that you can then name as a macro.

Silk appears to have a number of enhancements over versions 1A and 2.01 of 1-2-3 and is a fairly good value at $298.

SuperCalc4 1.0

SuperCalc4 version 1.0 for the IBM PC and compatibles ($495) from Computer Associates International has evolved along the lines of 1-2-3 and has many of the same features, but it outdoes 1-2-3 in many areas. One area in which it outperforms 1-2-3 is the Scroll Right test, mostly because of 1-2-3's sluggish performance in this benchmark. The error count in the Savage test was a fairly normal 10^{-8}. Note, however, that SuperCalc4 does not use BCD numbers in its arithmetic calculations. For extra speed on the 8087 coprocessor, the program uses 15-digit floating-point numbers exclusively, rounding off the last three digits before using the numbers for comparison. The maximum effective accuracy is then 12 digits, instead of the 15 digits of most other programs.

SuperCalc4 can use expanded memory and can link worksheets in a manner similar to 1-2-3, but it has no special networking or multidimensional capabilities. To make report-generating easier, a utility program called Sideways, which prints extra-wide spreadsheets sideways on most common printers, is bundled with SuperCalc4.

SuperCalc4 has 92 functions and 46 macro commands. Functions do not begin with an @, yet the program can easily distinguish labels from functions. Despite the large number of functions, none are for accessing text. The program can import 1-2-3 and DIF files. SuperCalc4 can learn macros by storing keystrokes into a range of cells. If you are not careful, however, it is easy to overload this range: What is not made clear to the user is that keystrokes are stored in a single vertical column, and, therefore, the width dimension of the range the user specifies is ignored.

SuperCalc4's program structure is composed of a series of overlay files. The documentation labels each file. Users who do not have a hard disk should be able to trim the unnecessary overlays and fit most of the desirable parts of the program onto a single floppy disk.

[Editor's note: *The author was unable to obtain the latest release of SuperCalc4, version 1.1, in time for this review.*]

Trapeze 1.0

Trapeze 1.0 for the Macintosh ($295) from Data Tailor seems to have done away with the rows and columns of all other spreadsheet programs. In their place, it uses *blocks* of data. Each block can contain a single value, a row or column of values, or a table of them. You can use blocks in the way that you use ordinary cells or ranges in other spreadsheets.

Trapeze incorporates 127 functions, including an inverse Gudermannian function and a polynomial least-squares regression function. The functions all use blocks for input and output, and the blocks can be single values or arrays. Some functions even create graphs.

Trapeze is so different from other spreadsheets that I had trouble testing it with the standard benchmarks, which are all designed for more conventional spreadsheet programs. For example, the Savage test consists of 1000 cells arranged in a column, with each cell being a function of the cell above it. To duplicate this benchmark in Trapeze, I would have had to set up 1000 blocks, which would have been laborious, since Trapeze does not include any macro features.

I was, however, able to emulate the 1000 steps of the Savage test by setting up a circular array of 10 blocks and iterating it 100 times. I was unable to implement the other standard benchmark worksheet, a 2500-cell table in which each cell is a function of the cell to its left. Thus, I did not run the three tests that are dependent on the worksheet (see table 3).

The results of the improvised Savage test suggest that Trapeze is not particular-

ly fast, but it is possible that much of this slowness is due to the overhead processing required by the iteration logic.

Another area of difference from other spreadsheets is Trapeze's command interface. Trapeze departs significantly from Excel and uses an interface that depends heavily on icons. Learning all the icons can require some time.

Although it is not the end-all of spreadsheets, and it might not lend itself to certain applications, Trapeze has enough interesting and unique features to merit a place in many offices.

VP-Planner 1.3

VP-Planner 1.3 for the IBM PC and compatibles from Paperback Software International has received a considerable amount of attention as an inexpensive ($99), non-copy-protected clone of 1-2-3 version 1A. As with any clone, however, in some ways it outshines the original.

As of this writing, Lotus Development Corp. has filed suit against Paperback Software over infringement on Lotus's rights to the 1-2-3 user interface. Although VP-Planner's interface is similar to that of 1-2-3, it is clear that its programmers spent a great deal of time ensuring that the visual similarity of the two products was small. In at least one respect, Paperback Software has actually improved the interface. The VP-Planner interface indicates the definitions of all the function keys and graphically indicates the address of the cell pointer.

In terms of performance, VP-Planner is fairly good. In the benchmark tests, it usually finished among the top four or five programs. The exception is the Insert Row test, where it finished dead last. The program scored second among IBM PC-compatible programs in the Savage test and featured the lowest error count of all programs: 10^{-12}.

I found VP-Planner to be a good emulation of 1-2-3 version 1A. It has 59 functions and only nine macro commands. The only problems I noticed were minor. For example, on some occasions, long labels would not extend completely across the screen. This seems to be a program bug, as I was not able to associate the problem with any particular function.

In addition to being a close clone of 1-2-3, the program also has some features not found even in 1-2-3 version 2.01. VP-Planner can record macros and access information from a dBASE II file. The program advertises a five-dimensional database that you can link to a worksheet. Although this is a significant enhancement over 1-2-3, it uses a completely different user interface and is rather difficult to work with. All database parameters must be defined prior to the start of the spreadsheet session, and the screens used to define these parameters bear no resemblance to existing spreadsheet user interfaces and are difficult to understand at first.

At $99, VP-Planner is a good value.

A Wish

All nine programs exhibit at least one state-of-the-art feature, and each might be particularly well-suited for a given application.

After looking at all these programs, I wish that one product could combine all these features. It would have the popularity and support of 1-2-3; the natural-language interface of HAL; the three-dimensional capabilities of Boeing CALC; the speed, graphics, and flexibility of Excel; the time-series modeling capabilities of Silk; the compact code size of SuperCalc4; the functions and array-processing power of Trapeze; and the low price of VP-Planner. In the real world, such features would probably be mutually exclusive—at least for the immediate future. ■

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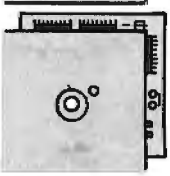

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From the Open Access II Network File

A crowd is gathering in front of the boat yard as *Stars & Stripes '86* is maneuvered into a stall at Driscoll Boats on Shelter Island, San Diego. World renowned 12 meter racing boats are a common occurrence at Driscoll's and the craftspeople go on about their business of repairing and constructing sleek racing and sailing boats. Driscoll Custom Boats, well known for its state of the art craftsmanship, is also known as one of the most efficiently run businesses on the Island. At the controls is Tom Driscoll, and the controls are Open Access II Network Software.

Tom's father, Gerry, started their boat yard back in the early '40s. Times have modernized boat building techniques, but not the business procedures of most yards. Few boat yards have been computerized, fewer still are sophisticated enough to have LANS; the exception is Driscoll Boats. Tom, having computerized in the early '80s, saw the effectiveness of having PCs at strategic locations throughout the yard to keep everyone continuously updated. He installed a four station network using 3Com's Etherlink cards and Novell's Advanced Netware 286.

Already an avid Open Access II user, he installed Open Access II Network Software on his network. Open Access II Network consists of a relational Database with programming, multi-user Spreadsheet with 3-D Graphics, Word Processor, Communications, and Pop-Up Desk Accessories.

Now, as materials go out of the stockroom they are charged to a specific job. As carpenters accumulate hours on finishing, the hours are logged in to the jobs as well as their individual timecards. Estimates are compared to actuals in daily reports. Customers are kept informed as their job progresses.

"Boat repairs and renovation are labor intensive. Customers want to see who worked on what, where and when. Using Open Access II Database we can give them an itemized, exact billing of everything that went into their boat." Tom grimaces as he recalls, "We used to do that all by hand. What a nightmare! Now I join five files together to build an invoice in a couple minutes; it used to take all day."

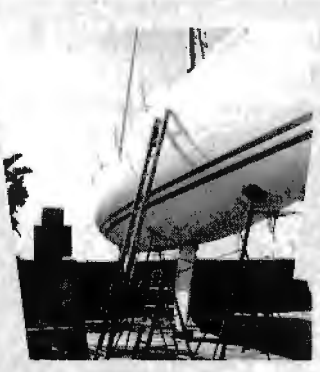
Most boat yards have a fixed rate for labor. However, using the calculations available in Open Access II Tom figures wage, overhead, insurance, workmen's comp and can charge labor at a variable rate dependent of skill level.

"The beauty of Open Access II is that we could develop sophisticated programs that are easy to execute. Even my brother Joe (he hates computers) can run them," Tom laughs. "SPI's support is the best I've seen. They've guided us through a lot of questions. They are very patient and very available."

Tom's sister Mary-Carol uses the Spreadsheet Module for payroll calculations and accounts payable/receivable worksheets. The entire family gets on the network and with a few key strokes can generate reports on labor, customer accounts, actuals vs. estimates, materials, and more. With Open Access II Network they can all be working in the Database at the same time in the same files. If they are in Spreadsheet they can see each other's figures updated simultaneously. All the information is gathered together and reports and correspondences are written in the Word Processor.

The next step in the automation of Driscoll Boats? Tom wants to add a Compaq Portable III to the other Compaqs on the network. Then, using the Open Access II Communications Module, he can work from anywhere — even the high seas.

"I'd Be Sunk Without Open Access II Network Software"



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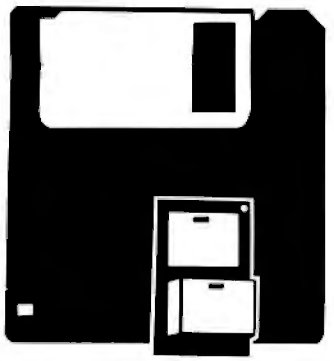

Database Managers

A sample of the latest products for MS-DOS and the Mac

Q&A 2.0
ALPHA/three
Reflex 1.1
OverVUE 2.0d
FileMaker Plus 2.0
Powerbase 2.3
Universal base SIX 6.6
R:BASE System V
Paradox 1.1
Reflex 1.01
Omnis 3 plus 3.24
Double Helix

■ **Charles Spezzano**

Deciding what is state of the art in database management is a bit like picking the best cars in the world. The answer depends on the specific needs of the driver: where he wants to go, how fast he needs to get there, and how many people and things the car is carrying. As database management software has evolved, two main categories have emerged, and I can make a reasonable attempt to identify the state of the art in each one.

I will draw the dividing line between programs that manage one file of records at a time, usually called *flat-file managers* or simply file managers, and those that can manipulate multiple files, usually called *relational managers*.

This article will identify what is innovative and excellent in database management applications. The focus is on the direction in which database management software is evolving and on those programs that are leading the way.

I'll take a look at a dozen database packages: Q&A 2.0 for $349, ALPHA/three 1.0 for $395, Reflex 1.1 for the PC and Reflex 1.01 for the Macintosh (at $149.95 and $99.95, respectively), OverVUE 2.0d for $295, FileMaker Plus 2.0 for $295, Powerbase 2.3 at $295, Universal base SIX 6.6 at $395, R:BASE System V 1.0 for $700, Paradox 1.1 for $695, Omnis 3 plus 3.24 for $495, and Double Helix for $495.

File Managers

Flat-file databases are so called because they organize data into simple two-dimensional tables that resemble spreadsheets. Each row is a record, and each column is a field. When the data appears on-screen, you can organize it into forms with the fields relocated to positions similar to paper forms. Because file managers work with only one file at a time, you must close the first file to see records in another. Similarly, you cannot pull data from two files into one report.

Despite these limitations, the file managers reviewed here are efficient tools for many business and professional computing tasks. Each has some feature or combination of features that places it on the cutting edge of software development in this category. See table 1 for an overview of these file managers; see the text box "The Database Benchmarks" for details on the benchmark timings.

Q&A

Q&A directly challenges PFS:Professional File in the category of simple and easy file management systems, and it wins. Q&A has menus, prompts, and procedures that will be familiar to any PFS user. The procedural similarity starts with the "paint-the-screen" system (that is, you can place the fields anywhere you want on the screen), made popular by PFS, for positioning fields on input forms. It also ends there. One of the reasons PFS is so simple is that it limits your options: Defining a field involves nothing more than naming it. This means that all fields are "garbage" fields: You can put anything into them, regardless of what you intended them to hold. Q&A asks you which of seven types of data will be acceptable for each field. Among these is a powerful keyword field type that accepts multiple values.

Once you've created a basic form design, Q&A lets you add many custom features that make data entry and updating easier, quicker, and less error prone. The Global Format Options menu lets you specify a format for values that you will enter into number, money, time, and date fields. Unique fields avoid accidental duplication of data, such as social security numbers. You can index fields that you use often for searches. Q&A's programmable forms capability lets you enter programming statements into fields so that

continued

Charles Spezzano (950 East Harvard Ave., Denver, CO 80210) has a Ph.D. in clinical psychology and has written books on computers and psychology.

the program automatically performs many tasks a typist would have to do manually with PFS:Professional File, such as calculate field values, look up values in tables, figure out overdue dates, or move the cursor from field to field.

Q&A's report generator, like the one in PFS:Professional File, takes information from a file and prints the results in columnar form. However, once you get beyond the basics, Q&A again parts company with PFS:Professional File. For example, PFS always positions fields on the output form in the same order as they appear on the input form. That is, how you define the input screen determines your output form. Q&A lets you put fields where you need them for your report.

Whether you're designing a database file, searching for records, or generating reports, Q&A offers the simplicity that made PFS's file management programs so popular, while adding a level of power and flexibility that makes it a state-of-the-art product rather than something to practice with while you get ready for more powerful filing applications.

ALPHA/three

Don't evaluate ALPHA/three, at $395, as a lower-cost alternative to extra copies of dBASE where dBASE III is the standard. It's not meant to compete with the top-speed, fully relational, command-language-driven programs that can handle a virtually unlimited number of records and files. It's a flat-file manager that compares only with other programs in that category, and its compatibility with dBASE files is just icing on the cake.

ALPHA/three does have a few state-of-the-art extras that give it a distinctive, standout personality among file managers. To begin with, it provides several multifile management capabilities. When you use the Post command, values from a source field in one file can be added to, subtracted from, or substituted for the current value in a target field in another file. The Join, Intersect, and Subtract commands let you join two files to create a composite third file, join only records that exist in both files, or create a new file of records from those that have no matches in the original files.

In addition to the usual character, numeric, date, and logical fields, ALPHA/three offers uniquely designed calculation and memo fields. You can construct equations for the calculation fields from a pop-up menu of 57 built-in functions. Memo fields attach 5000-character text notes to each record. The contents are stored in a separate file, and a pointer in the record forms a link to its memo. Only records with memo-field entries take up disk space in the memo file. This two-part system avoids having large memo fields slow down manipulation of the main records. Because ALPHA/three lets you search for a character string anywhere in a memo field, it can double as a text database.

ALPHA/three facilitates fast, accurate data entry. Formatting templates automatically arrange social security and telephone numbers. To protect against errors, you can designate fields as unique, specify range checks for numeric and date fields, or set default values that the program automatically enters into a field. You can create prompts that appear at the bottom of the screen when the cursor enters a field. Unlike other programs with data-validation features, ALPHA/three lets you build in the option of allowing exceptions to rules.

ALPHA/three's searches are quick and simple. The Find and Locate commands work with a single search criterion. The Find command searches for exact or partial matches based on the index field. The Locate command searches any field. Find is faster, but Locate is more flexible. For more complex searches, you use the Search Data command. You can specify up to 15 search conditions, including ones for phonetic searches. You can also save search criteria for reuse. Although the program does not have a procedural language, you can use its 57 functions to build queries with relational and logical operators. When the search is complete, the program keeps the found records in a temporary file that you can subject to further searches. You can also edit and save the search file for later use.

The program provides two methods for setting up search criteria: table mode and equation mode. Table mode is a variation on the increasingly popular query-by-example method, highly touted in Paradox (described later). Menu-driven pop-up lists of available field names and operators aid the process. You can pick a field and an operator from the lists and enter the value or character string to which the operator is to be applied. You can also use AND or OR to create compound search statements involving up to 20 fields. A phonetic operator finds close matches for misspelled text strings.

One of ALPHA/three's high points is its flexible full-screen visual report generator. It lets you easily design custom reports, using either the quick setup option or a freeform layout feature. The report writer will also automatically calculate sums, averages, counts, maximums, and minimums for specified fields.

The form-letter generator lets you create variable-text form letters using either the built-in editor or your word processor. It generates conditional paragraphs, triggered by the values of specified fields in the record, letting you customize invoices according to the status of the account and other factors.

ALPHA/three's flexible form-letter generator and ability to join and manipulate data from separate files rank it as a state-of-the-art file manager.

Reflex for the IBM

Two years ago, Reflex set a new standard in one area of file management, and no product has yet surpassed it. The area is not financial or statistical analysis of data, despite Reflex having more built-in functions than most file managers. It's viewing the data. Before Reflex appeared, most file and database managers showed you your data one record at a time, like PFS, or in a list, like dBASE. This never made sense: To use your data for all it's worth, you must be able to manipulate it on-screen. To facilitate that, Reflex comes equipped to import data from 1-2-3, dBASE II and III, and PFS:Professional File.

Reflex offers five different ways to look at data. The Form View lets you enter data and examine it one record at a time. The List View displays records in a spreadsheet-like table. The Graph View provides instant and dynamically interactive scatter, line, bar, stacked bar, or pie charts. The Crosstab View cross-references the data in two fields of a file—such as the salesperson and model-sold fields of a purchase-order file—to uncover previously hidden relationships, such as how many of each car model each salesperson sold. The Report View lets you generate labels and reports with breakpoints and calculated fields. Unfortunately, to use it you must exit to DOS and run the Report utility.

Reflex is so good at displaying data in interesting and informative ways that it might serve as a "sidekick" to spreadsheets and other database managers. Table 2 shows how Reflex compares to the other applications in displaying data. [Editor's note: *The current version of Reflex for the IBM PC is 1.14. The new version has a rewritten manual.*]

FileMaker Plus

FileMaker Plus does everything you expect from a file manager in the easiest and most efficient way possible, and adds an unsurpassed forms-generation capability. Everywhere you look is a feature that makes this program the standout Macintosh file manager.

