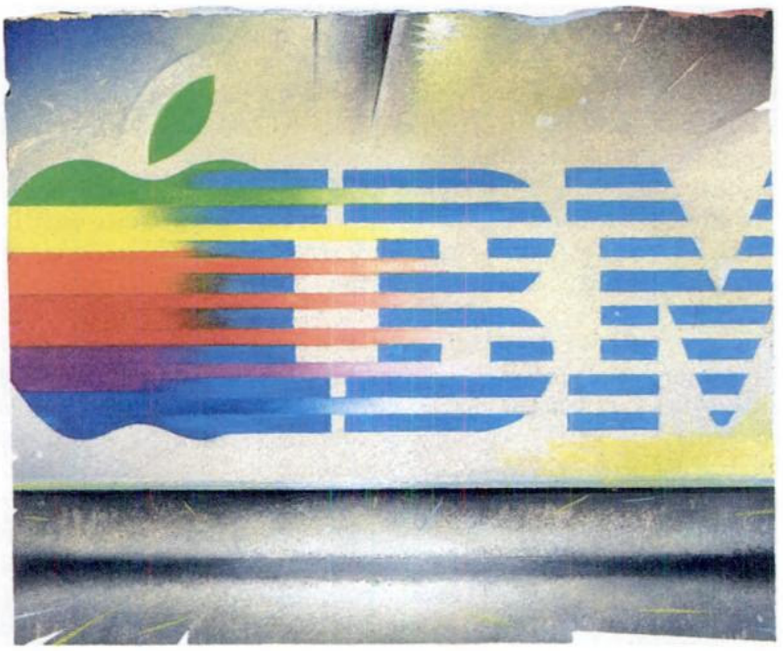


THE BEST OF BOTH WORLDS

It used to be an easy choice: IBM for work, Mac for home. Things aren't so simple anymore.

COVER STORY JIM SEYMOUR

The similarities are almost as interesting and remarkable as the differences between them. From their announcement dates exactly one month apart, the Apple Macintosh II and IBM PS/2 Model 80—the new flagships from Apple and IBM—have shared strikingly similar specifications and roles in their makers' lines. Indeed, it sometimes seems they have more in common than at odds.

Both computers introduce new bus structures for their makers—in both cases, sharp breaks with earlier designs. Both forfeit hardware and software compatibility with earlier models in the interest of much better performance. Both rely on fast ESDI hard disks for much of their speed. Both mark their makers' leaps to new, more powerful microprocessors from the same families as those used in their earlier machines.

Both introduce new graphics systems, at identical 640- by 480-pixel resolution levels on their standard color monitors. Both offer new mice as integral pointing devices, without requiring users to forfeit expansion slots for the mouse interface. Both are clearly intended for the brave new world of megamemory, where 1 megabyte is just an opening bid and at least 2 to 4 megs are required for serious work. Both stand to benefit dramatically from new operating systems designed with these machines in mind. And both made it to market a year later than expected.

WATCHING THE OTHER GUY Indeed, examining both systems under the hood, and using similar applications on

Illustration: Cary Henrie

both machines, it becomes clear that Apple has learned a lot from watching IBM: how Big Blue sees the future of personal computing tied to system-to-system connectivity, and how it prices and positions new top-of-the-line products. And it's equally clear that, as much as it would resist the suggestion, IBM has learned a lot from watching Apple redefine user interfaces, use great gobs of memory for fast context-switching, and build into its machines the fundamentals of connectivity.

Both machines are hot boxes—two to three times faster than their makers' previous mainstays and potentially much faster with coprocessor cards certain to appear for their new (and very different) buses—buses finally receptive to true multiprocessor computing.

Both are hot in another sense, too: they're hard to find, with the few units that make it into dealers' hands generally going to satisfy backlogs of orders placed months ago. Big Blue began deliveries of the Model 80 a shade sooner than promised, in early summer. But they're still tough to find. Apple shipped the Mac II more or less on schedule, shortly before IBM—but a squabble with Sony, the source of the superb 13-inch Apple RGB monitor designed for the Mac II, has kept Big Fruit's new wonder a rarity because the color displays have been almost impossible to find.

POWER SPECS Now that Apple has a Mac ready to play in the big leagues, and now that IBM has finally rolled out its first 80386 PC, we thought it was time to take a look at the vendors' top-of-the-line systems to see how they compared one-on-one, as well as how they coexist in a mixed-hardware environment.

First, a quick look at both machines.

IBM's PS/2 Model 80 8580-041 lists for $6,995, plus another $685 for the pick-of-the-litter Model 8513 12-inch color display, and $120 for the PC-DOS 3.3 operating system package. Add $95 for a *lumpen* IBM PS/2 mouse. For your $7,895, you get a 16-MHz Intel 80386–based tower-style PC with IBM's excellent 101-key enhanced keyboard, an ESDI (enhanced small-device interface) 44-megabyte hard disk drive, a 3½-inch 1.44-megabyte microfloppy disk drive, and seven available expansion slots in the new Micro Channel Architecture bus design. You also get 1 megabyte of 80-nanosecond RAM on a motherboard that accepts up to 4 megabytes (using 1-megabit chips, presently available only from IBM), in a system that accepts up to 16 megabytes with add-in upgrade memory cards.

The Video Graphics Array (VGA) display and associated circuitry (finally built into the PS/2 motherboards) allow 16 of 256 colors in its standard 640- by 480-pixel high-resolution mode.

One interesting option: a 16-MHz 80387 math coprocessor chip (not yet available) at $1,195.

MAC PRICING Apple's new Macintosh II comes to $6,997 when configured with the superb Apple 13-inch RGB color display, 16-MHz Motorola 68020 main CPU and 68881 math coprocessor chips, Apple's new and mediocre 81-key keyboard,

The Macintosh II looks more like an AT-compatible machine than the familiar one-piece unit from which it has evolved. The full-size (13-inch) color monitor, a feature long desired by Mac users, offers the same kind of Macintosh high resolution that has always awed PC users.

PC MAGAZINE FACT FILE

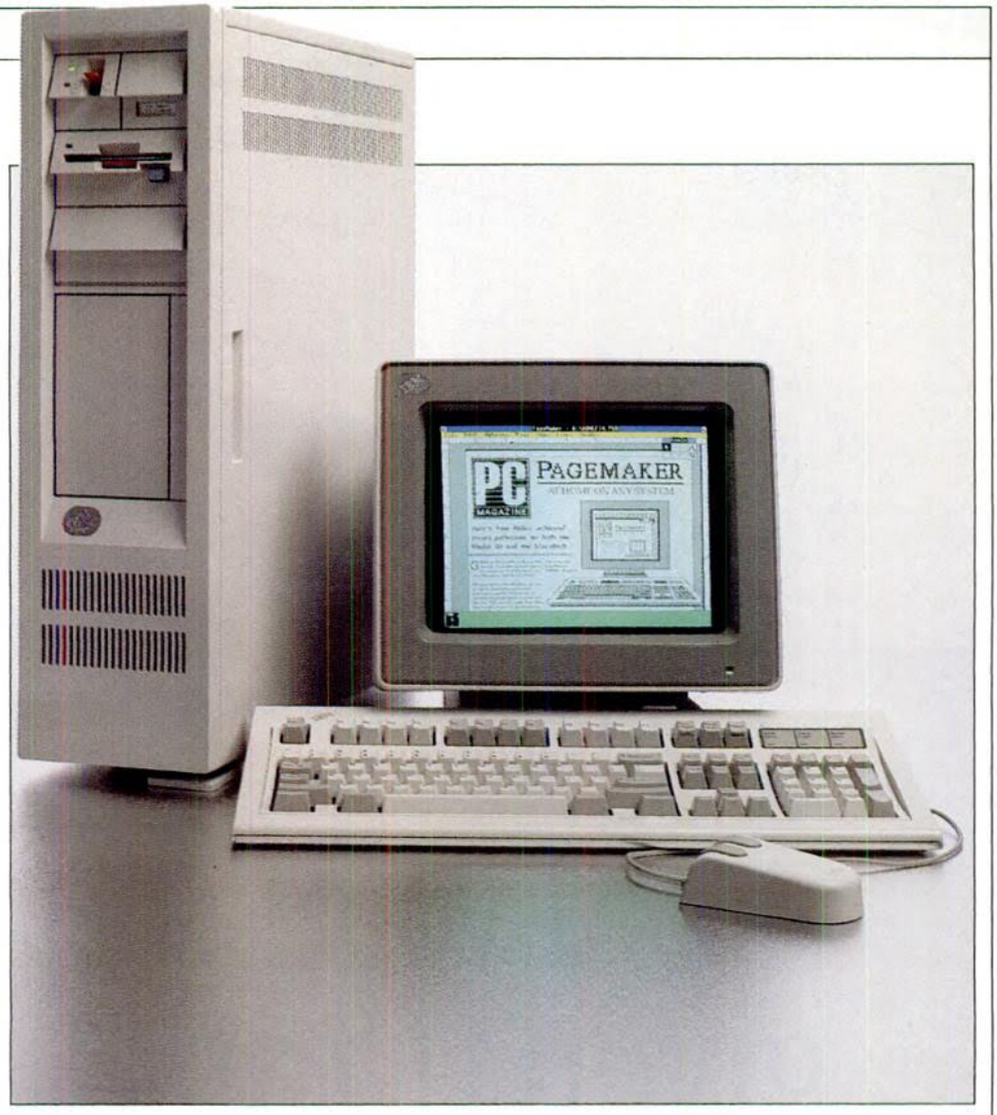
Apple Macintosh II
Apple Computer Inc.
20525 Mariani Dr.
Cupertino, CA 95014
(408) 996-1010
List Price: $3,898 (includes one floppy disk drive; 16-MHz 68020 processor and 68881 math coprocessor; 1 Mbyte RAM; 6 expansion slots); with 40-Mbyte hard disk drive and Apple keyboard, $5,499; 12-inch hi-res monochrome monitor, $399; 13-inch hi-res RGB monitor, $999; Macintosh II video board, $499; Apple extended keyboard (with function keys), $229; 1-Mbyte memory expansion board, $349; 2-Mbyte memory expansion board, $999.
In Short: An innovative and long-awaited flagship for the Apple family. Its friendly interface and speedy mouse operation are key to its attractiveness, and new business software is helping it find a place in the office.

CIRCLE **685** ON READER SERVICE CARD

PC MAGAZINE FACT FILE

IBM PS/2 Model 80
IBM Corp.
Consult your local authorized dealer.
List Price: Model 80 8580-041, $6,995 (includes 1 Mbyte of RAM; 1.44-Mbyte floppy disk drive; 44-Mbyte hard disk drive; clock/calendar; serial, parallel, mouse, and video ports; 8 expansion slots; 225 watts power; and IBM enhanced keyboard). Model 80 8580-071, $8,495 (includes 70-Mbyte hard disk drive; 2-Mbytes RAM). For both Model 80s: 12-inch VGA monochrome monitor, $250; Model 8513 12-inch VGA color monitor, $685; mouse, $95; DOS 3.3, $120. Model 80 8580-311, $13,995 (includes 20-MHz 80386 processor; 2 Mbytes RAM; 314-Mbyte hard disk drive); second 314-Mbyte hard disk drive, $6,495. Model 80 8580-311 available first quarter 1988.
In Short: A large and powerful machine in which applications programs perform better than ever before. The promise of OS/2 adds even more to its potential.

CIRCLE **686** ON READER SERVICE CARD



As the flagship of the PS/2 family, the IBM PS/2 Model 80 provides 80386 processing power, and VGA resolution circuitry, which is built into the motherboard, allows the monitor to generate high levels of resolution and 16 of 256 colors on-screen.

an excellent one-button Apple mouse, one 3½-inch 800K-byte microfloppy disk drive, an ESDI 40-megabyte hard disk drive, six expansion slots of standard NuBus design, and 1 megabyte of RAM on a motherboard that accepts up to 8 megabytes (in a system that can handle up to a giggly 2 gigabytes with add-in cards).

The standard video board supplied with the Mac II provides 640- by 480-pixel resolution with up to 16 colors from a palette of 256. Most buyers will opt for Apple's $149 kit of video-memory RAM chips, which cranks the color palette up to 256 out of 256,000.

Apple includes in the hardware price the *System* and *MultiFinder* programs, which together constitute the Mac's operating system, as well as the new *HyperCard* "stackware" program (see the sidebar "The New Seekers: Hypertext Comes of Age").

On a spec-versus-spec basis, the two computers appear close. On the Mac II, which has a slightly smaller disk drive, Apple tosses in the math coprocessor, the mouse, and the system software IBM charges for separately; hence the price advantage may go to Apple. But IBMs are more commonly and more deeply discounted than Apples—and in any case, in this league no one chooses one system over the other to save a few hundred dollars.

APPLES AND ORANGES? A direct, rigorously quantified comparison of the performance of computers built around different microprocessors, running different operating systems, is almost impossible. Even when test programs written for one environment, such as the PC Labs benchmark tests for PC compatibles, are recompiled for the other machine, too many differences remain for anyone to draw precise conclusions.

Getting lost in a maze of Whetstones, Dhrystones, and Dhampstones leads to conclusions such as "Both machines deliver 2 to 4 MIPS of computing power." Aside from the uselessness and ease of manipulation of MIPS figures—millions-of-instructions-per-second measurements, popularly known among computer techies as Meaningless Indices of Performance—that kind of comparison isn't very helpful to someone more interested in producing letters, spreadsheets, mailing labels, and presentation graphics than in charting speed tests.

That's because our perception of the performance of a computer is based on how it handles the applications programs we use to do real work. It's perfectly possible to argue, for example (as some do), that using a disk-caching program to speed up apparent performance is just a cheap trick: the computer isn't really that fast.

Or that using a program such as *Microsoft Word*, which does its own extensive (and invisible) prefetching of first, previ-

Photographs: Roberto Brosan

THE NEW SEEKERS: HYPERTEXT COMES OF AGE

Sometimes very powerful ideas get lost in the background noise of technology until equally powerful tools come along to help us understand those ideas and put them to work. Ted Nelson's "hypertext" idea has been rolling around in the computer industry for almost two decades, without catching on, perhaps because it has yet to attract that critical mass of products that put an idea to work in a form people find useful.

No longer.

In August at the MacWorld Expo in Boston, Apple presented two new products, one of which has the juice to popularize the idea and the use of hypertext far beyond today's limited understanding of the term. Apple calls the product HyperCard, and to see it at work is to understand immediately how very powerful Nelson's idea was.

HyperCard is in effect a database/applications-building tool. But that's about as clumsy as calling a Steinway a music/applications building tool, for HyperCard (known as WildCard during development at Apple) is an elegant product that's useful right out of the box.

HYPERTEXT LINKS The basic idea of hypertext is simple: gather a lot of text, perhaps in a lot of files; then make possible links, or leaps, from any word or item to any or all related words or items anywhere else in that mass of text.

Say you're reading an electronic encyclopedia's entry on Iowa and are in the middle of a passage on corn production. You should be able, hypertexters argue, to put your cursor on one of the occurrences of the word *corn*, hit a key, and jump to any and all corn-related entries in the whole encyclopedia, from corn bread recipes to cornflakes to "corn-likker" to microwave popcorn to U.S. corn exports in 1985 to . . . maybe even cornball comics and corny jokes.

Great idea. But how do you implement it?

Apple's Bill Atkinson, who applied Nelson's ideal (and who also wrote *MacPaint*), started with the assumption that index cards are a convenient way for many of us to gather information. But the very discreteness of those index-card entries and the disparate nature of the information they hold defy organization and retrieval beyond simple alphabetization of first-line entries and maybe some keyword indexing.