Summary fields display the kind of data most programs make available only in reports. While you are browsing through a group of records, the summary

continued

Table 1: *The five file managers reviewed. ALPHA/three does not use a sort command, relying instead on its indexing capabilities. Reflex and OverVUE don't have indexing capabilities, so no benchmark times are shown. FileMaker Plus automatically indexes data as you enter it, so no index benchmark times exist for this application.*

	Q&A 2.0	ALPHA/three 1.0	Reflex 1.1	FileMaker Plus 2.0	OverVUE 2.0d
Machine	IBM PC, XT, AT and compatibles, PS/2	IBM PC, XT, AT and compatibles	IBM PC, XT, AT and compatibles	Mac 512K, 512KE, Mac Plus, XL, Mac II, Mac SE	Macintosh
Program Limits					
Maximum characters/field	1679	254	254	250	62
Maximum fields/record	2182	128	250	Disk space	64
Maximum records/file	16 million	65,565	65,520	Disk space	RAM
Maximum record size (bytes)	16,780	4048	32,512	Layout size (36 by 36 inches)	3968
Field Types	Text, Number, Money, Keyword, Data, Hours, Yes/no	Character, Numeric, Data, Logical, Memo (5000 characters)	Text, Data, Numeric, Repeat Text, Integer Date	Text, Date, Picture, Calculations, Summary, Numeric	Anytext, Alphabetic, Alphanumeric, Numeric, Money, Phone, Date, Time, Yes/no
Selecting specific records					
Query by example	Yes	Modified	Yes	Yes	No, enter by column
Compound AND/OR/NOT searches	Yes	Yes	Yes	Yes	Yes
Phonetic searches	No	Yes	No	No	No
Wild card searches	Yes	Yes	Yes	No	Yes
Save selected subset	No	Yes	Yes	No	Yes
Save query	Yes	Yes (up to 256)	No	Yes	No
Indexing and sorting					
Number index fields	115	5	N/A	Automatic	N/A
Number sort fields	512	N/A	5	Disk space	64
Compound indexes	No	Yes	N/A	No	No
Number of spreadsheet functions available for calculations	17	57	43	33	27
Multiple file-handling capabilities					
Maximum files open	1	2	1	8	1
Join two files on a common field	No	Yes	No	No	Yes
Look up data in another file	No	No	No	Yes	No
Use data in another file to calculate a field value	No	No	No	Yes	No
Multifile reports	No	No	No	No	No

continued

Table 1: *Continued.*

	Q&A 2.0	ALPHA/three 1.0	Reflex 1.1	FileMaker Plus 2.0	OverVUE 2.0d
Report capabilities					
Report design methods	All reports in column format Mail merge available Derived columns	Quick setup report Default layout	User positions field No automatic report Preview on screen	Automatic column reports Freeform reports Summary reports Lines, boxes, and graphics reports	Print spreadsheet Custom formats Graphics and charts
Report formats can be saved (# formats)	100	26	Unlimited	Unlimited	8
Headers	Yes	Yes	Yes	Yes	Yes
Footers	Yes	Yes	Yes	Yes	Yes
Sort levels	100	Indexes replace sort command	5	Unlimited	64
Number of labels across	8	6	1	99	4
Data transfer					
Imports	pfs: File, IBM Filing Assistant, 1-2-3, Symphony, ASCII, DIF, dBASE II and III, IBM WordStar	1-2-3, Symphony, dBASE II, III, III Plus, pfs: File, SYLK files, ASCII, DIF files, (VisiCalc)	ASCII, DIF, dBASE, SDF, 1-2-3, pfs: File, Symphony	ASCII, BASIC, SYLK	1st Base, ASCII, DB Master, DIF, MacWrite, MS-File, MS-Word, Multiplan, Helix, Omnis, pfs:.File, SYLK, dBASE II
Exports	ASCII, DIF, dBASE II, III	Same as imports MultiMate	ASCII, SDF	ASCII, BASIC, SYLK, MS-Word, Merge document	MacWrite, MS-File, MS-Word, Multiplan
Documentation	587-page manual	761-page manual	492-page manual	317-page manual	332-page manual
How many disks	5	5	3	3	1
Minimum RAM	512K	320K	384K	512K	128K, 512K preferred
Benchmark speeds					
Index 500 records	12.5	21	N/A	N/A	N/A
Sort 500 records	9.4	N/A	3.5	27.5	4.75
Find 1 of 500 non-indexed records	1.2	2	1	2.5	N/A
Find 1 of 500 indexed records	Instahtaneous	Instantaneous	N/A	2.5	N/A
Price	$349	$395	$149.95	$295	$295

field shows the total, average, count, minimum, maximum, or standard deviation of the values in the field you specify for all the records in the file or all the ones you just selected to view or edit.

A sophisticated set of options lets you view records in whatever way will be most informative, and you can look at eight files at once. You can choose to have FileMaker display records one at a time or in a continuous list with fields arranged in columns. When you view records separately, a book icon with a slide handle in the left margin speeds up sequential browsing or lets you go directly to a specific record.

FileMaker has a facility called *scripts* to streamline the process of performing repetitive tasks. Scripts remember precisely where you are in the program at any moment and what is being done. Once stored, they can return you to that point of operation with a click of the mouse.

Like ALPHA/three, FileMaker straddles the border between file managers and multifile managers. A powerful look-up feature will retrieve information from another file and copy it into the currently active file as you add or update records. In addition to simple lookups to avoid repetitive typing of addresses or part descriptions, FileMaker can look up information based on a value that is calculated in the current file. For example, you might have a calculation field that sums values in a price field to get a subtotal of purchases. You can have FileMaker look up the discount percentage in a separate

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Table 2: *The capabilities of each database manager to display data. Note: Reflex for the IBM PC can also display data in a report, but you must leave Reflex and run a utility program to do this.*

Product	One record at a time	Spreadsheet	Graph	Cross tabulation	View related files	View multiple files	Multiple views of file
Q&A	•	•					
ALPHA/three	•	•					
Reflex (IBM version)	•	•	•	•			
OverVUE	•	•					
FileMaker Plus	•	•					
Powerbase	•	•					
Universal base SIX	•	•					
R:BASE System V		•		•	•		
Paradox	•	•				•	•
Reflex (Macintosh version)	•						
Omnis 3 plus	•						
Double Helix	•						

• indicates that the application has this feature

file based on the subtotal in the current file.

FileMaker eliminates two of the most error-prone decisions you might make for data entry. It doesn't force you to specify a field size ahead of time, nor does it demand that you decide which fields to index. Number and calculation fields will automatically expand to accept up to 250 characters, and text fields stretch out to 32,000 characters. FileMaker automatically indexes every word, number, and date you enter. The penalty for this flexibility is that lots of indexes take up lots of disk space.

No file manager designs report forms better than FileMaker. Just as a picture field lets you paste graphics images into your records from the Clipboard, you can import graphics to dress up report forms. You can also add any number of lines and boxes to any layout, not only to box in a field or group of fields, but also to create flow-chart templates, rules for tables, and borders.

This ability to produce customized reports, the flexible field format, and the utility of the summary field to assist you in examining the data make FileMaker state of the art.

OverVUE

OverVUE might be characterized as the spreadsheet of Macintosh database programs. Instead of showing you one record at a time on-screen, it displays fields in column format with one record to a row. Even the manual's language suggests OverVUE's roots in the world of spreadsheets. The set of rows and columns is called a data sheet, and an item in a record is called a data cell rather than a field. In addition to the usual simple spreadsheet functions (+, −, *, /), OverVUE can perform over 20 special functions within an equation. Like spreadsheet functions, these perform calculations on dates and times, find the length of text, test data, and perform various numeric operations.

OverVUE's data structure lets you analyze data more quickly and easily than most databases, and more like a spreadsheet. If, for example, your ticket agency had its available tickets sorted by date and you wanted a count of the number of tickets on hand for all events at Carnegie Hall, you would choose the Sort Up command from the analyze menu. Now all the tickets for events at Carnegie Hall are grouped together. Next, you choose the Group command from the analyze menu. This separates the groups from each other by inserting lines with each location name into the records associated with that location. It also lets you perform operations on these groups. The Count command, for example, will insert a record count for each location on the same line. If you now choose the Select Summaries command, OverVUE will display a list of all locations and the total number of tickets for each.

Making four choices from the appropriate menus has taken you from a chronologically ordered display of records to a summary report of tickets by location. This example captures the unique blending of database sorting and selecting capabilities into a spreadsheet structure that gives OverVUE its power as a data analyzer.

Although entering data is much like filling in a spreadsheet, OverVUE offers a host of features to make the process smoother. Value Bars let you specify a fixed set of choices for a column where only a few values are valid, and then select them for automatic insertion rather than keying them in again and again. The No Unique and No Duplicates features will, respectively, warn you if you mistype a new value into a column that shouldn't have any variety, or attempt to enter the same social security number in two different employee records.

A final set of time-savers comes in the form of two tasks you don't have to do with OverVUE. You don't have to specify the length of a field, and you don't have to create indexed fields. You can always enter up to 62 characters in any data cell no matter what you have set its display width for in the data window, and you can sort any field quickly without indexing.

You might object to OverVUE's presence in the file manager category, because it is often identified as a "fully relational" program. OverVUE's claims to relational-database status rest on its ability to join two of its data spreadsheets. This operation begins by creating a relation file with a word processor. This simply consists of one line of text for each pair of related fields, but you must leave OverVUE to create it unless you have installed a text-editing desk accessory such as MockWrite. You specify one of the column pairs common to the two sheets

continued

as the "link" pair by listing it first.

While this operation lets you relate fields in one file to fields in another file through a common linking field, the link is not dynamic. You are creating a third file not connected to the two that spawned it. If you change the information in either of the linked files, you must update it in the newly made join file or perform the join again.

OverVUE's speed, ease of use, ability to join files, and capacity to speed up numerical and financial data analysis with spreadsheet functions and macros combine to make it a state-of-the-art Macintosh file manager. [Editor's note: *The current version of OverVUE is 2.1a. This version fixes some bugs and features*

Table 3: *The seven relational database managers reviewed. Double Helix did not have a sort command, so no benchmark time is shown.*

	Powerbase 2.3	Universal base SIX 6.6	R:BASE System V	Paradox 1.1
Machine	IBM PC, XT, AT	IBM PC, XT, AT and compatibles	IBM PC, XT, AT and compatibles, PS/2	IBM PC, XT, AT and compatibles
Program Limits				
Maximum characters/field	80	80	4092	255
Maximum fields/records	64	65	800	255
Maximum records/file	65,530	Unlimited	Unlimited	65,000
Maximum record size (bytes)	1600	1024	4096	4000
Field Types	Text, Numbers, Money, Date, Yes/no	Text, Numbers, Money, Date, Time	Text, Numbers, Date, Time, Integers, Currency	Alphanumeric, Number, Dollar, Date, Short number
Selecting specific records				
Query by example	Yes	Yes	No, uses where clauses	Yes
Compound AND/OR/NOT searches	Yes	Yes	Yes	Yes
Phonetic searches	Yes	Yes	No	Yes
Wild card searches	Yes	Yes	Yes	Yes
Save selected subset	No	Yes	Yes	Yes
Save query	No	Yes	Yes	Yes
Indexing and sorting				
Number index fields	6	5	800	255
Number sort fields	64	9	10	255
Compound indexes	Yes	Yes	No	Yes
Number of spreadsheet functions available for calculations	5	None	70	100
Multiple file-handling capabilities				
Maximum files open	25	10	80	Unlimited
Maximum files that can be merged	2	20	5	Unlimited
Look up data in another file	Yes	Yes	Yes	See Other entry
Use data in another file to calculate a field value	Yes	Yes	Yes	See Other entry
Multifile reports	Yes	Yes	Yes	See Other entry
Other	10 levels of zoom links between related files	Posting	Link one file to multiple files	Enter data into multiple files with one form. Use one form to update records in multiple files. Query for multiple files. Generate report.

some enhancements, such as printing reports to disk.]

Relational Database Managers

When E. F. Codd developed the relational model of database management at IBM in the late 1960s and early 1970s, he didn't foresee the Pandora's box he was opening. In his model, "relational" meant something specific: Records are conceptualized as rows in a spreadsheet-

continued

Reflex for the Macintosh 1.01	Omnis 3 plus 3.24	Double Helix 1.0
Mac 512K, Mac XL, Mac Plus, Mac II	Mac 512K, Mac Plus Mac II, Mac SE	Mac 512K, 512K Mac Plus
Text, Number, Integer, Date, Time, Yes/no, Sequence number	Text, Number, Yes/no, Date, Time, Sequence character	Text, Numbers, Pictures, Dates, Yes/no
254	12	Unlimited
254	9	Unlimited
Yes	Yes	Yes
16	12	Unlimited
16	24	8
Yes	Yes	Yes
Yes	Yes	No
Yes	Yes	No

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Table 3: *Continued.*

	Powerbase 2.3	Universal base SIX 6.6	R:BASE System V	Paradox 1.1
Report capabilities				
Report design methods	Column format report printscreen	Quick reports Custom reports Form letters	Automatic reports Custom reports 10 subtotal levels in reports	Standard row-and-column report Freeform reports
Report formats can be saved	Yes	Yes	Yes	10
Headers	Yes	Yes	Yes	Yes
Footers	Yes	No	Yes	Yes
Sort levels	5	9	10	16
Number of labels across	9	9	1	1
Data transfer				
Imports	ASCII, Word Perfect, DIF, dBASE II, III, pfs: File, SDF, Symphony, SYLK, Multiplan, 1-2-3, Multimate	ASCII, DIF, SDF	ASCII, DIF, dBASE, 1-2-3, TAC, pfs: File, SYLK, Symphony, SDF	1-2-3, Symphony, dBASE, pfs: File, VisiCalc, ASCII
Exports	Same as imports	Same as imports	Same as imports	Same as imports
Documentation	500-page manual	195-page manual	900 pages in three manuals	841 pages in three manuals
How many disks	5	5	11	5
Minimum RAM	384K	192K	512K	512K
Benchmark speeds				
Index 500 records	45	72	13	6
Sort 500 records	35	N/A	3.6	3
Find 1 of 500 non-indexed records	2.1	17	2	2
Find 1 of 500 indexed records	1.7	1	1	1
Price	$349	$395	$700	$495

like table. In the hands of public-relations specialists, however, relational has come to mean "powerful and flexible," and any program that can link two files in any way wants to be identified as relational.

In Codd's model, each column in the row is a *field*, and each cell contains a *field value*. A record might not display exactly that way on the screen, but a relational program treats the data internally this way. The advantage of this tabular arrangement is its potential for taking in fields from another table and, conversely, for breaking down a larger table into several smaller, but related, tables. The key to such flexibility is the common linking field. That is, you can combine all such records in different tables that share the same value in the same field into one larger table.

The relational model lets you set up files with a manageable number of fields and then pull data from certain fields in selected files for viewing, editing, calculating, or reporting. It's simple and elegant, as many great ideas are. However, it's not functionally sufficient to be considered state of the art in 1987. Many software developers have built into their implementations of the relational model shortcuts that eliminate the need for you to first combine files in order to relate them. Or they have found ways to extend the basic relational model's capabilities for multifile data management, retrieval, and reporting. Table 3 presents a summary of the database packages examined here.

Powerbase

Relational programs link files. Some do it better than others. Powerbase does it with a set of commands—Zoom, Function, and Lookup—that make it the state-of-the-art product for immediate access to linked records and for controlled transfer of data from one file to another. Even a new user can quickly learn to link up to 10 files into a sophisticated network of data.

Zoom lets you treat two files as if they were one. It provides instant access to related records in another file. You can Zoom from one file to another while adding records to a database. A Zoom performed while in Add-Data in the source file places you in Add-Data in the target file. The target field will be automatically filled in with the Zoom value for each record that you add.

You can also Zoom from one file to another while you are editing records. You can establish up to 10 levels of Zooms between related files. A file can have multiple Zooms. A source field can be related to only one other file, but you can create dummy copies of that field in the source file, and these can establish Zoom links with other files. You can set up a Zoom in

Reflex for the Macintosh 1.01	Omnis 3 plus 3.24	Double Helix 1.0
Automatic spreadsheet reports Customized layout reports	User positions fields on screen Grid	Uses icons and visual design tools to create forms
Yes	Yes	Yes
Yes	Yes	No
Yes	No	No
All fields in report	None	Unlimited
1	1	1
ASCII, Clipboard, Mail Merge	DIF, SYLK, ASCII, Cricket Graph	ASCII
Same as imports	Same as imports	ASCII
327-page manual	605 pages in two manuals	534 pages in three manuals
2	4	3
512K	512K	512K
10	44.3	89.5
9	N/A	N/A
3.1	1.6	2.0
2.7	1.0	1.0
$99.95	$495	$495 single user; $595 multiuser; $100 each additional user

each direction between two files. And you can use all Zooms to create multifile reports.

A Lookup field automatically retrieves its value from one record in another file. A Function applies a statistical function to values from a number of records in another file. The available statistical functions are sum, maximum, minimum, average, and count.

Powerbase also offers a complete array of high-end database features. It is fully menu-driven with a command mode that lets experienced users move through menus quickly. It offers flexible searching through a query-by-example system that lets you go directly to the record you need, and it has a flexible report generator that handles data from as many as 10 files with multiple sort levels. You can easily customize mailing labels, and a Quicklist feature provides fast, on-screen reports that you can preview before printing. Each file can have up to six indexes. Global update lets you revise multiple records simultaneously.

The fact that Powerbase does all this, and more, without the use of a programming language makes it unique among all available databases.

Universal base SIX

Universal base SIX is the only relational database manager that relates files automatically, without table-joining commands, equations, or programming-language statements. SIX also performs automatic joins for data entry, reports, labels, and queries.

The key to this automated file relating is the indexed field. On any SIX data-entry form, an indexed field automatically owns all the fields below it. This ownership extends to all files throughout the database in which the owner-index appears above the owned field on the data-entry form. This system, called universal relational technology, yields several benefits not available with other relational schemes.

Once you enter data on a data-entry screen, you never have to retype it. You can recall it on any other screen simply by designing future screens to include the original's indexed item(s) and any of the dependent items you want. If, for example, a client's indexed account number is followed by the client's name and address on one data-entry screen, as soon as you enter the account number on any other data-entry screen where the name and address fields follow the client account number field, the correct name and address for each client will be automatically recalled. You can recall data for any item, provided it depended on indexed items in the previous screen.

The second benefit of universal relational technology is automatic updating. When you change data, it changes throughout the database. All screens that contain that field with that item of data in it will show the new value even though you enter the change on only one screen. This can be a double-edged sword. For example, if you change the unit price for a product in your inventory, as soon as you change it on the inventory data-entry form, it will change on all invoices where the indexed product number is followed by the unit-price field for that product.

Another benefit of SIX's universal relations is data integrity. You can enter only one set of information for each value of an indexed item. You can't shut this off in SIX, and that might tie your hands in ways you don't like. It does assure that only one customer record exists for each customer number and that a customer's address is current everywhere in the database.

The final benefit involves reporting dependent data. SIX's automatic indexing lets you include data from multiple files in one report. A report can include any data items that are dependent on the same set of indexed items. This is true whether or not you include the indexed items in the report. Joins are always made dynamically at run time, so that only those records used for the immediate task are joined. SIX does all this simply and easily, as it is menu-driven.

As you enter data, SIX can automatically recall data, post data from one field to another, and perform predefined calculations. SIX's data-formatting and validation features ensure that information is entered according to your specifications. You can find and display any record at any time simply by filling in the values of its indexed fields on a data-entry form.

continued

The Database Benchmarks

The benchmark file is an ASCII text file made up of 501 records with 16 fields of data. The benchmark starts by importing the file, unsorted and unindexed, into the application. The program displays the first record. It performs a timed find on the last record. Next, the program performs a timed sort on an unsorted field. Finally, it indexes a field and performs a timed find-last-record command in the indexed field.