So Atkinson built HyperCard, which allows users to accumulate huge piles of metaphorical index cards, organizing each "stack" of cards around some common theme but enabling many stacks to be linked in ways that allow lightning-fast hypertext-style searches. Each card can hold up to 32K bytes of data (including graphics as well as text); each stack of cards can hold up to 500 megabytes. Searches are blindingly fast: about 1 second to search through a stack of a few thousand cards.

Atkinson says files as large as 20 megabytes ought to be searchable in just 2 seconds or so. And HyperCard also automatically handles data compression at a 30-to-1 ratio. The observant will note that the data capacity of a HyperCard stack is almost exactly the same as that of a CD-ROM disk, which, along with the search-speed improvements produced by its data compression routines suggests that HyperCard may become a primary indexing and retrieval medium for small optical disks.

NOW: STACKWARE Because not all of us have the time, patience, or good ideas needed to assemble useful stacks of HyperCards, Apple has begun pushing the idea of "stackware" to use with the program. HyperCard is so easy to use that you really don't have to be a programmer to build stacks; indeed, among the first stackware products announced are series from management guru Tom Peters, the staff of the *Whole Earth Catalog*, on-line database vendor Lockheed DIALOG, and author Danny Goodman (whose *Business Class* stackware, from Activision, supplies travelers with a database of information on 60 countries).

There have been rumbles about a similar product for the IBM PC. Apple says it won't do that product and thinks it would take anyone else a long time. But Owl International, publishers of *Guide*, a hypertext program already available for the PC and PS/2, says it will have a HyperCard-compatible version, running on the PC under *Microsoft Windows*, by the end of this year. Owl says its product will be able to read stackware developed for HyperCard on the Mac.

WHERE ARE YOU, OS/2? In August Apple also rolled out its new multitasking operating system, *MultiFinder*. For some time Mac users have been able to do simple context-switching quickly and easily using Andy Hertzfeld's clever program, *Switcher*, to juggle several pro-

ous, next, and last screens of a document—to make jumping to the next or previous screen, or to the top or bottom of a document, appear much faster—is also a cheap trick: the computer just isn't that fast.

So what? For all practical purposes, perceived speed is the same thing as real speed in using a personal computer. Software that exploits the hardware features of a given system to produce more *effective* speed is justifiably called fast software. Since when we work with a computer we're working with a system, not just hardware or software, shouldn't the hardware that makes that apparent speed possible get the same credit?

A ROSE BY ANY OTHER NAME But the comparison problem is even more complex. Applications programs that

grams and datafiles in memory.

But *Switcher* doesn't (yet) work reliably on the Mac II. In any case, it requires a lot of memory to be very practical—memory unavailable, at least from Apple, on the Macintosh until the Mac SE and Mac II appeared. Thus *MultiFinder*, Apple's first stab at a multitasking operating system.

Effective use of *MultiFinder*, like almost all multitasking operating systems, still requires a lot of memory—at least a megabyte, according to Apple, but in practice 2 to 4 megabytes. Since the Mac II's motherboard can hold up to 8 megabytes, the only disadvantage of adding memory is the cost of the chips.

MultiFinder hadn't yet shipped by press time, but demonstrations show it to be a useful advance—and a nice piece of one-upmanship for Apple, which can point out quite fairly that the IBM PC's mainstream multitasking operating system, OS/2, won't be available until sometime in 1988.

The Apple entry isn't a true multitasking operating system, though it's much more than a context switcher. *MultiFinder* can handle just two concurrent programs, and the one in the background gets only tiny slices of the Mac's CPU; the CPU remains dedicated mainly to powering the program running in the foreground. But *MultiFinder* is available, and OS/2 isn't: score one more for the Cupertino crowd.

Both HyperCard and *MultiFinder* are now included without extra charge with new Macintoshes. Owners of existing Macs can buy HyperCard and *MultiFinder* for $49 each.—**Jim Seymour**

share the same name in versions for both the Mac and the IBM—Aldus's *PageMaker* and Microsoft's *Word* and *Excel*, for example—aren't really the same programs at all. While the user interfaces of *PageMaker* and *Excel* on the two machines are very similar, for example, the underlying code is very different. Aldus, particularly, has gone a long way toward sharing code between the two versions, but even so, at their core the programs are different beasts.

So, although comparing apparently similar applications on the two machines, as we have done, appears to provide a common ground, the fundamental differences between PC and Mac versions of the "same" program mean that conclusions such as the apparent speed of program execution are only very rough rules of thumb.

Microsoft Windows, for instance, provides a congenial and Mac-like home on the PC for applications such as *PageMaker* and *Excel* that are coming to the PC from the Mac. But *Windows* itself exacts a substantial penalty in performance. Thus, *Excel* on the PC may in fact be as fast as or faster than the Mac version—but we'll never know, because that speed is irretrievably masked behind the busywork of *Windows*.

And remember that speed isn't everything, even in speed-oriented hardware like that of the Mac II and Model 80. The quality of the human interface, both on-screen and through the keyboard and mouse or other pointing device—as well as the intelligence of the metaphors adopted by the operating-system and applications-software designers—count for a lot, too. So we looked beyond pure speed of execution at how both systems worked with well-regarded, high-profile programs to get the job done.

A quick general impression: overall, excluding graphics programs and including operations such as saving files to disk, the PS/2 Model 80 feels and measures about 10 to 15 percent faster than the Mac II. But on graphics packages and on comparable applications using the *Windows* graphics interface, the Mac is slightly to substantially faster—often by 25 to 50 percent.

Second general impression: programs that spring from the Mac environment consistently work, look, and feel better on the Mac. *PageMaker* and *Excel* implementations on the PC are very good, fully featured, and amply fast on a speed demon like the Model 80. But they're still quicker and smoother in operation on the Mac.

Now for some specifics.

PAGE MAKEUP CA. 1987 Though *Ventura Publisher* is giving Aldus a run for its money on the PC, and *Ready, Set, Go!* and *Quark's Express* are hot on the Mac, *PageMaker* still stands astride both markets like the Colossus of Rhodes: the dominant product in both camps and with a well-deserved reputation for mixing power and ease of use, enjoying high name identification among personal computer users and lots of happy customers.

Aldus's versions of *PageMaker* for the PC and for the Mac are by far the best-matched, most similar applications available on both systems.

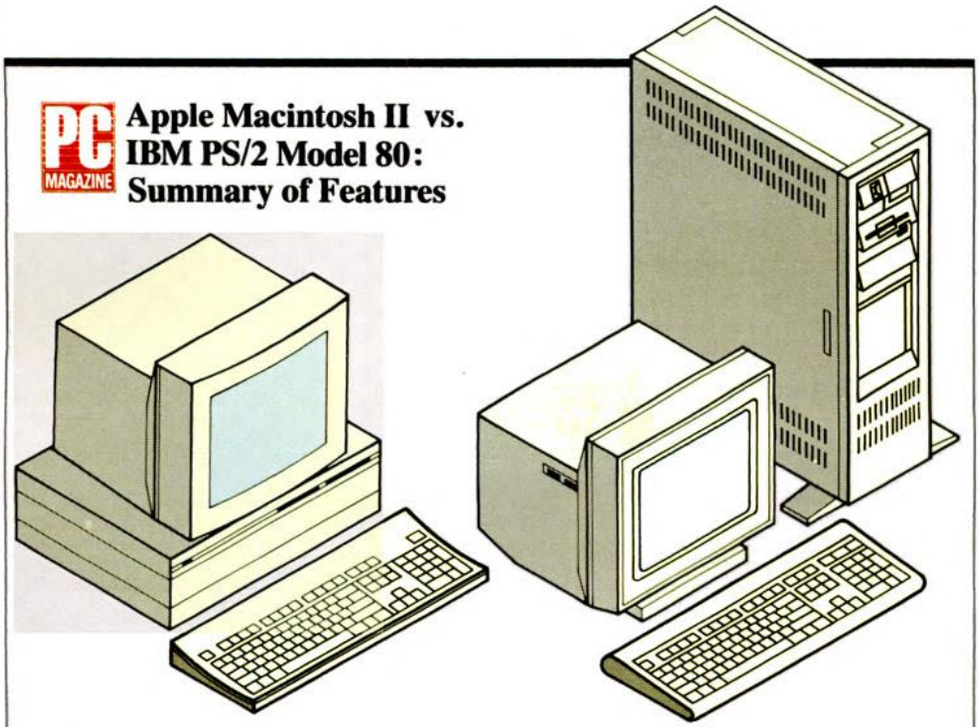
Aldus's current versions of *PageMaker* for the PC (Version 1.0a) and for the Mac (2.0) are by far the best-matched, most similar applications available on both systems. They also feature a very high degree of exchangeability and interchangeability: *PageMaker* on both machines can read files created by the other version, as well as word processing files from programs such as *Microsoft Word*. We ran *PC PageMaker* under *Microsoft Windows*, Version 1.04, the current release.

Because PC *PageMaker* runs under *Windows*, it supports the fairly wide range of monitors and printers supported by *Windows* itself, or for which *Windows* drivers are separately available—and no others. Mac *PageMaker* by definition supports all the monitors available for the Mac, with video-display issues resolved in the hardware.

WELCOME TO THE MAC Users of PC *PageMaker* will be immediately comfortable using their favorite page-makeup program on the Mac II. And vice versa: with few exceptions, the same commands do the same things.

Even those used to running PC *Page-*

Apple Macintosh II vs. IBM PS/2 Model 80: Summary of Features



Apple Macintosh II $5,499 with 40-Mbyte hard disk drive		IBM PS/2 Model 80 $6,995 with 44-Mbyte hard disk drive
SPECIFICATIONS		
1 megabyte	RAM	1 megabyte
Up to 8 Mbytes	Memory expansion	Up to 16 Mbytes
16 MHz	Clock speed	16 MHz
Motorola 68020	Microprocessor	Intel 80386
Motorola 68881 standard	Math coprocessor	Intel 80387 optional
Mouse-driven graphics	Primary interface	DOS commands
DOS through add-in board	Secondary interface	Mouse-driven graphics through *Microsoft Windows* (now) and OS/2 Presentation Manager (1988)
NuBus	Motherboard	Micro Channel Architecture
6	Expansion slots	8
PERIPHERALS		
Comes with 81-key Macintosh Plus style; IBM Enhanced keyboard option, $229	Keyboard	Comes with IBM Enhanced keyboard (101 keys, incl. 12 function keys)
12-inch hi-res monochrome, $399; 13-inch hi-res RGB, $999	Monitor options	12-inch VGA monochrome, $250; 12-inch VGA color, $685
Included	Mouse	Option, $95
MISCELLANEOUS		
Yes	Clock/calendar	Yes
90 days	Warranty	1 year
Beep, boing, clang, chimp screech	Audio feedback options	Beep

Maker on a fast Model 80, though, will be surprised at the speed with which the Mac version gets and places graphics and text, and rescales artwork as it builds pages. On the Model 80 the process is fast—and dramatically faster than on an 8-MHz PC AT, the least powerful machine on which I think *PageMaker* makes sense—but on the Mac II, graphics and text almost snap into place when you click the mouse button to insert them.

That crispness is characteristic of almost every operation in *PageMaker* on the Mac II. That *ought* to be the case, of course: an intensely graphical program such as *PageMaker* should perform better on a graphically oriented and graphically optimized system like the Mac II.

Because the Mac and the LaserWriter Plus are themselves tightly integrated systems, Mac *PageMaker* handles printing more easily than does PC *PageMaker*. Though the PC can drive the LaserWriter, many more PCs are connected to Hewlett-Packard LaserJets. LaserJet users must make certain that their printers have enough memory (at least 1.5 megabytes; preferably 2.5—possible only on the new LaserJet Series IIs), and must first convert the BitStream (and other) bit-mapped font files for use by *PageMaker*.

The almost infinitely scalable internal ROM-based fonts of the LaserWriter give a great deal more flexibility, and often better-looking output, than the more limited typeface selection and type sizes (up to only 30 points, or about ¾ inches high) available on the LaserJets.

The results? Overall, *PageMaker* on the Mac bests its counterpart on the PC by a fairly wide margin.

STATE-OF-THE-ART WP When Microsoft introduced the new 3.0 Version of *Word* for the Macintosh early this year, it got a lot of attention. That was partly because the revision was so late—Mac *Word* users had been limping along on Version 1.05 for 2 years—but also because *Word* 3.0 looked like what Mac power users had wanted for a long time: a state-of-the-art word processing program that put PC word processing in its (musty) place.

Previewing Mac *Word* 3.0 last fall, I saw the future of word processing on personal computers: a plethora of features,

The 81-key Macintosh Plus–style keyboard that comes standard with the Macintosh II has no function keys but does have a unique power on/off button located at the top center.

The 101-key IBM Enhanced keyboard is standard with the PS/2 Model 80. Its solid feel and audible and tactile feedback remain unmatched by any other keyboard. It has 12 function keys.

menus of user-selectable length and thus complexity, true WYSIWYG displays including accurate representations of type sizes and fonts, and the powerful text-formatting features long associated with *Word* now made easier to understand, easier to get at, easier to use.

Word 3.0 turned out to be all that and more. And unfortunately, also less. Version 3.0 was as buggy as a Moscow embassy. The phone lines at Microsoft lit up with complaints; the Mac bulletin boards and conferences of on-line services blazed with vivid, often unprintably harsh criticisms; and Mac *Word* users generally lit up, furious that a program so long awaited, and so full of promise, could be so flawed.

Mac users as a class are a knowledgeable and demanding lot who suffer neither fools nor flawed programs very well. Microsoft eventually acknowledged the problem and over the summer sent out "maintenance release" Version 3.01, to fix those bugs.

GETTING BETTER, NOT OLDER Meanwhile, Microsoft continued to improve PC *Word*, moving to Version 3.1, then 3.11, then the new 4.0, shipped in September.

Word 4.0 on the PC may be the most dramatically improved version ever released of an already well-established program. Much faster in almost every way than its predecessors, *Word* on the PC has forever shed its reputation as the tortoise of word processing software.

We compared PC *Word* 4.0 on the Model 80 with Mac *Word* 3.01 on the Mac II. Both *Word* 4.0 and the Model 80 came out way ahead.

Though the Mac *Word* interface is appealing and the new, larger display of the Mac II shows WYSIWYG at its current best, the program is sometimes sluggish.

What made the Mac credible wasn't the advent of desktop publishing. It was the advent of Microsoft's *Excel*.

Using the "elevator box" that is an integral part of the ROM-based Macintosh interface is a clever but often slow and clumsy way to make major jumps in a document—say, to the last screen, or to a designated page. Keystroking that jumps on the Model 80 with *Word* 4.0 is faster and more convenient. Microsoft has done an excellent (if unMac-like) job of offering keyboard moves with Mac *Word*, rather than forcing users to move to the Mac's mouse, but things still happen faster on the Model 80.