For the MS-DOS applications, the benchmarks were run on a NEC APC IV (AT compatible) running at 8 megahertz. This machine uses a 40-megabyte hard disk. The Macintosh benchmarks used a Mac Plus with a DataFrame XP Twenty hard disk. The application was loaded into a RAM disk and the files were kept on the hard disk. The author gratefully acknowledges the help of Chip Luther of CW Electronics in obtaining some of the Macintosh benchmarks.

This method provides instantaneous retrieval. Or you can use SIX's query module to retrieve sets of records that match selection criteria for specified fields.

Universal base SIX's file-relation capabilities, combined with its dynamic updating of the database, make it a state-of-the-art application.

R:BASE System V versus dBASE III Plus

Choosing between these two programs is a matter of timing. At any given moment, one of them takes the lead in state-of-the-art features for high-powered IBM PC relational database applications. This is the territory where software publishers face the challenge of satisfying the programmers who develop customized database management systems for Fortune 1000 corporations, while at the same time seducing professionals, managers, and small-business owners who want to set up multifile applications without writing a single line of program code. Whenever Microrim upgrades R:BASE to outdo the latest version of dBASE, Ashton-Tate fires back with a more powerful package.

Ease of use can be a misleading term when you're talking about developing customized turnkey applications. Good database models don't just appear on-screen: You have to plan data entry, connect files, organize information, and generate reports. Nobody's menu-driven front end is going to do all that for you, but R:BASE's four menu-and-prompt-driven program modules (called Definition Express, Forms Express, Reports Express, and Application Express) make it easy.

True to the relational model, R:BASE refers to files as tables, fields as columns, and records as rows. You use the Definition Express module to set up a complex network of linked tables with features like computed columns, Rules to automatically validate data entries, and Views that combine up to five related tables of data. You use the Forms Express module to construct sophisticated windows on your database that you can use to add, update, and delete data in as many as five tables at one time. Reports Express organizes your data into reports, based on a single table or a multitable view. You can look up and display data from other tables and views in the report. Finally, Application Express helps you quickly build a turnkey application that includes a complete database, menus, help screens, data-entry forms, and reports, by simply following the prompts and choosing what you want from the menus that appear. When you leave Application Express, it writes and converts the program code into a ready-to-use application. Experienced applications developers can use Application Express to create a rough draft of the code and then modify it using R:BASE's programming language.

These modules take you far beyond the level of applications development you could achieve with dBASE. With dBASE, you cannot establish data-entry validation rules without programming, and you are more limited in your choices than you are with R:BASE. You cannot set up a computed field on a dBASE data-entry/viewing form. You can set up a long-text memo field with dBASE, but you cannot search on it as you can on an R:BASE note field. You cannot establish Views without programming in dBASE.

As you look further into R:BASE, you find more ways in which it outshines dBASE. It's better for financial analysis. To begin, you can display multiple records on one screen in row-and-column format. This spreadsheet-like capability was a big part of the positive initial reaction to Paradox, but it has not yet made its way into dBASE.

R:BASE also offers a Crosstabs command that counts how many times a specified value in one field coexists in the same record with a specified value in another field. The program sorts the information alphabetically according to column values and displays it in tabular form. You can use the resulting tally to perform calculations on the values obtained in a third column and display the results. As an example, this lets you see how many units of each product each sales representative sold in a table listing products down the leftmost column and the salespersons' names across the top row. Then you can add across a row or down a column to quickly display total sales of a product or total sales for each salesperson.

Finally, R:BASE includes more financial and scientific functions for analysis of numerical data than dBASE offers.

Once you have prepared the basic application, R:BASE's high-level procedural language lets you open up to 80 tables to create the environment within which you can design complex applications. With dBASE, you can open a maximum of 15 database or command files. You can work with no more than 10 database files at once, 9 if you open a catalog file. For large or complex applications, this file limitation might unnecessarily complicate programming, whereas the R:BASE limit of 80 open tables is highly flexible. Another dBASE limitation is that it will not let you create a simultaneous link from one file to several other files. You can link file 1 to file 2 and file 2 to file 3, but you cannot link file 1 to both files 2 and 3 at the same time. By contrast, in an R:BASE System V application, you can simultaneously link a transaction file to a customer file and a sales representative file that are not linked to each other.

In programs of this size and complexity, it is not surprising that neither one is state of the art across the board. While R:BASE's combined programming language and Express modules are much easier to master than the dBASE programming system and reduce programming time for applications developers, the dBASE III Plus programming language offers over 150 commands to R:BASE's 89.

If you're planning to network, R:BASE has the advantage because one package can serve multiple workstations at no additional cost. With dBASE, every workstation must have its own access disk. Multiple users must have multiple packages or purchase the $995 Ashton-Tate LAN package to get access disks for five users. (The single-user version of dBASE III costs $695).

R:BASE's state-of-the-art system of menus, prompts, and on-line help go further than dBASE's menu-driven facilities in helping nonprogrammers tap its power. It gets the nod as the package that

provides more power and flexibility for a broader range of users.

Paradox

Paradox is a deceptively powerful and programmable relational database manager. The program is easy to learn, and you might get the impression that you're dealing with a bantamweight version of heavyweight programs like dBASE III Plus and R:BASE System V. You're not. Except for its maximum file size of 65,000 records, this program is a rival for those two applications. If you're used to 1-2-3, it's a spreadsheet with relational database capabilities. If you're more familiar with dBASE, it's a relational database that displays records in tables for a quick overview.

Paradox adheres closely in structure to Codd's original relational model, with all the information arranged in tables. Fields are columns, and individual records are arranged in rows. With a single keystroke, however, you can display a record on a form. If you change the information on the form, it changes in the table as well. Paradox automatically creates one form for each table, but you can also customize your own.

Each Paradox form and report is normally associated with only one table. To overcome the potential limitations of this setup, the program comes with menu-driven procedures for establishing functional links between tables. The Modify/MultiEntry selection lets you easily enter records into two or more tables through a single form. The Tools/More/MultiAdd selection provides a similar capability when you want to use a single table to update records in more than one table at a time. By running through the Viewing tables menu option several times, you can display more than one table simultaneously, and, when jumping between tables, Paradox remembers your last position in each and returns you to it. You can also use View to display two or more sections of the same table at once so you can compare records located in different parts of a large table. But, you can edit only one image of a table at a time.

Querying from several tables is not much more complicated than querying from one table. Despite its powerful programming language, Paradox features a query-by-example system that lets you view, update, and select data from multiple tables without any programming. You do this by filling out a *query form* for each table. A query form contains all the columns of the table, but the rows are blank. You check off the columns you want to display, and you select rows (records) to be displayed by entering selection conditions in the appropriate columns of the query form. Next, you tell Paradox what are the common fields that link the tables from which you want to draw information. You do this by entering examples in those fields of the query form. An answer table displays the query results.

You generate a standard report of an answer table by pressing two keys. If you prefer a customized report, you must first rename the answer table and then save it to disk. Now you can deal with it like any table, so you can create customized report forms for it. If you use a query regularly, however, this table would not suit your purposes because it cannot reflect changes in the tables. Paradox provides a Scripts/Query/Save option to save a query that you can use to display up-to-date data each time.

Scripts are a powerful Paradox feature. At first glance, they look like macros (macros are a recorded collection of keystrokes), but they can do much more than record and play back keystrokes. Each script is automatically recorded and saved as a Paradox Application Language program. By editing scripts with PAL and linking them together, you can create highly sophisticated programs. You can print scripts to facilitate documentation or debugging.

Although its commands number only 66, PAL includes a library of 100 built-in functions, much larger than the function library in either R:BASE or dBASE III Plus. You can supplement the built-in functions PAL provides by defining a procedure and procedure libraries. Procedures bundle command sequences like scripts, but they can take input parameters and return a value. You can use this value in an expression the same as a built-in function. Further, whereas scripts always reside in files on disk, once you define a procedure, it resides in memory for faster execution.

Because its query-by-example system

continued

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File Managers

Q&A 2.0
Symantec Corporation
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ALPHA/three
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Burlington, MA 01803
(617) 229-2924

Reflex 1.1
Borland International
4585 Scotts Valley Dr.
Scotts Valley, CA 95066
(408) 438-8400

OverVUE 2.0d
ProVUE Development Corp.
222 22nd St.
Huntington Beach, CA 92648
(714) 969-2431

FileMaker Plus 2.0
Forethought Inc.
250 Sobrante Way
Sunnyvale, CA 94086
(408) 737-7070

Relational databases

PowerBase 2.3
Powerbase Systems Inc.
32100 Telegraph Rd.
Birmingham, MI 48010
(313) 540-2398

Universal base SIX 6.6
ASAP Inc.
1041 41st Ave.
Santa Cruz, CA 95062
(408) 476-3935

R:BASE System V
Microrim Inc.
P.O. Box 97022
Redmond, WA 98073
(206) 885-2000

Paradox 1.1
Ansa Software
1301 Shoreway Rd.
Belmont, CA 94002
(415) 595-4469

Reflex 1.01
Borland International
4585 Scotts Valley Dr.
Scotts Valley, CA 95066
(408) 438-8400

Omnis 3 plus 3.24
Blyth Software Inc.
2929 Campus Dr.
San Mateo, CA 94403
(415) 571-0222

Double Helix 1R35 (single user)
Double Helix 1R+32 (multiuser)
Odesta Corp.
4084 Commercial Ave.
Northbrook, IL 60062
(312) 498-5615

lets you view many tables without relying on a programming language, Paradox qualifies as a state-of-the-art application.

Reflex for the Macintosh

Unlike the MS-DOS version, Reflex for the Mac is a fully relational, multiple-file manager. Up to 15 files can be open at one time, and a window menu lets you switch easily between them. You define links between two files by creating a special link field in each file and dragging the link field of one file into that of the other. A line is produced on-screen as you do this to establish a visual link between file images. These links are truly interactive and can be one to one, one to many, or many to many.

Typing and use of a command language is minimal. You do have to type the name of a field when you create it, and you do have to enter data, but much of the rest of what you do involves simple visual design. You can resize, reshape, and reposition fields by clicking and dragging. Reflex fields can be one of seven different types. They are automatically text fields when they are first created, but you can change that by clicking another type on the describe menu. Reflex automatically checks for data of the correct type for each field, and you can further define more specialized data checks for each field. Oddly, for a program that aims at being a surrogate spreadsheet, you cannot set up a calculation field except in reports. On the positive side, you can add, delete, rename, reorder, and change types of fields and links, with automatic restructuring of data by Reflex.

Reflex provides powerful search and sort capabilities. You can use the Query-Build feature to easily retrieve records based on qualifications of values in fields combined with AND or OR. You can specify more complex retrievals with formulas. You can either type the formula or use the mouse to build it. This method lets you use Reflex 50 spreadsheet-like functions to design powerful search specifications.

Much of Reflex's power lies in its report generator. Computed fields are available in reports, with a full set of logical, arithmetic, date, time, statistical, comparison, and text functions and operators. Summary fields can be included for counts, sums, averages, minimums, maximums, standard deviations, and net present values. Nested control breaks are also allowed for more detailed summary calculations. Although Reflex sorts on one field at a time, it allows sorting on consecutive fields while it holds the previous sort order constant. You have access to headers, footers, and page breaks to customize attractive and informative reports. You also have access to the Macintosh fonts, sizes, and styles for data display as well as for reports.

Reflex for the Mac's visual relationship for data among files qualifies it as a state-of-the-art database manager, and it's priced at under $100. [Editor's note: *The current version of Reflex for the Macintosh is 1.01. The new version has a rewritten manual.*]

Omnis 3 plus and Double Helix

If you want to build complete turnkey database applications on the Macintosh, you have only two choices: Omnis 3 plus and Double Helix. Both let you create your own menus, dialog boxes, and custom commands. Beyond that, they differ significantly: Omnis 3 plus comes closest to having a procedural programming language of all Mac databases, while Double Helix lets you program by linking icons called calculations tiles.

Creating an Omnis database application or library begins with defining file formats. A file can contain up to 120 fields (12 of them indexed), and up to 12 files can be open at a time. Next you design data-entry formats with optional user-defined command buttons and pull-down menus. Data-entry forms can contain sequences, which are Omnis 3's answer to the programming languages that characterize all high-end MS-DOS database managers.

Sequences, like macros or subroutines, are a sequential list of instructions or commands that you put into action by initiating a single command. They tell Omnis 3 plus exactly how to process or manipulate your database records. You can create these miniprograms with little typing or memorizing of commands and the syntax in which they must be written. Instead, Omnis 3 plus prompts you with its various command options. All you have to do is click on any of the 55 menu-presented commands that you want to put in your sequence. Omnis 3 plus has commands for finding, editing, inserting, and deleting records; printing records, totals, or reports; clearing data from memory; and changing the main file, to name a few.

Double Helix, by contrast, uses icons and visual design tools to create all the forms, lists, analyses, and mail-merge letters you want to include in an application. You create visual statements of what you want to do by clicking and dragging from among the more than 80 calculations tiles presented in lists on the side of the screen. Just drop these icons into position on the main screen and type in data where needed. Connect the icons with arrows, and you have created a program that works automatically wherever it is placed in an application. The 80 calculations tiles offer the most comprehensive Macintosh collection of arithmetic, date, text, and logical operators, functions, and values.

Neither program sets any limits on the number of records in a file, but Omnis 3 sets a limit of 70 characters per field, while Double Helix allows variable-length fields with up to 32,500 characters each. For number fields, Omnis 3 is limited to accuracy of 11 significant figures and 6 decimal places. Double Helix supports the 17-digit precision SANE package. Omnis 3 offers a more sophisticated nine-level password-protection system than the three levels of password protection offered by Double Helix.

The relational capabilities of the two programs are different. Omnis 3 plus combines features of relational and hierarchical database management systems in its file linking. When you set a file connection, you establish a parent-child relationship between two files. One parent record can have more than one child record in the child file. File connections can be one to one, one to many, and many to many, unlike many relational programs that can't handle the one-to-many or many-to-many file links. Double Helix uses lookups and subforms to dynamically unite sets of records. Subforms are actually multiple lookups, so Double Helix is limited primarily to single and multiple lookups as a way of linking files. You cannot, for example, build in automatic posting from one file to another or updating of multiple files through a single form into a Double Helix application.

Because of this Double Helix limitation. Omnis 3 plus emerges as the only fully relational file-handling Macintosh applications generator. Double Helix's method of visually programming relations among data also places it in the state-of-the-art category. [Editor's note: *Omnis 3 plus's current version number is 3.24. This version corrects some bugs and has no copy-protection.*]

Where Database Software Is Going

Excluding programs from a state-of-the-art listing such as this is bound to raise the eyebrows of developers and users.

However, I think that this list accurately represents the cutting edge of database management software development. These programs show where the field is going: simpler programs that add more features without increasing the difficulty of learning the application, and powerful programs—originally the exclusive domain of full-time applications developers—that simplify their interfaces to let nonprogramming end users begin using them quickly and easily. ■

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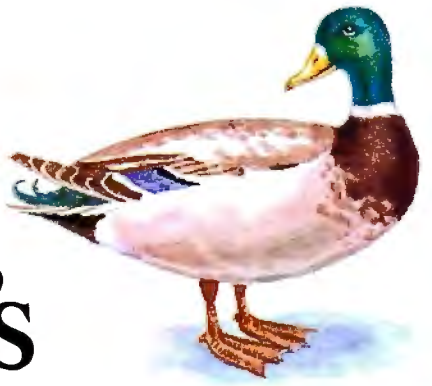

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■ **Brock N. Meeks**

Microcomputer-based telecommunications appears deceptively simple; it seems to be an easy matter of combining a computer, a modem, software, and a telephone line. In practice, however, combining all these elements can be difficult, especially when the details of telecommunications are not well understood. The truth is, telecommunications is something of an occult art.

There's not much you can do to tweak the components of your computer and modem other than to buy your way out of a bad decision. You have even fewer choices in selecting a telephone system. But when it comes to communications software, you have far more control of your own on-line destiny. In fact, the options are staggering.

The promising aspect is that there are so many programs to choose from. Some of these programs offer features such as automatic communications-parameter adjustments, unattended operation, autocallback, data encryption, and complex log-on scripts and macros. These capabilities will make you wonder how you ever got along without them. Other programs can target an application unique to your daily type of telecommunications. Still others are the workhorses of the telecommunications world; they aren't pretty, yet they outshine many of the popular programs for daily general-purpose communications.

Here's a look at the best and worst features of a dozen of the top communications programs available today. Not all of them are in the power-user category; some are here because of their continued solid performance. I chose others because of their growth potential; that is, the ability to handle more advanced communications applications as the user's needs increase. I've also included some of the old standards to provide the opportunity for a head-to-head comparison. Table 1 lists the various features of all these programs.

ASCII Pro 1.3

ASCII Pro version 1.3 ($99.95) from United Software Industries is a product of software evolution. This program was known earlier as Z-Term, P-Term, and ASCII Express: The Professional (for 8-bit Apple computers). ASCII Pro reached its evolutionary peak when it was ported to MS-DOS. The package offers macros, on-line help, several transmission protocols, and fallback error-checking. If it can't accomplish the more superior Xmodem CRC mode, ASCII Pro falls back to the less-reliable checksum mode.

With these and other capabilities, ASCII Pro will deliver 90 percent of the telecommunications power you'll ever need; it lacks only a script language (i.e., the capability to execute command scripts after receiving a prompt from the computer). ASCII Pro isn't padded with luxuries, like elaborate menus; it's designed for fast, straightforward operation.

Not only is it fast, it's bulletproof. The first time you run ASCII Pro, it automatically drops you into the installation program. Here, a series of menus covers everything from the modem you're using to the Welcome message you see when the program runs in unattended mode. If the technical questions these menus ask are beyond you, you can just answer the first two questions (computer type and modem) and run the program. After installation, you run the program with single-key commands.

ASCII Pro's macro language uses a series of symbols that the program interprets as commands, such as the dollar sign ($), which is used to represent the emulation mode. Entering the $ in a macro-command string toggles the default emulation mode on or off, depending on the mode's previous state. This makes creating sophisticated macros a

continued

Brock N. Meeks (c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458) is a freelance journalist. He is the telecommunications group moderator for BIX.