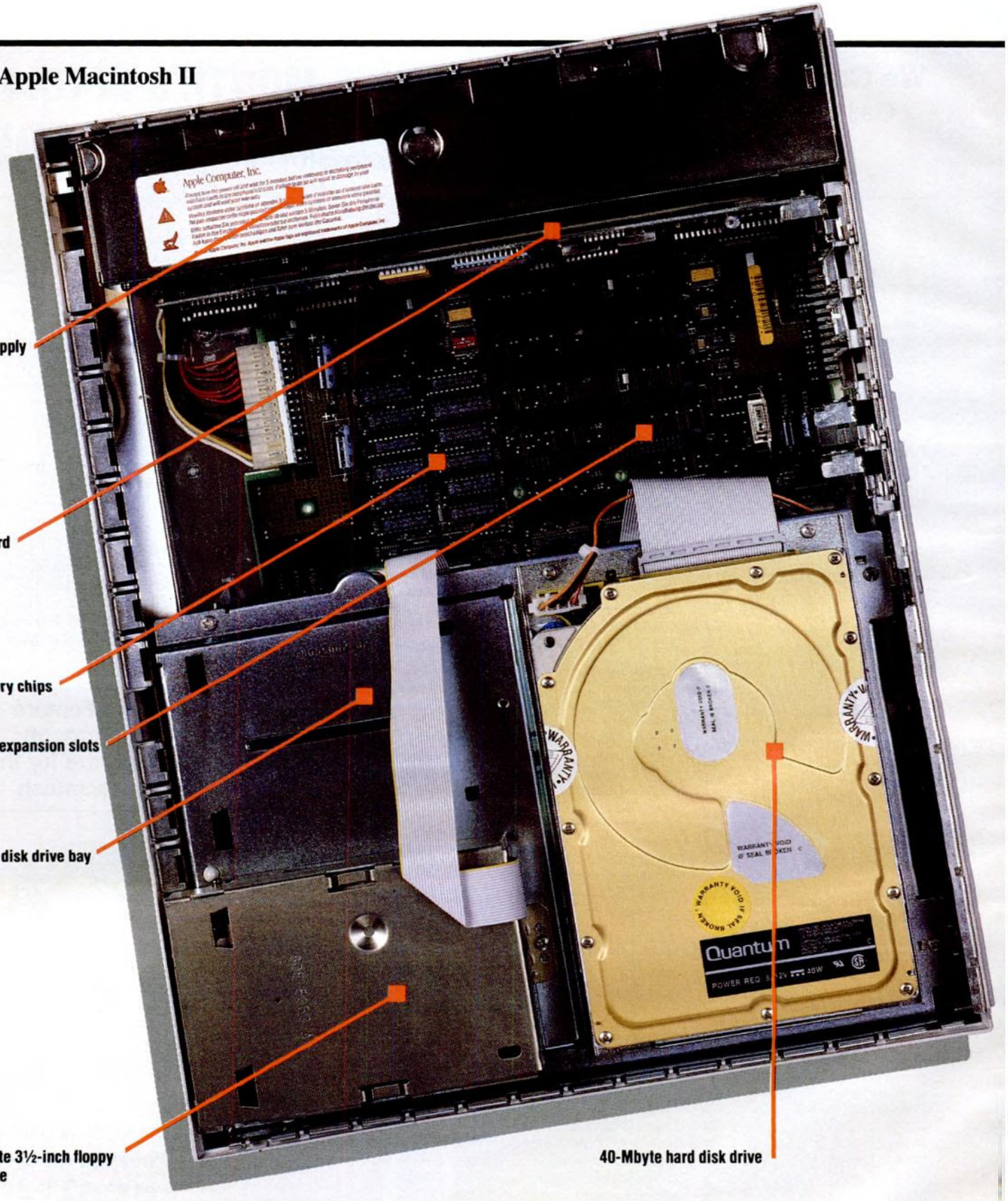
The Mac II's mediocre keyboard was a major factor in calling this one for the Model 80. The Mac keyboard is flat, compact, and attractive. It also has an awful touch, with too-short key travel; and for those who fall short of touch-typing status and need to peek at the keyboard, it features remarkably unattractive and hard-to-read characters on its key caps.

By contrast, the newish IBM 101-key enhanced keyboard, introduced on the RT PC a year and a half ago and now standard across IBM's PC and PS/2 lines, is big but has a magnificent touch, legible key caps, and—unlike the standard Mac II keyboard—function keys.

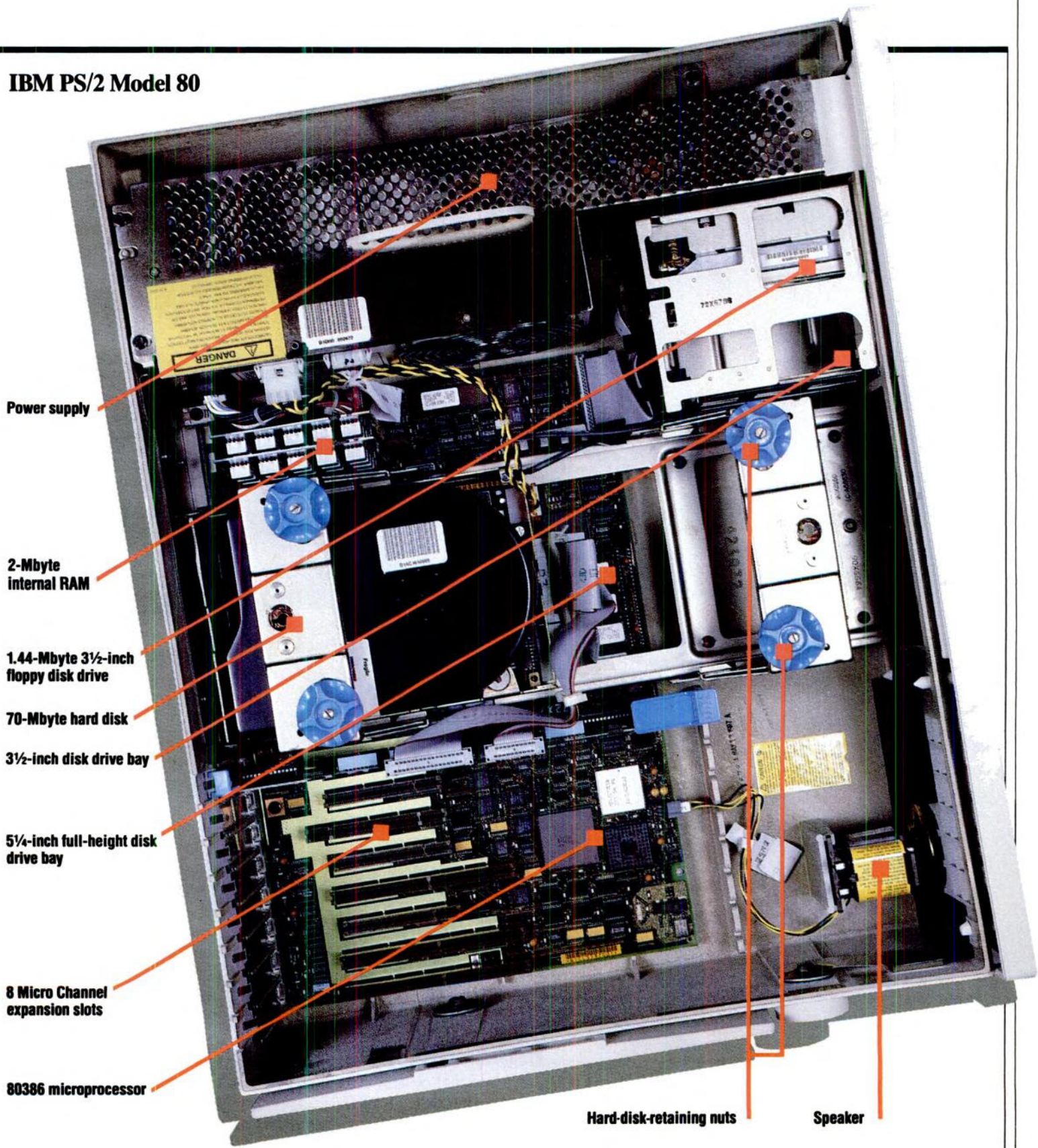
Function keys are the subject of much derision among the Macintosh faithful, but as the Mac moves into the office, more and more software for the machine will allow use of function keys as mouse-click alternatives—for those whose keyboards have them. In fairness, Apple does offer an enhanced keyboard (not yet available for review) similar in form and key layout to IBM's enhanced keyboard.