Table 1: *Features of the twelve communications programs.*

	ASCII Pro 1.3	Blast-II 8.0	Crosstalk XVI 3.61	Flash 1.12	HyperACCESS 3.20	MicroPhone 1.0
Company	United Software Industries Inc. 8399 Topanga Canyon Blvd. Suite 200 Canoga Park, CA 91304 (818) 887-5800	Communications Research Group 5615 Corporate Blvd., Third Floor Baton Rouge, LA 70808 (504) 923-0888	Crosstalk Communications 1000 Holcomb Woods Pkwy., Suite 440 Roswell, GA 30076 (404) 998-3998	Antic Publishing 544 Second St. San Francisco, CA 94107 (415) 957-0886	Hilgraeve Inc. P.O. Box 941 Monroe, MI 48161 (313) 243-0576	Software Ventures Corp. 2907 Claremont Ave., Suite 220 Berkeley, CA 94705 (415) 644-3232
Price	$99.95	$250	$195	$39.95	$149	$74.95
Command strategy	Menus	Menus	Menus; command line	Alt-key/alphabetic combinations; command line; mouse	Menus; function-key commands; command line	Mouse; Ctrl-key combinations
Access to DOS level	No	Yes	No	Yes	Yes	Yes
Built-in text editor	Yes	Yes	No	Yes	No	Yes
Bps settings	50 to 38,500	Automatic up to 19,200	110 to 115,200	300 to 9600	50 to 57,600	50 to 57,600
File-transfer options	Xmodem (128-byte and 1K-byte versions; CRC and checksum); Xmodem batch; Kermit	Xmodem (checksum); Blast	ASCII; Xmodem (checksum only); Kermit; Crosstalk	ASCII; Xmodem (checksum and CRC; 128-byte and 1K-byte blocks)	Xmodem (CRC and checksum); Kermit; Hyperprotocol	ASCII; Xmodem (128-byte and 1K-byte versions); MacBinary; Ymodem
Remote operation	Yes	Yes	Yes	Yes	Yes	No
Script language	No	Yes	Yes	Yes	Yes	Yes
Learn feature	No	Yes	No	Yes	Limited	Yes
User-defined macros	Yes	Yes	Yes	Yes	Limited	Yes
Memory-resident mode	No	Yes	No	Yes	Yes	N/A
System/RAM needed	MS-DOS, ProDOS; 128K	MS-DOS, CP/M, OS-9, VAX, Xenix, Unix, Tandy; 200K	MS-DOS; 128K	Atari 520ST, 1040ST; 512K	MS-DOS; 192K	Macintosh; 128K
Manual pages	231	320	158	50	310	184

complicated process. However, the time you invest creating macros is well-rewarded. For example, you can nest macros to call three different on-line services, download mail, and upload comments, all at a preset hour. The built-in word processor is adequate and uses WordStar-like dot commands. Although the editor can get the job done, because it is a line-oriented editor, I'd recommend using it only for memos.

ASCII Pro has an excellent unattended mode that can be set up in a few minutes to function as a file-transfer system. The unattended mode can be password-protected or left open, and remote users can take advantage of Xmodem, Kermit, or Xmodem batch file-transfer options. The program also enables you to run other programs without having to first exit from ASCII Pro. For example, if you need to edit a text file but don't want to use the built-in editor, you can exit to your word processor, edit the file, and then return to ASCII Pro.

It takes perseverance to wade through ASCII Pro's documentation package because it is so extensive. You won't need to read the manual to perform basic tasks, but learning the advanced features takes some study. An appendix section provides extensive technical data.

Blast-II 8.0

Communications Research Group's Blast II version 8.0 ($250), whose name stands

Microsoft Access 1.01	ProComm 2.4.2	Red Ryder 9.4	Relay Gold 2.0	Smartcom II 2.1	Telescape 1.0
Microsoft Corp. 16011 Northeast 36th Way P.O. Box 97017 Redmond, WA 98073 (800) 426-9400	Datastorm Technologies Inc. P.O. Box 1471 Columbia, MO 65205 (314) 449-7012	The Freesoft Co. 10828 Lacklink St. Louis, MO 63114 (314) 423-2190	VM Personal Computing Inc. 41 Kenosia Ave. Danbury, CT 06810 (203) 798-3800	Hayes Microcomputer Products Inc. P.O. Box 105203 Atlanta, GA 30348 (404) 449-8791	Mainstay 5311-B Derry Ave. Agoura Hills, CA 91301 (818) 991-6540
$250	$35 with manual on disk; $50 with typeset manual	$40	$250	$149	$125
Menus; function-key commands; Ctrl- or Alt-key combinations	Alt-key combinations	Mouse; Ctrl-key combinations	Menus; function-key commands; Ctrl- or Alt-key combinations	Menus; function-key commands; pull-down menus	Mouse; Ctrl-key combinations
Yes	Yes	No	Limited	Yes	Yes
Yes	No	No	Yes	No	No
50 to 9600	300 to 19,200	300 to 9600	50 to 19,200	110 to 9600	110 to 9600
Xmodem; X.PC	Xmodem (CRC and checksum); Telink; Modem7; Ymodem; Ymodem batch; Kermit; SuperKermit; Windowed Xmodem	ASCII; Xmodem; Kermit	Xmodem (CRC and checksum); Kermit; Relay	ASCII; Xmodem (checksum only); Hayes	ASCII; Xmodem (CRC); ASCII (DC2/DC4); MacBinary
Yes	Yes	Yes	Yes	No (Mac); Yes (DOS)	Yes
Yes	Yes	Yes	Yes	No	No
Limited	No	Yes	Yes	Limited	No
Yes	Yes	Yes	Yes	Yes	Yes
No	No	Yes	Yes	No	Yes
MS-DOS; 256K	MS-DOS; 140K	Macintosh; 512K	MS-DOS; 192K	MS-DOS, Macintosh; 192K	Macintosh; 128K
427	33; 111 pages on disk version	83	350	210	100

for blocked asynchronous transfer, is really a file-transfer protocol with a user interface. This package is available for more than 100 microcomputers, minicomputers, and mainframes from companies such as IBM, Digital, AT&T, Hewlett-Packard, Prime Computer, Kaypro, Data General, and Wang. For this review, I tested the MS-DOS version for the IBM PC, XT, and AT.

You can use the Blast protocol only when you are communicating with another computer that is running Blast-II. Otherwise, the program lets you use Xmodem, or you can send and receive non-error-checked ASCII files.

Blast-II requires 8 data bits and no parity checking, but, according to Communications Research, its throughput is up to 50 percent greater than Xmodem's because of the unique type of error checking used. Text or binary files are transmitted in 100-byte packets, one at a time. The receiving computer checks each packet and returns a single character to indicate whether the block contains errors.

Blast-II transmits all the packets without any kind of handshaking pauses before retransmitting any bad blocks. This constant flow of data and the follow-up transmission of any bad blocks inside this sliding window account for Blast-II's increased throughput. Two computers using Blast-II at a rate of 1200 bits per second have a throughput closer to a rate

continued

HyperPilot is the most powerful script language of all the programs I reviewed.

of 2400 bps for other protocols.

If a communications session fails because of problems, such as a disconnected phone line or high line noise, a built-in monitoring feature marks the point in the transmission at which the connection was broken. When you reestablish connection with the same remote computer, file transfer automatically restarts from the point of interruption.

Blast-II is menu-driven and easy to configure. The program includes a script language that can implement remote-host capability, and it has a WordStar-compatible text editor. The bottom line with this program is that for a given data rate, you can move a lot of error-free data faster than you can with other protocols.

Crosstalk XVI 3.61

You can tailor Crosstalk Communications' Crosstalk XVI version 3.61 for MS-DOS computers ($195) to almost any application by using its powerful script language. This language enables you to create scripts that can recognize character strings, such as `enter password`, and it can suspend program execution until a predefined time.

Some novice users may have a problem with the program, as it is not menu-driven. The program has built-in automatic log-on routines for the more popular on-line services, and, with its English-like command language, you can build your own. You need to use only the first two letters of commands, for example, to load a BIX log-on script file, you type `lo bix`, and the program executes your automatic log-on. You can also execute this script from the DOS prompt by issuing the command `xtalk bix`.

Crosstalk XVI incorporates Xmodem (checksum version only), ASCII, Kermit, and the unique proprietary Crosstalk file-transfer protocol. The program works with the newest modems that operate above 10,000 bps and even supports file transfers up to 115,200 bps for hardwired lines.

For remote access, Crosstalk XVI has a 4-tier structure that lets you assign different levels of access for each individual caller. Access levels range from one remote user being allowed only viewing privileges to another remote user being allowed to take complete remote control of Crosstalk. Even at the highest level, however, a remote user cannot access DOS.

[Editor's note: *The newest product from Crosstalk Communications, Crosstalk Mk.4, was not available in time for this review. The program features X.PC, Xmodem, and Kermit protocols and IBM 3101, DEC VT-100, and TeleVideo Model 900 terminal emulations. This package is based on a modular architecture (i.e., you can add enhancements by phone), and it has concurrent communications capability; you can run up to 15 simultaneous communications sessions, each displayed in its own window.*]

Flash 1.12

Flash version 1.12 ($39.95) from Antic Publishing (formerly Antic Software) is a program for Atari ST computers. It accepts three types of commands. The quickest way to enter commands is using the Alt key and a single alphabetic key, for instance, to toggle the capture buffer on and off, you type Alt-C. The second way is by pressing the Insert key and typing a two-letter abbreviation at the command line. For example, to download a file using Xmodem, you press Insert and type `DL XM B: FOOBAR.PRG`. Flash checks the B: disk to see if FOOBAR.PRG already exists, and, if it does, it gives you a chance to overwrite it or abort the download process.

The third way to enter commands is to use a mouse and the GEM interface; this is the easiest but slowest way to operate the program. Using the GEM interface, you follow the pull-down menus and point-and-click on the functions you wish to perform. Here, speed is sacrificed for expediency.

Flash lets you operate in two different screen types: terminal mode and a 4K-byte capture-buffer mode. Terminal mode uses a blank screen with a status line across the bottom. Capture-buffer mode uses a GEM screen complete with scroll bars on the bottom and right sides and a menu bar at the top. At any time, you can switch between the two screen types by pressing the right mouse button.

The capture-buffer GEM screen gives you full cursor positioning with the mouse, and you operate commands through dialog boxes. However, when you use this screen, telecommunications is suspended; you can interact only with a remote computer while in the terminal mode.

You can manipulate the capture buffer contents using the built-in word processor. You can mark blocks of text, cut and paste, read files into the screen, and more. This feature also lets you edit messages and respond without going off-line.

Xmodem and ASCII are the only protocols available with Flash. The Xmodem protocol has fallback capability. If the CRC mode fails, the program automatically drops into the checksum mode. A dialog box lets you adjust the timing of an Xmodem protocol with the ambiguous settings of "loose" and "tight." This adjusts the Xmodem time-out response to compensate for slow systems; this is common during peak use periods. The loose settting is better for multiuser systems; for computer-to-computer transfers, the tight setting is preferred.

Flash's dialing directory holds 60 phone numbers. Phone numbers entered with an @ extension execute a .DO file. These .DO files are macros that are constructed using Flash's commands. The macros are somewhat crude, as there are no advanced features like nesting or conditionals.

The documentation for Flash consists of a 50-page paperback book that's adequate for the experienced user, but a novice could use more examples, especially in the section that explains macros.

HyperACCESS 3.20

HyperACCESS version 3.20 for MS-DOS computers ($149) from Hilgraeve contains HyperPilot, the most robust script language of all the programs I reviewed. This script language, powerful enough to create a bulletin board system, contains 94 commands. Despite all its power, HyperPilot is easy to manipulate. Included are 30 prepared scripts to use as examples for writing your own commands. For most automatic log-ons, however, you won't need any more than three or four commands. The commands are very cryptic; two examples are `if wait match` and `if not wait match`. I would like to see HyperPilot make use of more English-like commands.

Once you've written scripts, HyperPilot automatically compiles them. This provides faster execution, and it keeps prying eyes from dissecting your scripts to reveal passwords and ID numbers, a common problem with placing script files on disk.

The phone directory holds 127 numbers and is extremely useful for travelers and those who use several of the popular packet-switched networks. All phone numbers are stored in a separate file. This allows you to use the same log-on script with several different phone numbers, a handy feature if you're dialing into the same on-line service from a different hotel room every other night.

The remote-access capability lets you leave your computer on-line when you're not using it. You can then choose to give the remote caller full or partial control of

your computer. HyperACCESS presents limited-use callers with a list of the commands that they can execute while logged on to your computer. The amount of control you give them resides in a file that you establish. HyperACCESS can also function as a callback system; anyone requiring access to your system can call your modem and hang up, and your computer then calls that user's computer at a predetermined phone number. This provides a great amount of system security.

A built-in call log provides statistics of every call made to or from your computer. Information stored includes the name of the user, length of the call, and operations performed while on-line, such as reading a directory.

You can run DOS commands and applications either while running HyperACCESS or while it remains in memory (192K bytes is the minimum requirement). The program supports Xmodem (CRC and checksum), Kermit, and a proprietary protocol called Hyperprotocol. However, a peculiar irritation is that you must enter the name of the program you wish to upload or download before performing the steps of the procedure. This can be tedious because you must repeat the steps of the procedure each time if you're transferring several files.

A disk-based tutorial takes you through each application of HyperACCESS, but to get the most from its advanced features, such as user control levels in unattended mode, the manual, which is highly readable, is a must.

MicroPhone 1.0

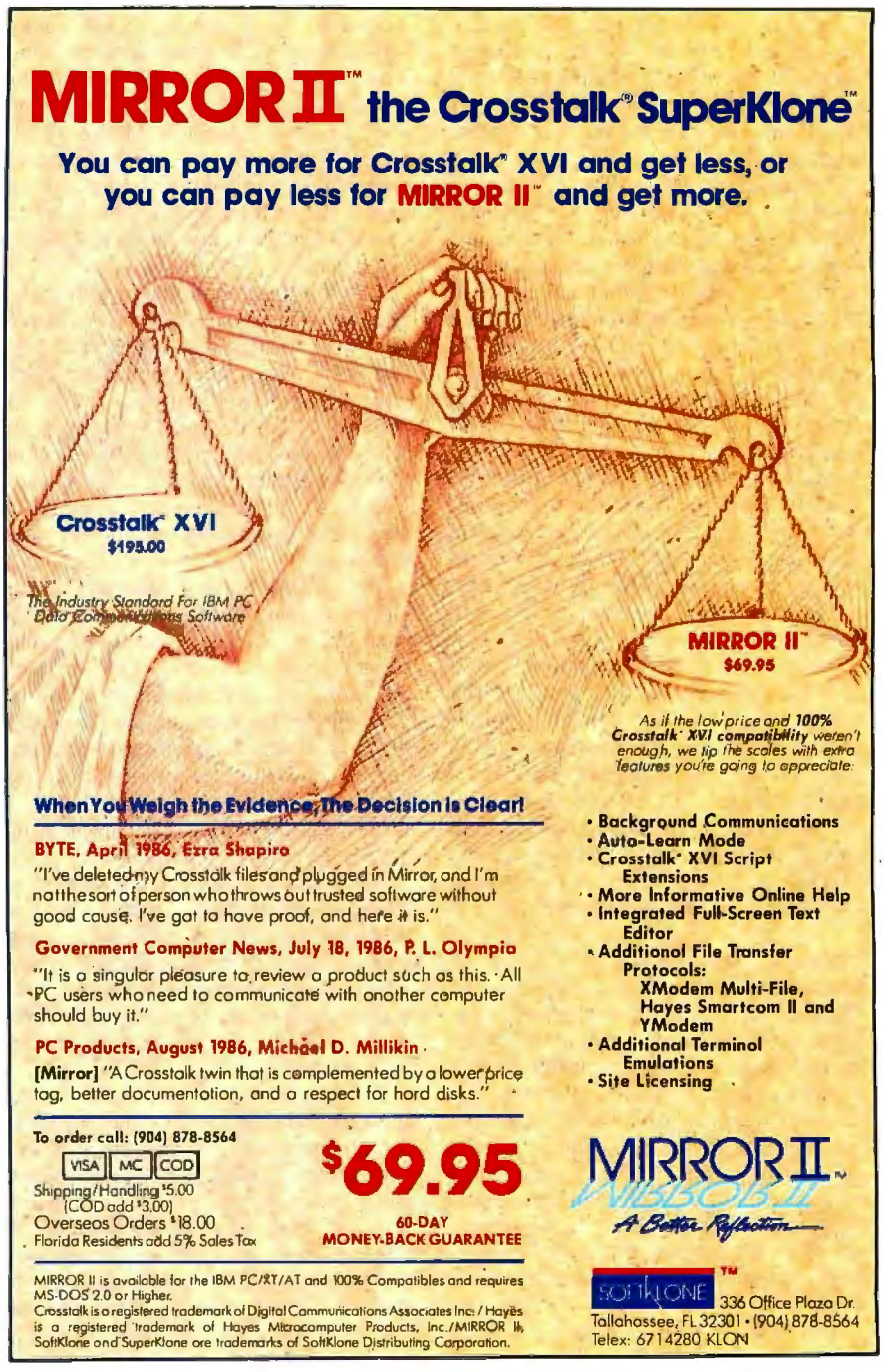
MicroPhone version 1.0 for the Macintosh ($74.95) from Software Ventures includes features for both novice and experienced users. This program supports 20 data rates ranging from 50 bps to 57,600 bps. The higher settings are a definite advantage for transferring files back-to-back with the use of a null modem, which is a cross-connected cable; transmission on one end is connected to receive on the other end, and vice versa. MicroPhone enables you to emulate both TTY and VT-100 terminals. Other emulation options include font size, cursor shape, backspace control, and screen display.

When setting up files with communications parameters, you can group like services under a single filename. For example, you can put all the local bulletin boards into a "Local BBS" file. This way you can set the communications parameters for a range of systems and not have to worry about shifting data rates, parity, and the like.

MicroPhone contains a flexible and powerful script-writing language with 74 commands for creating automated on-line procedures. You can create a script file in two ways. The first is to open a script-writing window and actually write the script yourself. Using the scroll bar, you search for the available commands, such as `Wait`, `Hang Up`, `Wait for Call`, or `Send Text`, inside a special dialog box contained in the script-writing window. When you click on the command, it is inserted in your script. You can also insert any text you desire at this time. MicroPhone has a check function that checks the script syntax for errors, like improperly nested loops. If MicroPhone detects an error, you'll have to rewrite the script; the program won't let you save bad syntax.

The second way to create a script file is with MicroPhone's Watch Me mode. The program records each of your keystrokes and every prompt you send to the computer. It then inserts the correct command from its script language to repeat this script when you need it. Scripts written with the Watch Me function can be edited in the Modify Scripts window. The only disappointment is that you are un-

continued



For the high-powered user, Microsoft Access supports the X.PC protocol.

able to alter communications parameters, such as data rate, from within a script file.

MicroPhone employs four file-transfer protocols: ASCII, Xmodem (both 128-byte block and 1K-byte block versions), Ymodem, and MacBinary. You can transfer text between two Macintoshes in a number of formats, including MacWrite and Microsoft Word. You use a straight ASCII text mode for text transfer to other computers.

MicroEditor, MicroPhone's simple window-based text editor, is extremely useful for massaging text that you've just downloaded and want to send on to another user. Any text that has scrolled across your screen is automatically stored in the expandable capture buffer, to which the program allots a percentage of the available system memory, and you can review the text by means of a scroll bar, even if you've been on multiple systems. Using the cut-and-paste feature, you can scroll backward through an on-line session and transfer text to a separate file. The program also includes Switcher, which you can use to insert downloaded text directly into a MacWrite document in progress.

MicroPhone's documentation is well laid out and well-written; it is a rarity among its genre. The manual is spiral-bound and comes in three sections: a Users Guide, a Reference Manual, and a section entitled "I Don't Need to Read the Manual" for the anxious modem user. Commands and functions are explained in nontechnical terms, which makes learning this program easy.