EXCELLENCE One of the enduring myths of the Macintosh holds that what made business take the Mac seriously was the advent of desktop publishing. That's nonsense. What made the Mac credible was the advent of Microsoft's *Excel*.

Apple Macintosh II



IBM PS/2 Model 80



MAC SOFTWARE GETS SERIOUS

Loyal, dyed-in-the-Blue-wool IBM PC users often dismiss the Macintosh as a yuppie plaything, a nice if expensive gadget for drawing grainy pictures and writing letters with rows of little bunnies printed across the bottom of the pages.

Though for some that attitude grew out of disappointing personal experience with the early, feeble, single-disk-drive 128K Mac, much of the disdain for the Mac among PC users arises from the perception that there isn't much good software available for the machine—certainly nothing like the diversity and quality of applications running under DOS.

Time to look again, friends.

While the PC leads the Macintosh in number of programs available by maybe ten to one—with about 2,500 programs for the Mac, as opposed to a reported 25,000 for the PC—in quality, the Mac software kit challenges almost anything on the PC.

To be sure, the Mac doesn't offer the hundred or more word processing programs available for the PC. But who's going to use a hundred word processors? What counts is that the very few from which you're likely to choose *your* program are good. On that basis, the Mac does very well indeed, with *Microsoft Word*, *MindWrite*, and *WriteNow* available, *WordPerfect* and *FullWrite* coming soon . . . and, yes, *MacWrite* for the occasional memo.

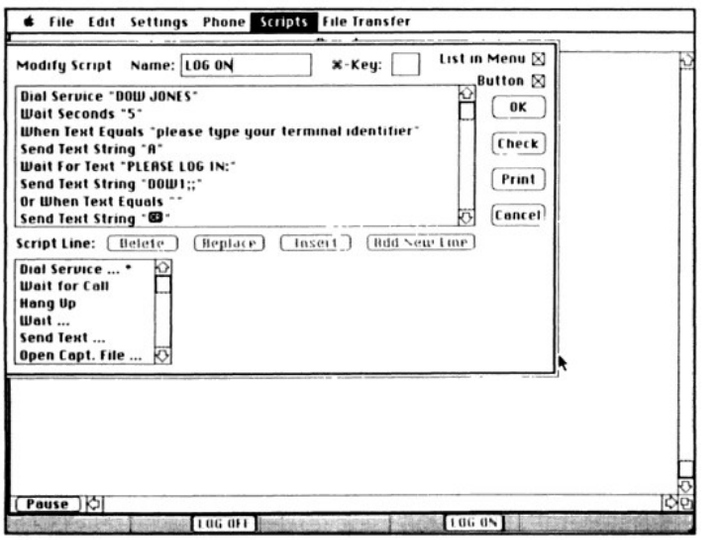
WATCH OUT, 1-2-3 In spreadsheets, the Mac has *Excel*, arguably the best spreadsheet ever written—and so good that it's coming to the PC this fall, under *Microsoft Windows*, as *PCExcel* (to be reviewed in an upcoming issue). There's also *MacCalc* and *Multiplan*, and an odd but useful program called *Trapeze*, which can hide its spreadsheet calculations behind attractive, unspreadsheet-like report-style printed pages.

In databases, the Mac spawned *Helix* (and now *DoubleHelix*) and *Omnis 3*—both powerful, versatile relational databases easier to work with than PC programs of similar power. Both are good applications development environments; *Omnis 3*, particularly, makes development of sophisticated, complex systems relatively fast and easy. And PC users who are fond of *dBASE III* can now buy *dBASE Mac*, which has an excellent, very Mac-like interface and features not found in the PC *dBASE* products.

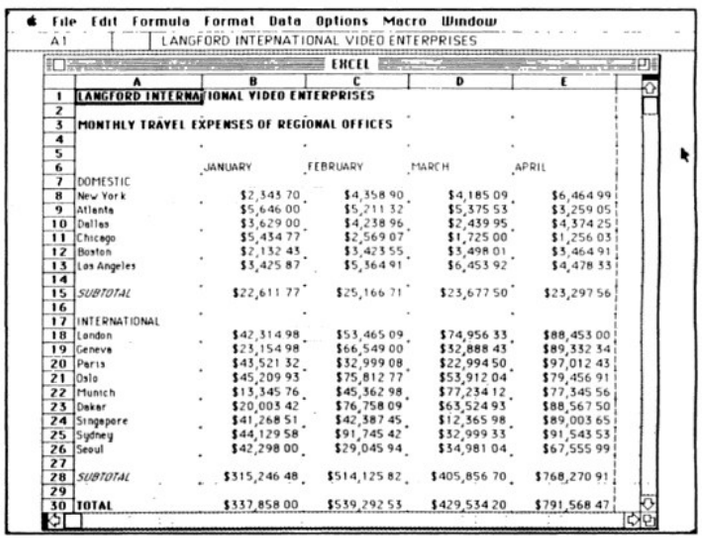
In communications software, Mac users have their own, superior version of Hayes *Smartcom*, which allows "live," real-time interactive editing of graphics images at opposite ends of a modem-linked telephone line. And the Mac has *MicroPhone*, Version 2.0, arguably the best personal computer comm program ever written.

Graphics software is in its element on the Mac, of course, and it ought to be good. It is. *FullPaint* and *SuperPaint* extend the original "paint" (bit-mapped graphics) idea, but more interesting are the object-oriented ("draw") programs for the machine, such as *MacDraw*, *MacDraft*, *MiniCAD*, *MGMStation*, and others.

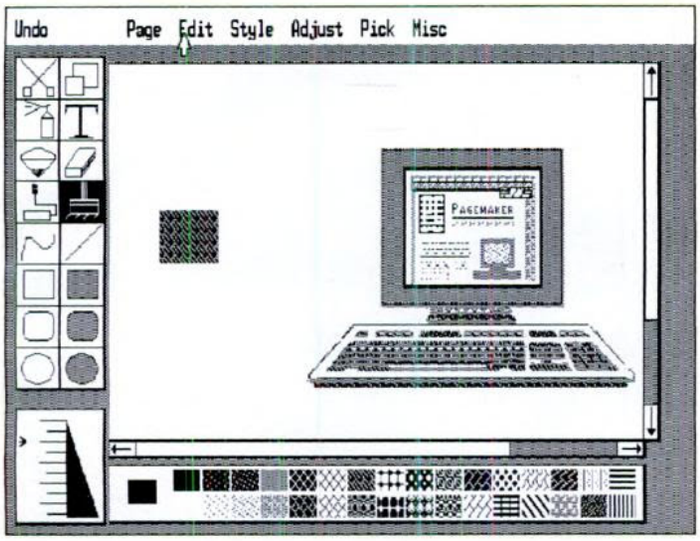
Among the most impressive graphics programs on the Mac are *Cricket Draw* and *Cricket Graph*—both of which are among the very few programs released so far that support color on the Mac II. *Cricket Graph*, particularly, is an excellent business graphics program, with a wide variety of graph types, nearly intuitive operation, and built-in support for color plotters—a rarity in software written for the Mac.