Microsoft Access 1.01

Microsoft Access version 1.01 for MS-DOS machines ($250) is rich with features, such as macros, on-line help, preset log-on menus, capture buffers, and a script language, which will satisfy the most demanding telecommunications user. The basic features of the program are readily available to the novice user, while the more sophisticated commands are folded into the underlying command structure. This enables users to expand their communications power as the need arises.

The heart of this package is its three programming levels. At the highest programming level, Access offers the Microsoft Access Script Command (MASC). This is like a cross between BASIC and Pascal. MASC offers about 100 commands, including conditionals and Boolean operations. You can use this language to write custom automatic scripts to perform an on-line session just as if you were sitting at the keyboard. You can create custom menus with MASC to guide another user through a particular sequence of commands; the user simply follows the prompts you've programmed and doesn't need to know anything about the program itself.

If you're not up to using the built-in programming language, Access has a self-learn mode. This mode of operation, when enabled, will track your on-line session and learn your on-line routine, automatically creating a MASC script. You can then edit and alter the script to perform any additional on-line procedures. The next time you log on, you simply tell Access to use the MASC script you created.

The third programming level is called Quickey. This feature stores sequences of keystrokes that you can later recall with two keystrokes, called Quickeys. These Quickeys are specific to each communication file. For instance, you can assign Alt-X to mean `logoff` for one system, bye for another, and `quit` for a third. You need only remember that the Alt-X command is your log-off for all three systems.

For anyone making extensive use of electronic mail, Access is a godsend. The electronic mail center is set up to resemble an actual mail room with in-boxes, out-boxes, and desk and file sections. Access will deliver your messages to several different electronic mail services, taking care of all the proper protocols and log-on procedures for you. You need only inform Access where each message is going and let the program run its course.

The speed and ease of this mail center makes using electronic mail as easy as dropping a letter in a mailbox. You can compose your mail using the text editor, which closely resembles Microsoft Word and is the most full-featured text editor that I've found inside a telecommunications package.

For the high-powered user, Access supports the X.PC protocol in addition to the more popular Xmodem. Using X.PC, you can carry on as many as eight different on-line sessions using a single phone line and modem. Access allows you to open as many as eight on-screen windows. For instance, while checking your electronic mail on MCI Mail, you can also be downloading the latest comments from your BIX conferences. Currently, only the Tymnet packet-switched network can handle such simultaneous sessions.

Another example of this application is that you can use COM1 and COM2 RS-232C ports simultaneously and be connected to an on-line service and patched into the corporate mainframe at the same time. These aren't prime functions for most users, but they're an excellent example of how the program can grow with your knowledge of telecommunications.

Access' 427-page manual is excellent, if imposing. But the program practically runs itself and has a foolproof configuration program that even lists the DIP switch settings for each modem it supports. Access would be a bit easier to use with the addition of a tutorial disk.

The only drawbacks to the program are its size (it requires a minimum of 256K bytes of RAM to run) and poor performance when used on a floppy disk–based system. Since the program is contained on three floppy disks, you need a hard disk to appreciate the total power of Access.

ProComm 2.4.2

ProComm version 2.4.2 for MS-DOS machines from Datastorm Technologies may be the best communications software value around. It is distributed as a shareware program; if you like it, you pay $35 or $50 for it, depending on the type of manual you choose; if not, you can erase it.

ProComm has a telephone directory that holds 100 numbers and rivals that of HyperACCESS. It also has a somewhat cryptic built-in script-writing language that is similar to Crosstalk's with more commands. I had no problem converting Crosstalk scripts for use with ProComm; the syntaxes for the two programs are very similar. However, ProComm's script language lacks a sophisticated branching capability. Add to this limitation Procomm's ability to program only 10 function keys and you have an adequate, but not flexible, script language.

The program comes with several predefined scripts for popular on-line services, though you'll find fewer than a program like Crosstalk provides. A novice user will find setting up scripts here a tedious process and more trouble than it's worth.

If you like lots of boxes, pop-up menus, and sound effects, you'll love ProComm. Almost every command you issue triggers some kind of graphic and sound effect. You invoke all the commands by using the Alt key in combination with other keys. This could be a problem if your RAM-resident programs

trigger on similar keystrokes, because ProComm doesn't allow you to reassign these command triggers.

ProComm supports file transfers at up to 19,200 bps and can emulate 10 terminals, including the ANSI-BBS, ADDS Viewpoint, VT-100 and VT-52, IBM 3101, TeleVideo Models 912, 920, 925, and 950, Heath/Zenith 19, and the Wyse 100. You can set a pathway to call up your favorite text editor while you're on-line, a boon to those who have ever suffered through using an on-line editor. ProComm will also run in Host mode. In the Host mode, a remote user can upload or download both binary and ASCII files. Advanced users might use the script language to configure a user-friendly interface for remote callers.

Although this is a shareware program, registered users are treated to full professional support. The program's authors run a ProComm bulletin board to supply answers to complicated application problems.

Red Ryder 9.4

Red Ryder version 9.4 for the Macintosh ($40) from The Freesoft Company has a name that conjures up a rough-and-tumble pioneer image. To get the most out of this powerful program, you've got to roll up your sleeves and dive into its 83-page manual. A novice to the world of communications programs should probably look for another program.

Red Ryder lets you pick from three different terminal-emulation modes; TTY, VT-100, and VT-52. The program can communicate at speeds from 300 bps to 9600 bps, but its file-transfer options are limited to Xmodem, Kermit, and straight ASCII. MacBinary is not available. The author of the program has tuned Red Ryder for maximum performance, making it the most efficient communications program for the Macintosh environment.

Anything that you can do manually, you can program with Red Ryder's more than 48 basic script commands with extensions. These script files are called procedures. One benefit of Red Ryder's frequent revisions is that the script language continues to become more impressive and flexible. A small quirk, however, is that to write a procedure, you must use a desk-accessory editor like MockWrite; Red Ryder doesn't have a built-in text editor.

In the Write Procedure mode, Red Ryder logs every prompt from the remote computer and every keystroke you issue in response. When you exit this mode, Red Ryder automatically writes a script file for that series of prompts and responses. To run the procedure, you simply choose the `Initiate procedure` option. This feature of Red Ryder worked flawlessly during the review, and it is a potential boon for users who want the power of Red Ryder but don't want to get into writing their own script files.

Red Ryder offers several ways to manipulate incoming data. You can set the number of screens it will hold in memory at any one time (20 is the number suggested for a 512K-byte Macintosh). You can review the screens held in memory by clicking on the scroll bar. For permanent copies of any incoming text, you can choose the `Echo to printer` option. The `Archive all screens` setting stores all screens to disk; you can output individual screens to your printer with a click of the mouse.

Because this is a shareware program, you can download it from several hundred bulletin board systems or from commercial networks, such as BIX. The program is distributed with a manual on disk. Printing the manual is guaranteed to chew up your ribbon and the better part of an hour. The documentation says you can use the program for 45 days before you

continued

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make a decision to trash it, give it away, or send the author a check.

Registered users get an additional bonus called Red Ryder Host, a bulletin board construction set. Again, this program is powerful and loaded with options, but it's not for the novice. If you're of adventurous spirit and don't mind getting your hands into code, you'll soon turn Red Ryder into the odds-on favorite among your stable of communications programs.

Relay Gold 2.0

Relay Gold version 2.0 for MS-DOS machines ($250) from VM Personal Computing includes a 100-command script language that you can use to automate any kind of on-line session. In addition, because you can call this program up from a batch file, you can set up Relay Gold as a turnkey communications system. You can create your own custom menus and turn a series of keystrokes into a single-key command.

Relay Gold offers you the advantages of a menu-driven command structure and the option of entering commands directly without menus. It has an option that lets you communicate with a remote host also using Relay Gold while you are transferring a file. With this feature, you can type messages to a person at the other computer while the file transfer is executing. With all the complexities of file transfers, you can use this feature to send reassuring messages back and forth regarding the progress of the transfer. The program sandwiches your keyboard text between the packet-switching of the file transfer as space becomes available. Relay Gold recognizes when it has connected to another system also using Relay Gold and automatically drops the two systems into two-way communications. Relay Gold supports Kermit, Xmodem (both CRC and checksum), and a proprietary protocol, Relay.

Major commands use single keystrokes from the computer's function keys. For example, F1 dials the remote system, F2 puts the modem into answer mode, and F9 stops printing. A multitasking mode lets the program run in the background while you perform other operations. Like Microsoft Access, Relay Gold has a built-in learn mode. You can edit learn-mode scripts just like Access scripts using either your word processor or Relay Gold's own editor. Its editor can do block moves, insertions, deletions, and block deletes. However, to use the commands of the editor, you have to exit the communications session and return to the program's command line.

The Call file, which is supplied on the distribution disk, comes with several examples of various on-line sessions, and you can modify it to meet your current communications needs. It should take moderate users about 15 minutes to modify this file to their particular application needs.

Smartcom II 2.1

Smartcom II version 2.1 ($149) from Hayes is for use with Hayes modems and hard-wired applications and is available in both MS-DOS and Macintosh versions. This program can be used only with 100 percent Hayes-compatible modems. For example, I tested this package on a Prometheus 1200-bps modem with no trouble; however, many other modems won't run Smartcom II, especially the 2400-bps variety. If you consider buying this package, make sure your modem will run it.

Smartcom II is one of the easiest communications programs to use. It is menu-driven; you select functions from a main menu screen. Smartcom II supports macros and comes with predefined automatic log-on macros for many popular on-line services. All this makes Smartcom II a virtual load-and-go program. You hardly have to do more than boot the program and turn on your modem to begin using it.

You can edit existing macros by selecting the appropriate menu function. You must edit the existing macros to install your account numbers and passwords, but this is a painless procedure. A nice feature of these macros is that you can give them names of up to 20 characters in length.

Smartcom II macros are triggered only on single characters, which makes it difficult to deal with less-than-ideal situations, such as when two different responses begin with the same letter. The program has no `IF. . .THEN` command capability. For example, if the remote computer doesn't send the expected prompt within a specified time, Smartcom II issues the command anyway. The results could be confusing at best and disastrous at worst.

You construct macro files by using a template consisting of screens into which you insert the needed parameters. While this makes it easy for the novice to generate macro files, it also limits how flexible these files can be.

Smartcom II stores up to 26 macro command sequences in files called batches. These batches can perform any sequence of Smartcom II functions in the precise order you've defined; you can record up to 500 keystrokes in a batch. You can then set Smartcom II to dial a computer anytime and run through your batch sequence. You could have a batch file that reads and uploads your mail, opens a capture buffer, reads any new conference messages, and logs off, all automatically. Batches can run in unattended mode, but macros must be triggered by keystrokes.

You can review text that has scrolled off the screen by using the Home, Page Up, or Up Arrow keys. The amount of text you can review is limited by your available memory; the capture buffer dynamically allocates system memory. When this review buffer fills up, the text that first comes in is the first to go. This buffer holds all text, even if you've accessed several different systems. Smartcom II offers no editor to cut and paste from this review buffer, but you could use a program like SideKick to handle this function.

The Macintosh version of Smartcom II is a more intelligent program than the MS-DOS version. The macro program, called Autopilot, uses English-like sentences, for example, `Look for [`*`character string`*`]`. This version also makes good use of icons. The review buffer offers the cut-and-paste option. You can also send graphics to another Macintosh by establishing a voice connection and then clicking on the data icon, switching from voice to data communications, and sending the graphics, all during the same call.

The Macintosh program, like the MS-DOS version, is particular about the modem it talks to. If your Mac isn't using a Hayes modem, don't bother with Smartcom II. Even the supposedly Hayes-compatible Apple Modem doesn't handle this program.

Telescape 1.0

Telescape version 1.0 ($125) for the Macintosh from Mainstay is a standard "vanilla" communications package with few unusual features. The program has less than 20 macro commands to work with, making all but the simplest automatic log-on scripts difficult to implement; you could not use the macro language to automate a sophisticated on-line session. Each macro script can contain only nine lines of commands. In addition, Telescape has no store-and-forward feature for delivering electronic mail in an unattended mode.

Communications parameters are simple to set up. Transmission rates run from 110 to 9600 bps. File-transfer protocols are limited to ASCII, ASCII (DC2/DC4), Xmodem (CRC), and MacBinary. These are adequate for most on-line sessions. Telescape includes an extensive terminal-emulation definition capability. The Telescape program comes complete with terminal-emulation definition for the TTY, VT-52 and VT-100, ADM-11,

ADDS, and TeleVideo Model 950 terminals. The user's manual lists over 50 other terminal definitions that you can obtain from Telescape's technical staff.

Setting up a terminal-emulation definition is a tedious process, and it could be confusing to the novice. Advanced users, however, can take advantage of this particular function to enhance the power of their Macs.

Telescape includes a turnkey bulletin board program. Setting up for the bulletin board is a point-and-click procedure. The first time I tried it, I had a bulletin board up and running in 2 minutes. The bulletin board program functions well as a file-transfer board, but it's not much good for anything else. There are no provisions for message sections; callers can only read an opening welcome message from you and send you, the sysop, messages in return. Subsequent callers cannot respond to messages left by previous callers.

Telescape includes a graphics application language called GAL. You can transfer graphics produced using the built-in GAL to be viewed in real time by other Telescape users. The GAL transfers are five times faster than transferring MacDraw graphics. Mainstay admits that GAL is a pioneering feature and says that more development will come. GAL graphics are somewhat crude; you can generate drawings with the mouse only. This is more of a novelty feature than a practical application, yet it is a glimpse of what is to come.

The Telescape user's manual is well done. It displays many examples of what the user will actually see on-screen. This orients novice users and keeps them from getting lost when clicking among all the various windows.

Drop Carrier

A review of this length obviously can't explore each of these program's strengths and weaknesses in intimate detail. During the review process, however, some patterns did materialize. The popularity of scripts to streamline telecommunications sessions is a driving force behind the development of more sophisticated script languages. Where an actual script file is lacking, the macro capability of many programs comes close to emulating the script-file process.

More and better data-transfer protocols are emerging. For instance, the Kermit file-transfer protocol, once an unsupported orphan, seems to have found acceptance. Users expect more sophistication in their communications software. Features such as auto-callback, data encryption, and unattended operation are becoming the norm instead of the exception. ■

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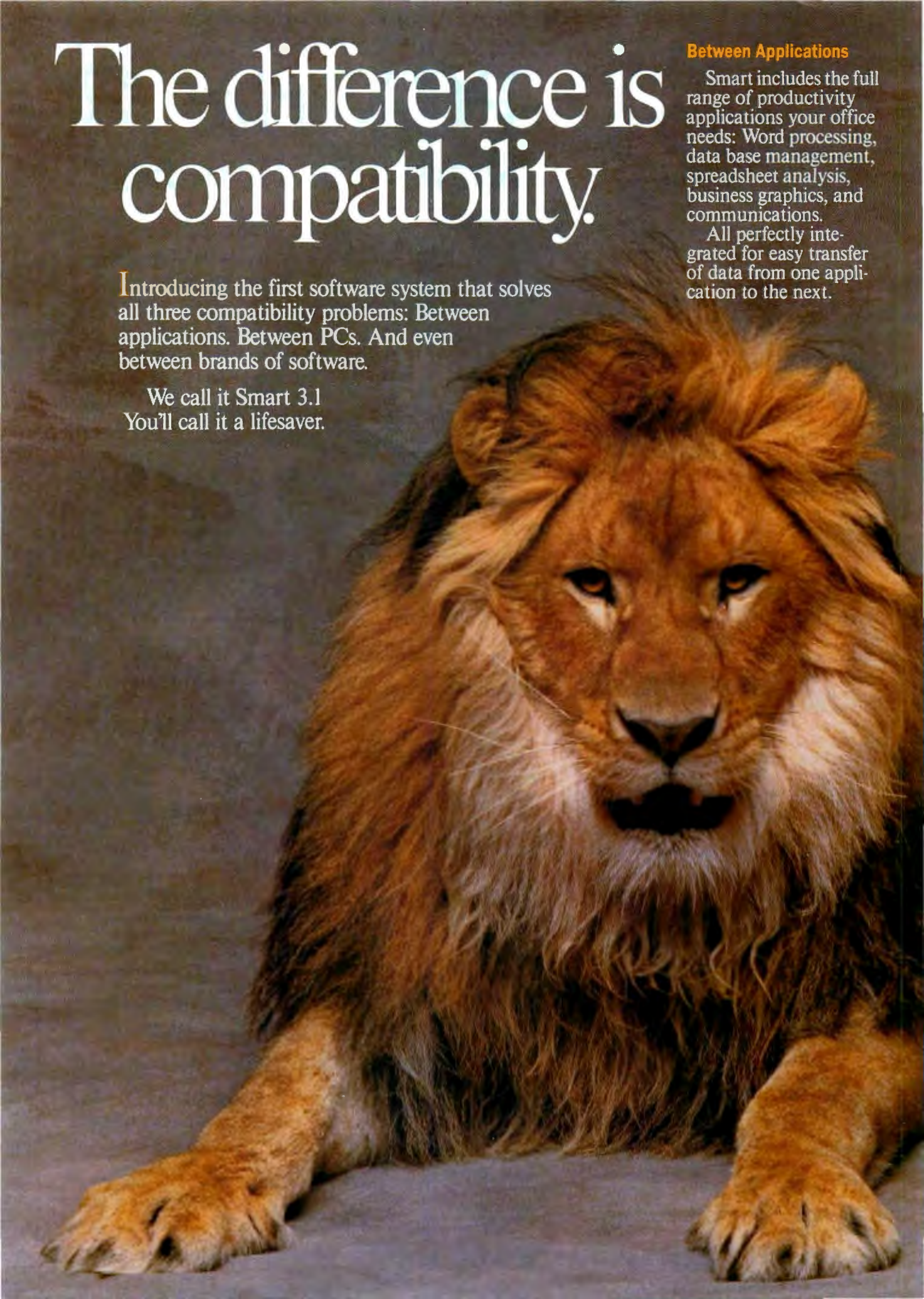
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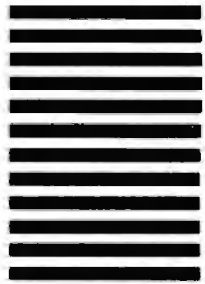