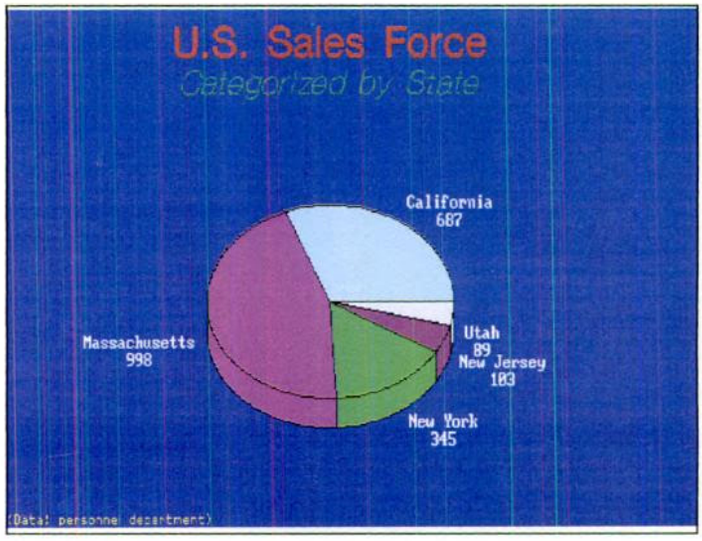
One of MicroPhone*'s cleverest features is its intuitive approach to building and modifying scripts. Script commands are chosen from the list in the bottom box.*



Excel *can support multiple worksheets open at once. It also features easy worksheet linking, intelligent recalc abilities, and superb built-in graphics.*



It may look like MacPaint, *but it's actually* Publisher's Paintbrush *running on the PS/2 Model 80. Its functionality is almost identical to that of* MacPaint, *and it will run in color.*

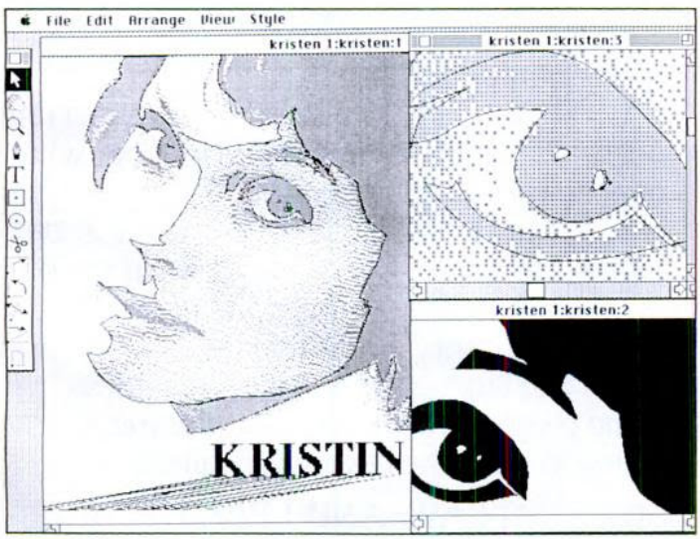


Harvard Graphics, *from Software Publishing, is one of the best business graphics programs for the PC. Its pop-up menus are mouse friendly for speedy chart design.*

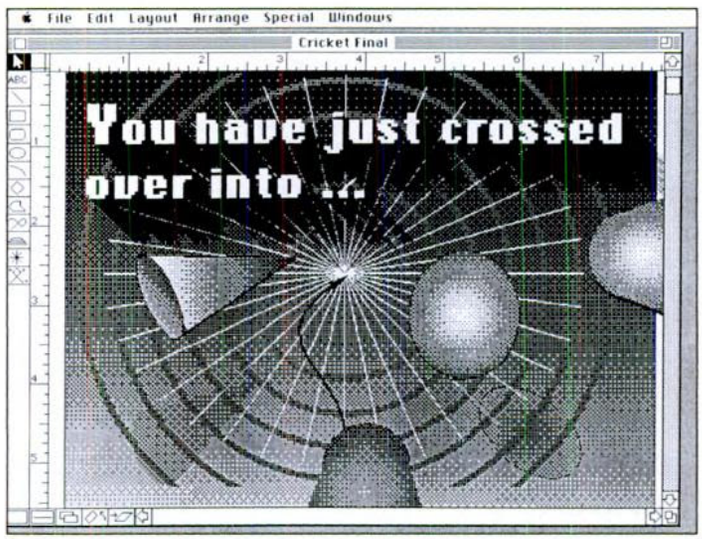
PRODUCTION-ART TOOLS Most impressive of all in the Mac graphics world is Adobe's *Illustrator*, a tough-to-learn but rich and rewarding drawing program. Adobe Systems, developer of PostScript, the page-description language that has come to dominate the laser printer and PC typesetting field, shows off the sophistication of the PostScript language in *Illustrator* by providing artists with the first personal computer drawing toolkit that meets the demands of the commercial and technical artist/illustrator.

Illustrator's ability, for example, to accept a scanned image, allow the user to trace over that image, rework in the tracing layer a very different piece of reproduction art, then finally discard the original scanned image in favor of the newly created illustration is exactly the kind of *production* art tool in demand among graphic artists. We can't get that kind of power on IBM PCs yet.

The output of these graphics programs is enhanced, of course, through PostScript output to Apple's LaserWriter



Adobe's Illustrator *is a complicated program that takes time to learn, but the freedom it gives artists to modify scanned images and the kit of tools it provides are immense.*



Besides its sophisticated graphics manipulation features, Cricket Draw *is one of the very few programs that support color on the Macintosh II.*

"Mac Software Gets Serious" continued

Plus, still the class act among desktop laser printers.

Away from mainstream horizontal applications, Mac software offerings thin out considerably, though there are some striking products out there. It's a lot harder to write for the Mac than for the PC, and the plethora of narrow-application, tiny-market programs for the PC is simply unlikely ever to appear on the Mac.

But the good, unusual Mac programs stand out. Great Plains' Macintosh version of the old *OneWrite* pegboard accounting system is not only the best implementation of that idea yet seen on a computer but probably the easiest-to-use "real" accounting software available.

For desktop presentations, Living Videotext's *MORE*, Version 2.0, and Forethought's *PowerPoint* (recently acquired by Microsoft) are superb tools. And then there's *MacSpin*, almost everyone's favorite tool for 3-D data analysis.

One thing becomes clear after wading through a few dozen, or a few hundred, Mac programs: the most successful ones, in terms of sales as well as usefulness and elegance, are those that most fully exploit the unique features of the Mac—especially the point/click/drag/pull-down menus interface. Shortly after the Mac appeared, for example, Software Publishing ported over to it copies of its *PFS:File* and *PFS:Report* packages—best-sellers in the Apple II and IBM PC market at the time. Both were quick-and-dirty translations of the IBM versions. Neither looked nor felt much like a Macintosh program; neither *worked* much like a Macintosh program. Both soon disappeared, rejected by Mac users who expected more than a fast port from the DOS world.

LUKEWARM JAZZ Another notable failure in the Mac software market was Lotus's *Jazz*, a klutzy multifunction program that fell well short of Lotus's reputation for fast, innovative, highly functional software. Bizarre, high-tech black-rubber packaging and expensive, high-energy print and TV ads proclaimed "*Jazz* boogies!" The marketplace saw less boogie than bogey; *Jazz* moved off the shelves at a distinctly *andante* pace.

MAC-TO-PC MIGRATIONS Though few programs have moved successfully from the DOS world to the Mac environment, it looks as if migration the other way will be a bigger success. Aldus built *PageMaker* into a smash success on the Mac, of course, then very carefully ported it to the PC, running under *Microsoft Windows*. Today, *PageMaker* comes closer than any other program to running identical versions in both environments. Microsoft itself rewrote *Excel* from the Mac to the PC, again under *Windows*. And now Blyth Software, developer of the superb Mac database *Omnis 3*, is bringing a version of it to the PC as *Quartz*—once again, running under *Windows*.

The result in each case has been a good-to-superb PC product. *Microsoft Windows* is the natural home for programs moving from the Mac to the PC, for it approximates (though hardly matches) the Mac's graphically oriented pull-down menu/dialog box environment. (Microsoft has acknowledged that debt to Apple by paying an undisclosed sum for the similarity of the *Windows* interface to the look and feel of the Mac interface.) Unfortunately, the code-shuffling overhead of *Windows* still exacts a penalty in performance for applications running under it. *Windows* and its applications make little sense on machines that are slower than 8-MHz PC ATs and don't really come into their own until they're loaded onto powerful 16-MHz 80386-based PCs—such as the PS/2 Model 80.