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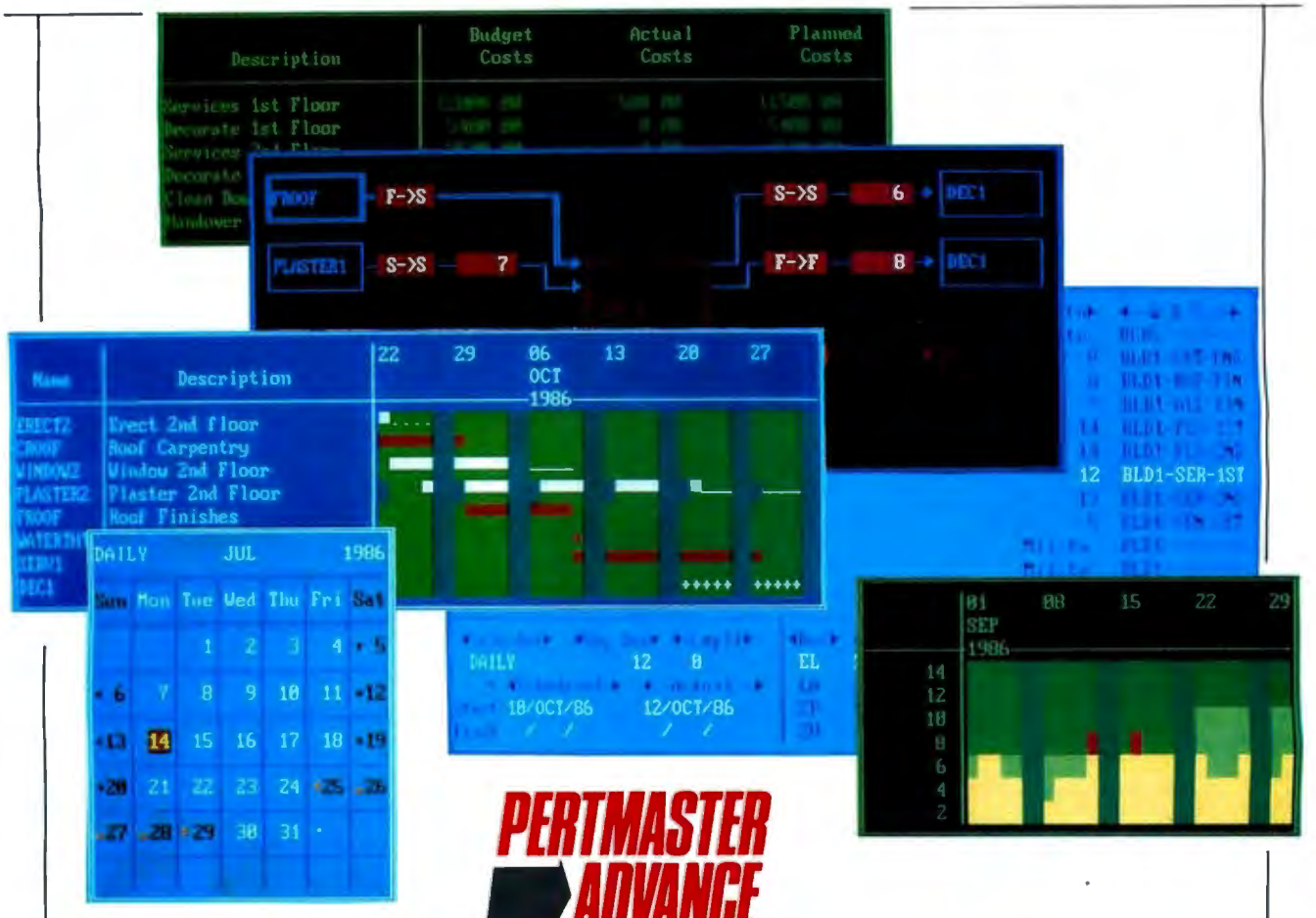

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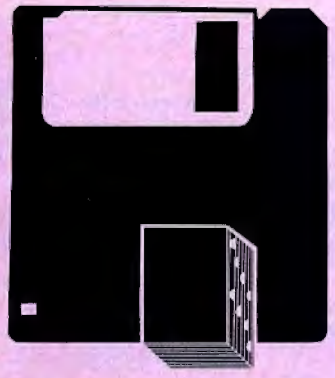

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The first applications software packages were stand-alone systems: If you were in your text editor and needed to do a calculation, you had to leave the editor, enter another program, do the calculation, then go back into the editor or do the calculation by hand on a piece of paper.

Then came integrated packages that let you move more easily from one application to another, but these were still essentially separate modules of one larger program.

Today, you can choose from a variety of RAM-resident programs—programs that you load into RAM and that can run "on top of" other applications. You can invoke them at any time by hitting predesignated "hot keys."

In this review, I'll compare RAM-resident utilities for the IBM PC and compatibles in a variety of categories: spelling checkers, thesauruses, macro utilities, desktop accessories, and a few special programs. Although this is not an all-inclusive review of such products, I've generally chosen the most well-known offerings in each category. I'll discuss the performance you can expect, draw conclusions about which of them I prefer in each of several categories, and provide some specific guidance for assembling a well-behaved, yet comprehensive, environment.

I have assembled the environments on an IBM PC XT with 640K bytes of RAM and a 10-megabyte hard disk drive; as a general rule, a full complement of RAM-resident programs will require much more than 256K bytes of RAM, and hard disks are essential to avoid the cumbersome chore of loading in the programs from an assortment of floppies each time you boot up.

Spelling Checkers

Spelling checkers come in two varieties. The first corrects your spelling as you write, by beeping when you misspell a word. This feature is fine for short documents, but the beeping might become annoying on longer documents. It is also useful when you are on-line, because you can correct your spelling immediately instead of using a cumbersome line editor.

For longer texts, spelling checkers that can proof an entire file at once are more appropriate, since they generally let you change every occurrence of a misspelled word (or ignore correctly spelled words that it doesn't recognize) in one step. Finally, with most spelling checkers, you can select a word and ask if it is in the dictionary or, if not, to see other possible spellings.

Turbo Lightning

Turbo Lightning contains user-selectable main dictionaries of 83,000, 50,000, 16,000, 12,000, and 6000 words. It also contains user-defined dictionaries of 2000 characters (about 300 words). [Editor's note: *For a complete review of Turbo Lightning and Strike, see the November 1986 BYTE.*]

Turbo Lightning is flexible in important ways. It lets you select support for 13 word processors, or you can configure your own support by using a separate configuration module. Lightning is also helpful at finding a word for which I am looking when I suspect I've spelled it wrong—the dictionary almost always turns up the correct spelling.

In addition to an on-line mode, Lightning provides screen-by-screen proofing; it highlights misspelled words and then lets you go back and correct them. When you begin editing the highlighted words, it turns the highlighting off, which can be troublesome—you might think you have to recheck the screen, which you don't. You can restore the highlighting by press-

continued

Jon Edwards (315 Nassau Hall, Princeton University, Princeton, NJ 08540), formerly review editor at BYTE, is now assistant to the vice president for computing and information technology at Princeton.

Spelling checkers/Thesauruses

Product	Turbo Lightning 1.00A	Whoops!	Strike 1.0	Webster's New World On-Line Thesaurus 1.03 (dictionary 1.0)
Manufacturer	Borland International	Cornucopia Software	S&K Technology Inc.	Simon and Schuster
Address	4585 Scotts Valley Dr. Scotts Valley, CA 95066 (800) 255-8008	P.O. Box 6111 Albany, CA 94706 (415) 528-7000	4610 Spotted Oak Woods San Antonio, TX 78249 (512) 492-3384	1230 Avenue of the Americas New York, NY 10020 (800) 624-0023 (800) 624-0024 in NJ
Word processors supported	13+	12+	7	30
Spell-checking features:				
Words	6000—83,000	50,000	50,000	N/A
Words in RAM	16,000	all in RAM or all on disk	all	N/A
Size of user dictionary(s)	2000 bytes each	15,000-20,000 bytes	30,000	N/A
Thesaurus features:				
Lookup Words	5000	12,000	N/A	N/A
Words in Dictionary	50,000	12,000	N/A	120,000
Hard, floppy, or RAM disk memory required	179K bytes for a full thesaurus	106K bytes for a full thesaurus	N/A	360K bytes
RAM required	69K bytes	82K bytes	128K bytes	44K bytes
Documentation	88 pages	28 pages, 2 pages for thesaurus	14 pages	126 pages
Price	$99.95	$49.95	$49.95	$69.95

ing another hot key.

Lightning's major drawback is speed. Checking a screen of a sample file took it more than 25 seconds. By contrast, Whoops! took only 2.2 seconds with the same screen; Strike took only 1.2 seconds. Lightning does have a much larger dictionary—83,000 words compared to 50,000 in Whoops! and Strike—so it checked for more words and highlighted fewer "mistakes." However, even with its 50,000-word dictionary, Lightning took 20.7 seconds to run the screen check.

Whoops!

Like Lightning, Whoops! 3.2 has an on-line mode and—if you feed it a misspelling—responds with a useful series of words from which to select alternate spellings. It does this more quickly than Lightning, but, as a later test clearly indicates, its selection of words is far more limited than Lightning's.

Whoops! also checks screens quickly and, in contrast to Lightning, retains highlighting on-screen after you begin editing the words. The program provides a separate utility for checking entire files; it goes through the file one mistake at a time and stops at each. You have the option of correcting the word, adding it to the dictionary, or moving on. The program will not stop again on a word that you have approved.

Whoops! also lets you import words from ASCII files into auxiliary user dictionaries. Whoops! supports hyphenation, but only if you mark syllables properly in the auxiliary dictionary.

Strike

Strike version 1.0 provides an on-line mode, and paragraph and screen proofing. Strike has a main dictionary of 50,000 words and a user dictionary of 2000 bytes (expandable to 30,000 bytes). However long the user dictionary, Strike insists that it reside in memory, which presumably makes it fast but establishes a limit on its size. Like Whoops!, Strike provides a utility that lets you place new words into the user dictionary from a list generated with your word processor.

Whenever I typed a word incorrectly, Strike offered only a single suggestion. Granted, it offered the correct word in almost every case, but this approach is not helpful when you are searching for the spelling of a specific word. If it did not recognize the word, Strike most often offered no spellings whatsoever, whereas the other products gave whatever words were closest to it in the dictionary, from amongst which I could usually find the correct spelling.

In addition to checking the entire screen at once, Strike lets you check spelling dynamically, stopping on words that it doesn't recognize. I did not find this mode convenient, perhaps because most of the words that it stopped to highlight on my sample screen were obvious proper names that I could easily have told it to ignore in a more panoramic screen or file check.

Rather than measure the time that Lightning, Whoops!, and Strike take to proof documents (which will depend largely on the individual user, since you have to make a decision at each word), I decided to test their ability against a dictionary. Using PC-Write as my word processor, I asked them to proof a list of 50

correctly spelled words from *Webster's Seventh New Collegiate Dictionary*, from "noun" to "nucleolus."

A Clear Winner

Lightning was the clear winner, recognizing 35 of the words, while Strike recognized 19 words, and Whoops! recognized 17 words. I can't help but wonder, however, how much Lightning's extra "knowledge" will help the average person—it spends a lot of time checking for words that the average person is not likely to use.

For example, Strike did not fare well in the *Webster's* test, but it was the only one of the three to pass my special "calender" test: A "calendar" keeps track of time, while "to calender" is to press between rollers or plates. When I incorrectly referred to my appointment "calender," only Strike was smart enough to reject the spelling.

On-Line Thesauruses

In addition to checking spelling, Turbo Lightning 1.0 and the latest version of Whoops! (3.2) help you find synonyms. Webster's New World On-Line Thesaurus version 1.03 is much closer to a true thesaurus.

You select a word in your document and then ask the thesaurus to find words with similar meaning. To evaluate the on-line versions, I selected 11 consecutive words from *Roget's Thesaurus*, a standard reference work, and compared the hard-copy entries to those provided by the on-line versions. The results are in table 1. As with the spelling checkers, I tested all three thesauruses in conjunction with PC-Write.

The Lightning Thesaurus

Turbo Lightning's thesaurus provides two options, a partial and a complete version of the *Random House Thesaurus* (approximately 50,000 words), although it recognizes only 5000 "lookup" words—keywords that it uses to look up the other choices.

Lightning required me to have the cursor on the first letter of the word for which I desired synonyms, until I ran an installation program that configured it to run with PC-Write. After that, I had no difficulty replacing words regardless of where I placed the cursor.

Unlike Webster's, Lightning requires that you feed it the common, singular form of the word you are replacing; it will not remove prefixes and suffixes. For example, it will give you synonyms for "rank," but not for "ranks."

As you can see in table 1, Lightning did not have many of the words that I tried from *Roget's*. When it did have a word in its list of lookup words, however, the alternate choices it presented were usually relevant.

Whoops!

I had some problems using the Whoops! thesaurus with PC-Write version 2.2: Although the manual lists 12 word processors that work with Whoops!, and the publisher claims it will work with many others, PC-Write was not on the list. [Editor's note: *According to Cornucopia Software, later versions of PC-Write should work with Whoops!.*] Even with nothing else in memory, non-ASCII characters appeared on-screen whenever I attempted to use Whoops! with PC-Write, and I found it hard to get Whoops! to remove the old word that I was replacing. I had to start with the cursor on the leftmost character of the old word, or the program would leave whatever characters were to the left of the cursor on the screen.

When the Whoops! thesaurus accepted words, the alternate choices it offered were fairly good. A few of the synonyms were off target—like "relax" for "rankle" and "abstain" for "rapid"—but enough were on target to make this a useful tool. Whoops! also provided antonyms, but it was the only one of the three programs not to offer multiword expressions as synonyms.

Webster's Thesaurus

Webster's New World On-Line Thesaurus from Simon and Schuster was the clear winner of the three. Webster's claims to work with 30 word processors, including Microsoft Word, WordStar, WordPerfect, PFS:Write, XyWrite III, Volkswriter, and MultiMate.

The program lets you replace words regardless of where the cursor is in the word. In the *Roget's* test, all the synonyms that Webster's picked were relevant. (The other two sometimes picked words that had absolutely nothing to do with the keyword.) Like *Roget's Thesaurus*, Webster's often follows its lists of synonyms with some suggested groups if you need to explore further. When the number of immediate synonyms is limited, it provides "See also . . ." instructions—words you can select to search for more synonyms. You can retrace your steps through a multiwindow search, flip from thesaurus "page" to "page," and even store your favorite synonyms on a special note page.

Webster's removed prefixes to find root words and easily dealt with the words "faster" and "programs" by looking up "fast" and "program."

Finally, the program also includes impressive attention to detail. In the phrase "a test," I changed the word "test" to

continued

Table 1: *A list of 11 words taken from* Roget's Thesaurus, *with the number of synonyms available in* Roget's *and each of three on-line thesauruses. The numbers under the on-line thesauruses indicate the number of synonyms that match those in* Roget's *list and the total number of synonyms provided by each of the utilities for that word. A blank indicates that the word was not in the thesaurus.*

Thesaurus	Roget's	Turbo Lightning	Whoops!	Webster's
rank	30	9/38	3/5	10/35
rankle	5	—	0/10	0/27
ransack	7	—	1/6	3/13
rap	6	—	—	2/7
rapacity	3	—	—	1/4
rape	4	—	—	2/26
rapid	9	5/5	4/10	3/6
rapt	3	—	2/7	3/10
rapture	4	3/6	2/17	3/24
rarefy	4	—	—	2/5
rarity	63	—	0/7	2/5

Macro Utilities

Product	Keyworks 2.0	SmartKey 5.11	SuperKey 1.03	ProKey 4.0
Manufacturer	Alpha Software Corporation	Software Research Technologies	Borland International	RoseSoft
Address	30 B St. Burlington, MA 01803 (617) 229-2924	2130 South Vermont Ave. Los Angeles, CA 90007 (213) 737-7663	4585 Scotts Valley Dr. Scotts Valley, CA 95066 (800) 255-8008	P.O. Box 45880 Seattle, WA 98145 (206) 282-0454
Maximum keystrokes in macros	9500	60,000	65,536	32,768
Approximate maximum number of macros	415	440	190	240
DOS command stack	Yes	No*	Yes	No
DOS shell	Yes	Yes	No	No
Cut and paste	Yes	Yes	Yes	No
Change keyboard layout	No	Yes	Yes	Yes
Works with SideKick	Yes	Yes	Yes	No
One-finger mode	No	Yes	Yes	Yes
RAM required	64-105K bytes	29K bytes	40K+ bytes	10K bytes
Documentation	200 pages	180 pages	210 pages	160 pages
Price	$89.95	$59.95 *DOSEDIT included on distribution disk.	$69.95	$129.95

"examination." Webster's changed the article and word to "an examination." Neither of the other programs did.

Macro Utilities

Macro utilities, or keyboard enhancers, let you record sequences of keystrokes and play them back—with just one or two keystrokes—whenever you need them. Macros save time and provide accuracy, especially during monotonous, repetitive tasks. They can also act as "scripts"; for example, I press a single key to load my telecommunications software, set the proper protocols, load and call the correct telephone number, and log me on to a remote system.

The four best-known programs in this category are Alpha Software Corporation's Keyworks, Software Research Technology's SmartKey, Borland's SuperKey, and RoseSoft's ProKey. All have easy methods for loading, saving, and recording macros; all come with sets of prerecorded macros; and all let you produce "display macros"—customized text in windows for use in your own help screens, a list of your macros, frequently used ZIP codes, etc. All let you nest macros within other macros so that you can produce looping macros that repeat until you hit the "stop" key. Finally, all four products also let you input fixed and variable strings during macro execution.

Macro utilities often include a variety of powerful but not macro-oriented features. For example, some add DOS shells that let you access DOS commands from within any application. Others have "command stacks" that let you edit and reissue recently used DOS (and, in some cases, applications) commands. All those mentioned here provide the ability to blank your screen if you issue no commands within a designated period of time, and all expand the type-ahead buffer from 16 to 128 keystrokes. Most of the programs let you encrypt files for security and cut or record a portion of your screen and paste or replay it at any future time, even in another application.

Keyworks

Most often, I get the idea of recording a macro just after I've executed what I would need to record. Keyworks 2.0 lets you record your most recently typed commands as a macro.

A special macro type using Alt-number combinations extends the number of available macros by more than 200, to 415. (Note that in counting the number of available macros for all these products, I didn't count plain keys, shifted keys, and others that would make typing practically impossible.) Keyworks also includes support for printers; you can set up fonts and type styles from within applications. And the cut-and-paste facility lets you direct output immediately to a printer or separate file.

Keyworks lets you create excellent display macros with moving selection bars for easy selection of other nested macros. You can include `GOTO` commands within macros, a useful addition for breaking out of a chain of nested macros. Keyworks also includes a DOS shell.

Keyworks does have a few drawbacks. You can load its macros only from DOS, not from within an application. However, this is not likely to be a problem unless you frequently change macro files.

Second, its command stack is cumbersome to use. Keyworks sets up a buffer to record your last 300 keystrokes. It uses this buffer to provide a record of *all* keystrokes, not just those entered at the DOS prompt. In a word processor, for example, you can easily fill up the buffer with plain text, and the buffer will "forget" any DOS commands you typed before entering the application. You can set the default to enter only DOS commands, but this rules out the possibility of converting recently recorded non-DOS commands into macros.

Finally, Keyworks is the most limited in terms of total number of macro keystrokes that you can load at one time, 9500. That's still a lot of keystrokes.

SmartKey

SmartKey 5.11 features a Supershift key (the gray + key on the far right of most PC keyboards), which doubles the number of macros available to 440, while providing an easier way to remember macros than Keyworks (since a "save" macro invoked by "Supershift-S" might be easier to remember than something like Alternate-193.) Like Keyworks, SmartKey lets you convert former keystrokes into macros, but the 64-keystroke buffer is smaller than that in Keyworks.

All the macro utilities save macros in ASCII files that you can edit with a text editor, but I found SmartKey's files to be formatted such that they are easier to read than the others, and thus the easiest to edit in this way.

SmartKey includes a larger variety of pauses for use within macros than the other products, and the DOS shell has a fairly comprehensive set of commands, including `whereis` (which searches for a file across subdirectories). You can specify the number of times you want looping macros to loop, and you can easily dump to a printer reports that list macros and their descriptions. This last feature is a nice touch; I keep such reports next to my keyboard to use as references.

On the distribution disk, SmartKey provides four different executable files in addition to the main program. One lets you use SmartKey with batch files, another provides encryption, another provides extra windowing capabilities, and PCKEY.EXE provides a variety of keyboard extras, like the type-ahead buffer, alteration of the keyboard layout, and addition of a keyboard click. With separate executable files, you need not encumber your RAM with features you don't require, although this setup makes loading in a fully configured system slightly more inconvenient. If you experience difficulties with other RAM-resident programs,

continued

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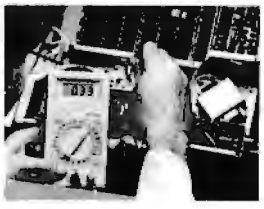

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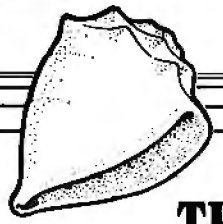

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you might have a harder time determining which program is the offender.

SmartKey does not provide an integrated DOS command stack, but the distribution disk includes DOSEDIT. After invoking DOSEDIT at the DOS level, you can hit the up- or down-arrow keys, which runs you through the DOS commands you've previously entered. You can then select, edit, and rerun a command.

SmartKey features mnemonics, the ability to read a set of letters and then expand them or replace them with a full-fledged macro. To play back these mnemonic macros, you first have to hit a special mnemonic key—not nearly as easy and effective as the dedicated abbreviation expanders described below.

I must admit I was disappointed by SmartKey's documentation, which requires many more examples to make the program easier to use.

SuperKey

SuperKey 1.03 is from Borland International, and therefore it works reliably with SideKick. You can include SideKick commands in your macros, like using a single key to bring up the calendar, notepad, or calculator—which normally take a couple of keystrokes—or using the dialer to call familiar numbers.

SuperKey provides flexibility in macros that involve file handling. You can include in your macros the logged drive and the logged path.

SuperKey's command stack is easy to use, but it has only rudimentary editing capabilities. You are able to scroll through your previously entered DOS commands, but there is no "home" key that returns you to the head of the string if you need to edit it.

SuperKey has only a few obvious disadvantages. It includes no Supershift key, mnemonics, or extended use of Alternate combinations. And because it is both command- and menu-oriented, it takes many of the Control and Alternate combinations for its own needs. The result is that far fewer combinations, about 190, are available for your use. This might seem like enough, but you can use them up quickly. Finally, SuperKey does not provide a DOS shell.

ProKey

ProKey, like SmartKey, provides mnemonics, but in an ineffective way when compared with the dedicated abbreviation expanders described below. One unique feature of ProKey 4.0 is the ability to designate "guarded macros," which will stay resident even if you load another macro file.

continued

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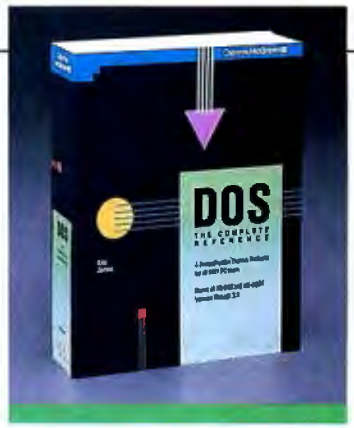

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Abbreviation Expanders

Product	jot! 1.0	PRD+ 1.4
Manufacturer	Beacon Software International Inc.	Productivity Software International
Address	120 Fulton St. Boston, MA 02109 (617) 523-0090	1220 Broadway New York, NY 10001 (212) 967-8666
Buffer size	1K to 999K bytes	40,000-character maximum; 20,000 maximum in a 128K-byte machine
Requirements	DOS 2.0 or higher, does not support EGA	DOS 2.0 or higher, does not support EGA
Change hot key?	Yes	No
Loading order?	if used with SuperKey and SideKick, load in this order. Key, jot!, SK	experiences difficulties running with some other RAM residents
Support expanded memory	Yes	No
Toggle off	Yes	Yes
Memory used	30K+-byte buffer, default buffer is 8K bytes	64K bytes, maximum buffer size N/A
Documentation	150+ pages	26 pages
Price	$69.95	$68

Unfortunately, the current version of ProKey has relatively little to recommend it. It does not provide a command stack, encryption, or a cut-and-paste option. Display macros are far more limited than those of the other three products, and it has no numeric and case filters on variable field input. That is, if you design a macro with a variable field, you cannot require that the input be, for example, only numeric (for use in a spreadsheet.)

Finally, ProKey is the only one of the four macro utilities not to provide access to SideKick. ProKey does allow 240 macros while taking up less RAM than any of the other products.

Abbreviation Expanders

Abbreviation expanders (or mnemonic macro utilities) let you type an abbreviation and press the space bar (or any of several other keys), and the utilities will replace the abbreviations with a full-length translation.

Some macro utilities, like SmartKey and ProKey, include mnemonic features, but, to play back these mnemonic macros, you first have to hit a special key. This is not nearly as easy and effective as having abbreviations expand when you type them out and hit the space bar. A new class of RAM residents, however, is designed specifically for mnemonic functions.

Beacon Software International describes jot! 1.0 as a RAM-resident typing accelerator. With jot!, you can easily add, delete, rename, and edit the abbreviations you designate. To add an abbreviation, you press the jot! hot key to bring up a full-screen menu, select A for add, type the abbreviation, hit Return, and type the translation (with full-screen editing available). To put the abbreviation into temporary memory, you press the Escape key, a wise design choice that lets you use the Return key as part of the translation. You can also save the abbreviation in a permanent file, and jot! comes with a standard file of some example abbreviations.

Abbreviations must be one to eight characters in length, they can contain only alpha and numeric characters, and the first character must be a letter. After you type an abbreviation, typing a space, return, or almost any punctuation mark will bring on the translation.

The program is case-sensitive: If you capitalize the abbreviation "Gvt," the translation will be capitalized "Government." The program does have a toggle-off, an essential feature if you need to type what otherwise would be regarded as an abbreviation.

You can also use jot! to nest abbreviations within abbreviations and can interrupt the playback of long abbreviations by hitting the hot key; otherwise, you could accidentally produce an infinitely recursive expanded abbreviation.

To help make jot! compatible with other programs, you can set three options for up to eight different applications (word processors, databases, and so on). You can regulate the speed with which jot! "feeds" the text to your application, you can specify the key your application uses as its destructive backspace key, and you can toggle jot! on and off.

My only complaint with jot! is that I occasionally activated the hot key (hitting Control twice) when attempting other Control functions. Still, you can easily give jot! another hot key during the installation process. The program claims to support WordStar, MultiMate, Microsoft Word, and WordPerfect, and it also worked perfectly with PC-Write.

PRD+ 1.4, from Productivity Software International, follows the same principles as jot! but is slightly more difficult to use. From PRD+'s main menu, you can create, modify, and merge "word lists" (which contain abbreviations of up to eight characters long and their translations), print copies of word lists, and get a count of the number of keystrokes you have saved by using the utility.

You can gain access to the PRD+ main menu only from DOS, unlike jot!. This is inconvenient if you use separate word lists for different tasks and must change them before, for example, editing a new document. Fortunately, you can initially load PRD+ and a word list simultaneously without going through the main menu. You can also add words to a word list from within an application, as well as edit or expand existing abbreviations, but you need to move the cursor to a blank area on the screen.

Including carriage returns in PRD+ abbreviations is more difficult than in jot!, since the abbreviation-entry process displays instructions in the same line where you are entering the abbreviation. On the other hand, jot! provides an empty screen where "what you enter is what you get." Also, PRD+ translations are limited to 240 characters, substantially shorter than the full screen's worth allowed by jot!.

Finally, several of the characters that let you expand abbreviations in jot! (the asterisk, dash, and plus and minus signs,

for example) do not work in PRD+. When you use several others, like the exclamation point and question mark, PRD+ inserts the translation but doesn't take out the original abbreviation.

However, PRD+ has several nice features. The toggle on/off switch involves one keystroke, compared to three in jot!, and the standard word list that comes with the utility is far superior. It contains abbreviations for the 100 most frequently used words, 200 most frequently misspelled words, the months of the year and days of the week, the 50 states and 30 major cities, and common phrases for business letters. Finally, PRD+ supports more capitalization rules than jot! does. If, for example, you capitalize your abbreviation, PRD+ will capitalize the entire translation, while capitalizing just the first letter will do the same to the translation.

Overall, I preferred jot! to PRD+. It has a better design and slightly more flexibility in its operation, although PRD+ has more features and is fully capable of doing the job. In the end, how well they perform with the other RAM residents is crucial; in that context, jot! will be a much clearer favorite.

Desktop-Accessory Programs

RAM-resident desktop organizers provide a variety of useful pop-up features, like an editor, calendar, and calculator. In this category, I reviewed Borland's SideKick (version 1.52A), Timeworks' Partner PC (version 1.5), and Brown Bag Software's Homebase (version 2.5) as representative of the large number of such products available.

Borland's SideKick was the first commercial product of this type, and it probably forms the base of most RAM-resident environments used today. However, SideKick is no longer a clear favorite.

The calculator in SideKick is about as elaborate as one you could now buy for $5. It lets you place only one number in memory, and it supports only the four basic mathematical operations. However, you might need its two special features: You can quickly operate on numbers in decimal, hexadecimal, and binary and convert any number from one to the other. Second, you can easily paste your output into your application.

Similarly, SideKick's calendar will satisfy only simple needs. You can enter appointments only by the half hour, and input is limited to 26 letters per entry. You can easily enter, obtain, and print the information using the cursor and function keys, but you can't, for example, automatically enter a year's worth of meetings, each on the second Thursday of the

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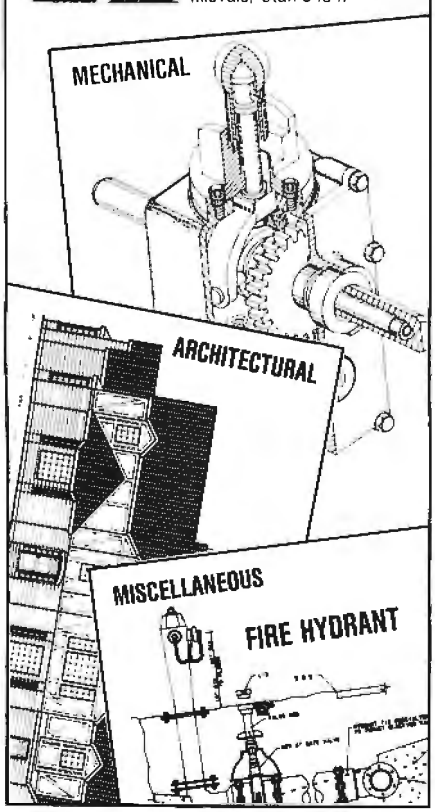


Desktop-Accessory Programs

Product	SideKick 1.52A	Partner PC 1.5	Homebase 2.5
Manufacturer	Borland International	Timeworks Inc.	Brown Bag Software
Address	4585 Scotts Valley Dr. Scotts Valley, CA 95066 (408) 438-8400	444 Lake Cook Rd. Deerfield, IL 60015 (312) 948-9200	2105 South Bascom Ave., Suite 164 Campbell, CA 95008 (408) 559-7090
Features	Editor, calculator, calendar, telephone dialer, ASCII table	Editor, calculator, calendar, telephone dialer, alarm clock, DOS functions	Editor, database, telecommunications, calculator, calendar, telephone dialer, ASCII table, alarm clock, DOS functions, more
RAM required for all features	62K bytes	233K bytes	200K bytes
Documentation	122 pages	143 pages	208 pages
Price	$99.95	$59.95	$89.95

month at noon.

The SideKick notepad is fully adequate to the task. You can adjust the notepad's size, and the commands are WordStar-like, although you can alter them to suit your preferences. Word wrap, block moves, and full search-and-replace capabilities are all available. The cut-and-paste facility is useful for transferring messages to and from on-line services.

Many SideKick users rarely use the calendar or calculator but swear by the telephone dialer. You can use the dialer with Hayes-compatible modems and with an on-line telephone directory of your choice. If you have a phone number in the middle of a text file on your screen, you can have the dialer do the dial. Nice stuff.

In its full configuration, SideKick uses about 62K bytes of RAM. While the program is not as full-featured as it could be, its main advantage might be that it is widely used. Most applications have had to incorporate compatibility with SideKick, which is therefore less likely to cause difficulties in simple environments. Moreover, three of the four macro utilities discussed above have specific provision for including SideKick functions in macros.

Partner PC

In addition to the usual calculator, calendar, notepad, dialer, and so on, Partner PC provides separate executable files that include an alarm clock that can work in conjunction with your appointment file with up to six alarms; a DOS shell with nine commands, including `type`, `xdir`, and `chkdsk`; and a utility that lets you suspend one application while you move to and activate another.

Partner PC also provides you with a choice of two calculators: an 18K-byte calculator with the usual arithmetic functions and a 33K-byte financial calculator with many business functions.

The calendar is disappointing; it provides only a three-month display of important dates and holidays but not an appointment facility. To record appointments, you must use the notepad.

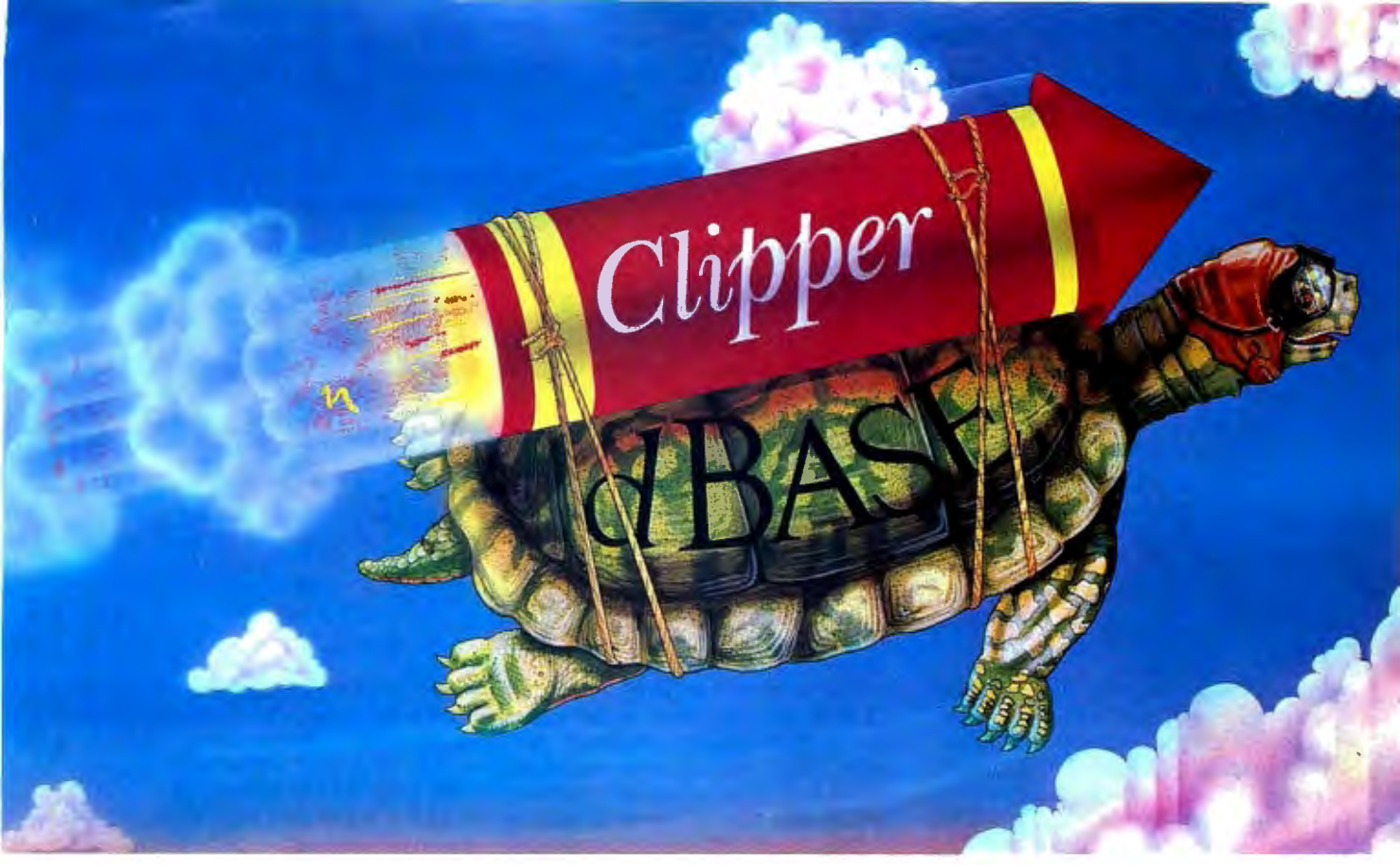
Like SideKick, the Partner PC notepad is full-featured. You can flip from window-based editing to a full-screen display, an arrangement that is slightly less flexible than the resizable SideKick notepad. Partner PC relies on the notepad for both appointment scheduling and to keep track of telephone numbers for the dialer. This means that it takes you slightly longer to access them, since you have to go through the notepad to get to them. Apart from that small disadvantage, I liked the dialer. It too works with Hayes-compatible modems, and it lets you call your three most-used numbers with the press of a function key.

The principal disadvantage of Partner PC is its size. A fully configured system, with an alarm clock, notepad, basic calculator, dialer, calendar, and DOS shell requires 233K bytes, far more than these features are worth to me. You do, however, have the opportunity to load only those features you want.

Homebase

At the heart of Homebase is a database that integrates with many of the other features. Database functions make the editor

continued



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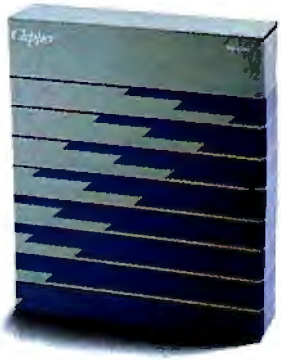

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22-page manual	54-page manual	128-page manual	5-page manual plus tutorial on disk	60-page manual
$29.95	$79.95	$49.95	$19.95	$69.95

more attractive by letting you incorporate text and search functions in the other modules, and you can set up "notebases" for storage and retrieval of your data. Already included with Homebase is an area-code directory, an ASCII table, and an address and telephone book.

The Homebase calendar is the most versatile of those in the three programs. It has an alarm feature (with an alarm scheduler and up to 12 alarms per day), expense-report capabilities, the ability to enter appointments for any time (rather than just on the half hour), and—because the editor is tied to Homebase's flexible database retrieval system—the ability to enter text of any length, search for needed items, and roll items in the appointment list to your to-do list.

The Homebase calculator includes the four basic operations, exponentiation, and storage for 26 variables, which you can subsequently use in your calculations. It also has a hexadecimal mode.

Homebase includes a straightforward telecommunications facility, which you can use as a simple dialer if, like me, you would prefer to use your favorite—and presumably more full-featured—terminal software. But you might find appealing Homebase's ability to send and receive electronic mail while you are working in another application. Unfortunately, you cannot send or receive XMODEM transfers while you work elsewhere.

Among the extras included with Homebase are an optional on-screen clock, a screen saver, a cut-and-paste facility, and the best DOS shell of all the tested programs. In addition to all the DOS commands you would expect, this feature lets you mark multiple files for copying, moving, and deleting; travel up and down your directory paths; get information on the contents of each directory; and sort files. Homebase also now comes bundled with PowerMenu, a menu system for those who hate DOS.

I think that Homebase is the winner among these desktop-accessory programs, but you might prefer one of the others. You might reasonably conclude, for example, that the power of each of Homebase's features doesn't compensate for the 200K bytes of RAM they require on your system.

Cruising and Noting

A huge number of other RAM-resident programs are on the market, too many to cover here, but the following utilities are unique and worthy of your consideration.

Cruise Control version 2.15 from Revolution Software increases the speed of your cursor keys. Without Cruise Control installed, it took me 7.4 seconds to move the cursor from the left to the right side of a PC-Write screen by holding down the right cursor key. With Cruise Control installed, the cursor zipped across the screen in less than a second.

If anything, the utility performs its function too well—it moves so fast, you can overshoot your mark—but after a month of working with the utility, I can generally stop on a dime.

The other main feature of Cruise Control is antiskid braking, which is useful in conjunction with applications like Lotus 1-2-3. With this feature installed, keyboard input ceases the moment you lift your fingers off the keys, eliminating the unfortunate tendency of the keyboard buffer to pour forth its contents well after you wish it would stop.

Cruise Control takes up 5K bytes of RAM and includes a screen saver and a date and time stamp.

SmartNotes

SmartNotes version 1.4 from Personics Corporation lets you attach Post-It–type notes to your applications. You position the cursor at the place where you'd like a note, hit the hot key, and enter your note. You can then save the accumulated notes in a note file for that particular document.

The program, which requires about 90K bytes of RAM, records the context in which you attach notes. When you reenter the application, SmartNotes uses pattern matching to reproduce the notes that you saved in conjunction with the document. I have found that notes reappear if the same text appears later on a different screen in the same document and stop appearing when I remove the text with which they were originally associated. When you reboot, the notes will not automatically reappear with your application until you reopen the appropriate note file, a small inconvenience. You will have to remember where you keep your notes, and I have found it useful to distinguish note files by using application-specific extensions.

You can take advantage of SmartNotes in many ways. In addition to PC-Write, I was able to attach notes to DOS directories, SideKick appointments, and as additional REM statements in BASIC programs.

The latest version of SmartNotes (1.4) lets you reconfigure the hot keys to avoid conflicts with your application or other RAM-resident programs and lets you open a note file using a batch file.

Tornado Notes

Tornado Notes version 1.72, from Micro Logic Corporation, helps you organize and locate information that you can place in multiple windows, all of which pop up when you hit the hot key. You can then edit the information in each window, import data from ASCII files, and jump from note to note.

Unlike SmartNotes, which attaches notes to specific documents, Tornado Notes clusters notes in a RAM-resident

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area. At any time, you can access the notes area, skip from note to note, and, most importantly, search for the single item you need from among all the notes. The search is well-structured and lets you see the number of matches found with each new letter in the search string. In other words, you might need to type in only four letters to find whatever entry you need.

Compact, but Non-intuitive

The application requires a minimum of 50K bytes of RAM, plus whatever space you reserve for notes, up to 55K bytes. I imported my to-do list, my electronic Rolodex, and several other important files there, but the editor is quite adequate for entering that type of material directly. Tornado Notes lets you adjust the size of note windows, import and export ASCII files, and page through the notes quickly.

The commands required for Tornado Notes are not intuitive; it will take you a while to master them. For example, several important functions are listed under the nondescriptive menu heading "other." Each menu itself appears as a note, but they are too small and cryptic to provide much help in the beginning. Still, Tornado Notes might be the right addition to your environment to organize your scraps of paper and lists of information.

Putting It All Together

Working with a number of different RAM-resident programs is like mixing chemicals in a laboratory: You'll have your share of accidents in getting them to work. As the resident programs compete for memory and control of the keyboard, they can crash an application, freeze your screen, and lose your work.

Of the possible mixes of RAM residents, Borland provides perhaps the easiest environment to assemble. With SideKick, SuperKey, and Lightning as a foundation, you get most of the features you require, although some significant items are absent, and you might want to add them. For example, I added jot! as an abbreviation-expander facility, Cruise Control, Tornado Notes, and a couple of other utilities. (I also tried PRD+ in place of jot!, but it introduced a variety of problems; for example, SuperKey wouldn't function.)

The order of loading is important, although none of the Borland manuals states exactly why. You have some limited flexibility, but you must load SuperKey, Lightning, and SideKick in that order, and SideKick should be the last of all the RAM-resident programs.

The only major disadvantage with the environment is that it does not include a DOS shell. I also missed the area-code database available with Homebase, since I make many long-distance calls. Therefore, I added a public domain area-code finder to my applications subdirectory. I set up a macro to install and use the databasefrom DOS. However, the disadvantage is obvious—I have to leave the application I'm in to get to it, hardly the illusion of multitasking that the RAM residents were meant to provide. If I get ambitious, I could always enter the area-code information into a Tornado Note.

A More Elaborate Approach

For the second environment, I tried to combine the best of each category of RAM-resident software. I began by loading in DOSEDIT, PCKEY (which redefines the keyboard to my liking), and SmartKey, all of which are on the SmartKey distribution disk. Then I loaded Homebase and changed directories.

The setup "blew up" with a stream of system error messages. DOSEDIT appeared to be the offender, since its docu-

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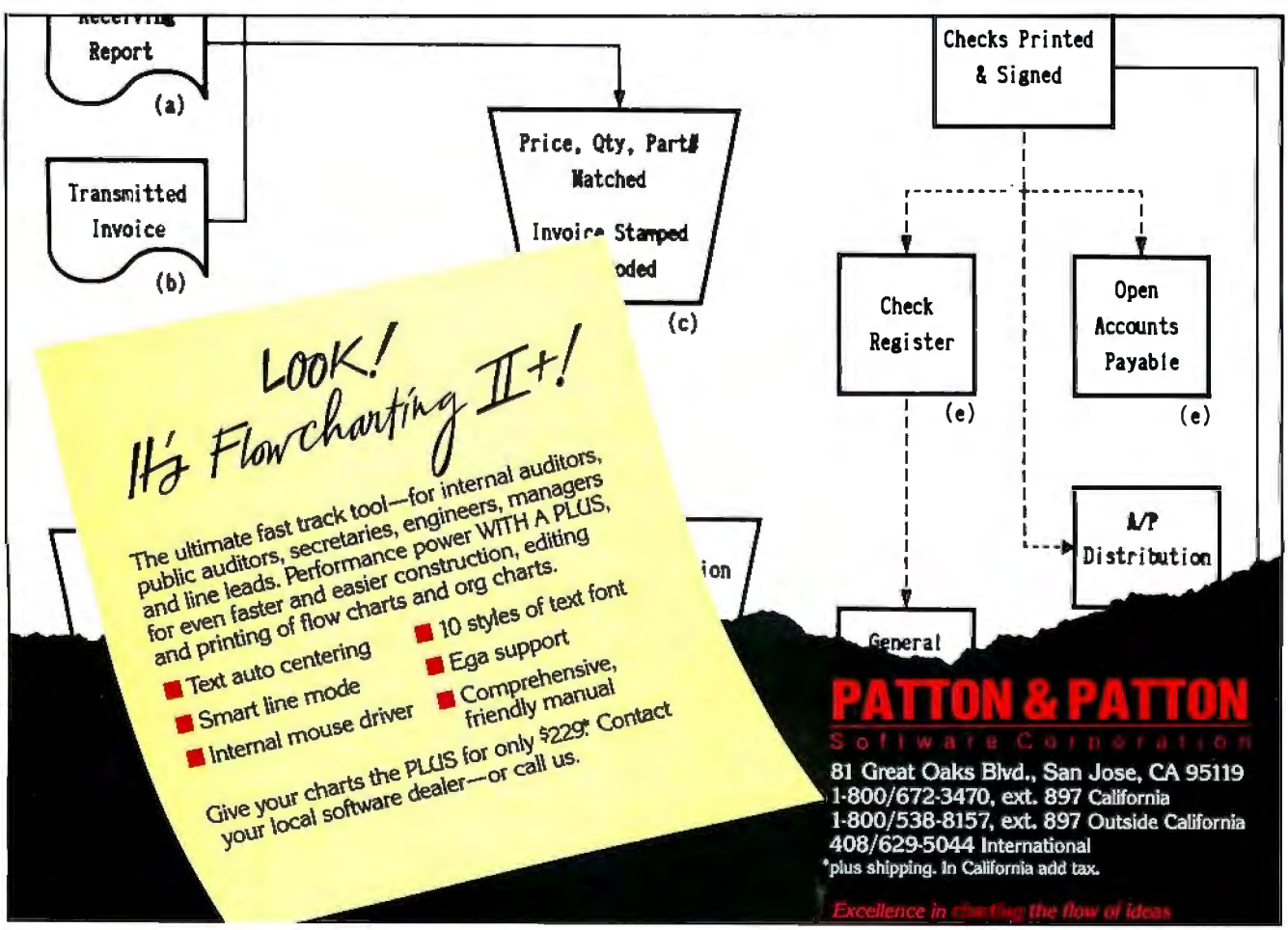

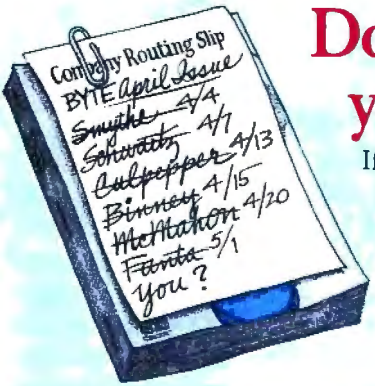

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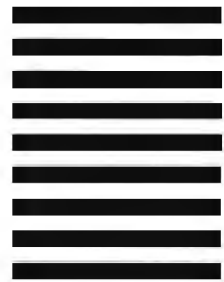

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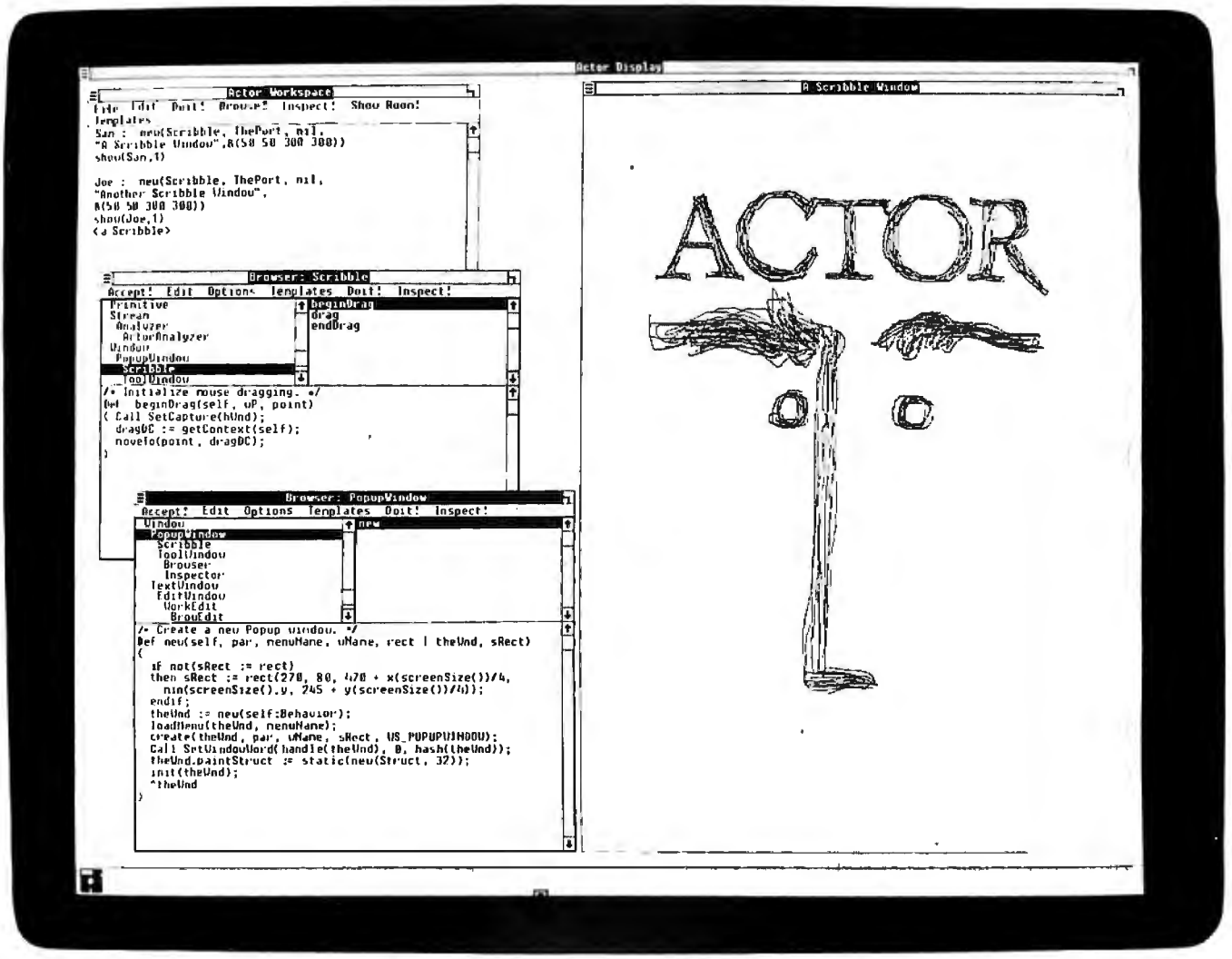

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mentation revealed that it had been tested only under DOS 2.1; I was running 3.1. Also, in a 20-page addendum to the manual, a lone instruction recommended that DOSEDIT be loaded after Homebase, despite earlier instructions to load Homebase last. I loaded DOSEDIT last, and it thereafter worked well.

Before adding a spelling checker and thesaurus, I loaded in jot! and Cruise Control. Cruise Control didn't cruise, and jot! froze the keyboard. PRD+ fared no better. I repeatedly tried changing the loading order of the utilities, but nothing worked until—following a tip from the SmartKey manual—I removed PCKEY.

I prepared to add Webster's thesaurus, then the system crashed at the DOS prompt. Out came jot!, which seemed to solve the problem. Webster's went in, this time without a hitch.

I then tried both Whoops! and Strike. Strike would not work with Cruise Control loaded, and it performed badly in conjunction with the Homebase editor. I had to change the Whoops! hot key to avoid a conflict with Homebase, but the configuration program made this easy, and Whoops! worked fine thereafter.

This setup exhibited a series of small successes and failures. Cruise Control would not work in conjunction with SmartKey's cut-and-paste facility. Fortunately, Homebase also has cut and paste, and Cruise Control worked well with it. To use Homebase's cut and paste, however, I had to reassign the main SmartKey hot key (because Homebase requires the use of that key to cut text), a complicated but not insurmountable task. I did find that SmartKey could use DOSEDIT functions in its macros, a real plus.

Making RAM Residents Behave

Even assuming that a RAM-resident environment is itself well-behaved, it will not function with some applications. For example, the telecommunications program I use, Yterm from Yale University, is completely incompatible with all the RAM residents that use keyboard interrupts. Rather than reboot every time I want to use Yterm, I can use either Referee version 1.0B from Persoft or PopDrop version 2.0 from InfoStructures Inc., which mediate between the RAM residents, albeit in different ways.

Referee lets you specify your applications and the RAM residents active with each. In principle, it is a wonderful and convenient idea. However, I could not get Referee to overcome the incompatibilities with Yterm, and it introduced one of its own. SuperKey and SideKick no longer communicated.

PopDrop fared much better. PopDrop lets you set up "layers" of RAM residents. When a layer becomes inconvenient (perhaps you need the memory for another application, or you would prefer to load in a different environment of RAM residents), you can "peel back" a layer (PopDrop allows up to eight) and proceed.

Yterm operated perfectly under the PopDrop scheme. Reloading all the RAM residents after every Yterm session still takes time, but this is more convenient than rebooting.

Let the Builder Beware

I'm more convinced than ever that building an environment of RAM-resident utilities is not an exercise for the weak of heart. For the moment, I can recommend the Borland and Homebase-SmartKey solutions, and I would like to hear about the environments that other readers have assembled. [Editor's note: *BYTE will feature a review of Metro, a desktop-accessory program recently released by Lotus Development Corporation, in an upcoming issue.*] ■

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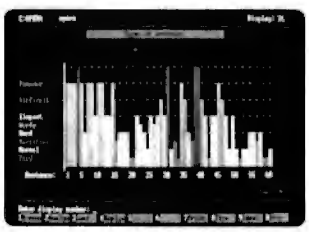

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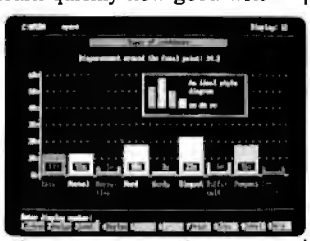

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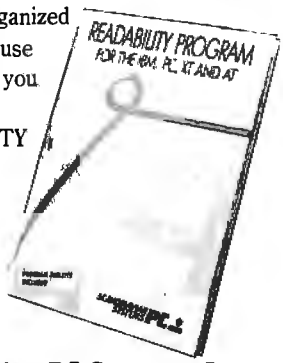

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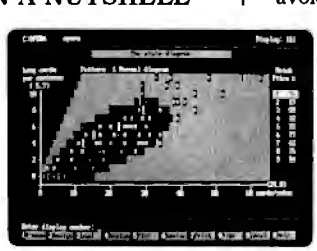

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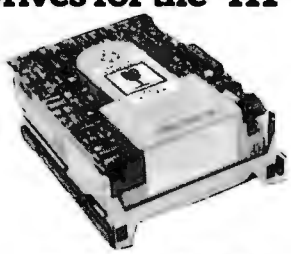

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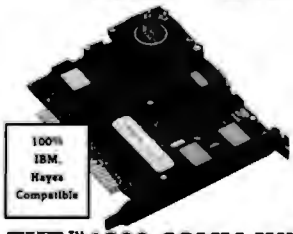

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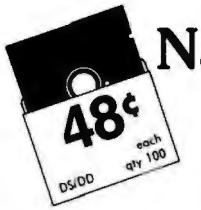

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14	36	58	80	102	124	146	168	190	212
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233	255	277	299	321	343	365	387	409	
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