The market success of the PC version of *PageMaker*, and the attention that will inevitably be paid to both *Excel* and *Quartz*, bode well for further translations from the Mac environment to the PC environment. Before long we may see in concurrent release for both machines many or most of the programs that are presently popular on each system.

—Jim Seymour

There were already a lot of Macs—guerrilla computers, in a sense—to be found in corporate America before Aldus cooked up *PageMaker* and invented both an application and a market. The users of those business Macs, certain they'd seen a better idea at work, had gone out on a limb to buy them, and often had taken a lot of hard-edged joshing from their PC- and *1-2-3*–using colleagues: "When are you going to get rid of that little thing and get a *real* computer?" "How can you stand that little rattly keyboard?" "Too bad there's nothing like *1-2-3* on that little thing . . . it's so *cute!*"

Then came *Excel*. Mac owners were finally vindicated because they could drag in their PC-using colleagues, show them *Excel*'s tricks, and watch their jaws drop. *Excel* was simply a better product than *1-2-3*, and that was most evident to experienced *1-2-3* users.

Just as *Excel* won Mac users' hearts by validating their choice of the machine, it fascinated PC users (not to mention Lotus): who wondered when, not if, it would come to the PC?

Microsoft ultimately answered with PC *Excel*, due out this fall—running, of course, under *Windows*. We compared a late beta version of *Excel*, running under a beta run-time version of *Windows* 2.0 (the combination Microsoft says it's about to ship) on the Model 80, with *Excel* Version 1.04 on the Mac II.

Remember that even very late beta-version software is often different from release versions, and that one of the last steps in preparing programs for market (in this case, both PC *Excel* and *Windows* 2.0) is to tweak them for increased speed. And remember also that the performance of *Windows*-based software on the Model 80 is likely to be much better under *Windows* 386, allegedly coming soon from Microsoft.

EXCEL MEETS BIG BLUE PC *Excel* isn't a subset of Mac *Excel;* it's a *superset*. With features such as arrays (groups of cells manipulable as one, with memory-usage advantages growing from the storage of only single copies of shared formulas), variable line spacing (allowing typeset-look laser-printed output), and the ability to use the data-pipelining features

of *Windows*' Dynamic Data Exchange to share data in real time with other *Windows* applications, PC *Excel* is a spectacular product.

And *Excel* on the PC supports color, especially useful in its superb charting capabilities, while Mac *Excel* won't offer color on the Mac II until next spring.

Mac II or Model 80? It's a toss-up. To my taste, despite all of PC *Excel*'s additional features, *Excel* still looks and works

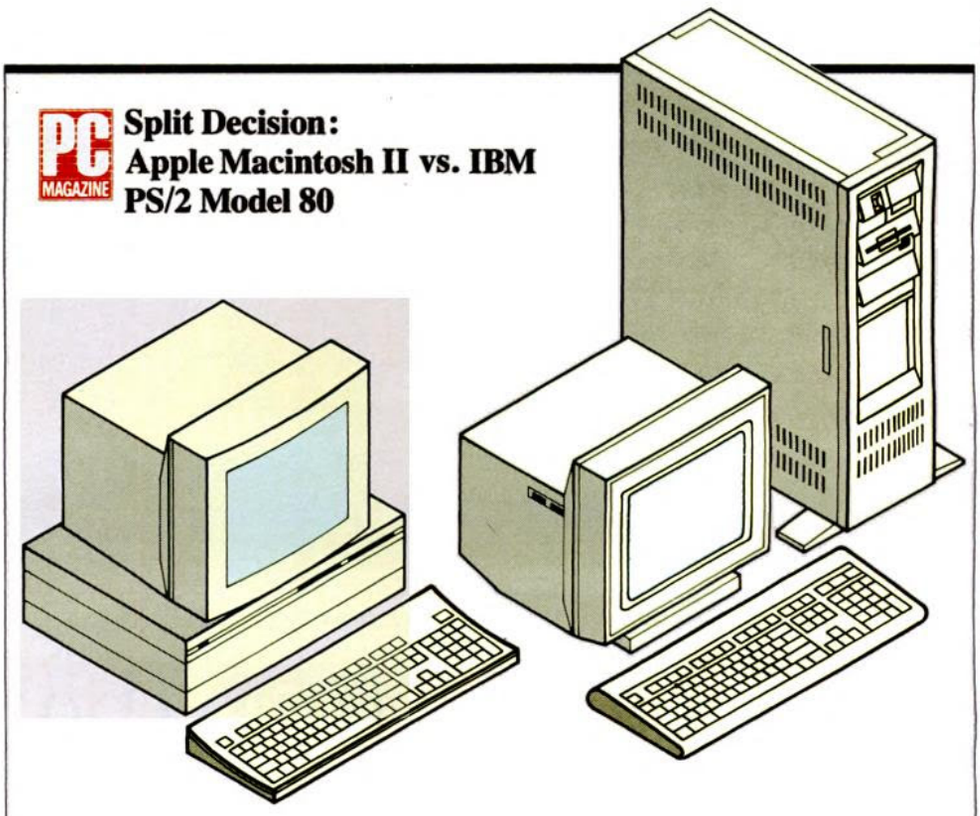
Excel on the PC supports color, especially useful in its superb charting capabilities, while Mac _Excel_ won't offer color on the Mac II until next spring.

better and faster on the Macintosh II than on the Model 80. But it's much too close to call with conviction.

Recalculating a 2,500-cell worksheet was about 20 percent faster on the Mac II. Saving and retrieving files was faster, too. On the standard Mac color display, *Excel*'s characters are larger and much easier to read than on the Model 8513 12-inch VGA color display of the Model 80—and on the large monitors available for the Mac, users get a much larger patch of spreadsheet onscreen, too.

Larger monitors with more than 80-column by 25-line displays aren't yet available for the PS/2 line; current oversize multiscanning monitors for the PS/2, such as the 19-inch analog units from Microvitec, Conrac, and NEC solve the small-type problem but don't yet have the capability to show larger areas of the worksheet matrix. (Oversize monitors for standard PCs and ATs, such as Moniterm's Viking 1 and Sigma Designs' LaserView, with their own video boards and special *Windows* drivers, do show more of the *Excel* worksheet.)

Split Decision: Apple Macintosh II vs. IBM PS/2 Model 80



Apple Macintosh II	Category	IBM PS/2 Model 80
	SPEED	
	Character applications	★
★	Graphics applications	
	SOFTWARE	
★	*PageMaker*	
	Microsoft Word	★
TIE	*Excel*	TIE
★	TSR programs	
	Business graphics programs	★
	Terminal emulation software	★
	Software library size	★
	HARDWARE	
	Keyboard	★
★	Mouse	
★	Networking capability	
★	Innovation	

The Mac II and Model 80 are evenly matched, which doesn't make the choice any easier. What may help is that their strengths lie in different areas. If you rely on graphics-intensive applications like desktop publishing, the Mac is the clear choice.

But if you're more interested in an established library of business software and character-oriented applications like spreadsheets and word processing, the PS/2 could be the better pick.

ACROSS THE GREAT DIVIDE: DATA TRANSFER WITH DAYNAFILE

One of the tools most likely to help the Macintosh II become a powerful second standard in Corporate America doesn't come from Apple.

Dayna Communications, of Salt Lake City, has been trying to build bridges between the IBM PC and Macintosh worlds for a long time. Its first effort brought forth MacCharlie, an odd, clunky device that sort of turned early Macs into PCs. In theory, users could effortlessly run PC software on their neither-fish-nor-fowl MacCharlies.

Yes, the DOS prompt came up. Yes, *1-2-3* would load. End of good news. MacCharlie was slow, cranky, and doomed ultimately by economics: if you had a Mac and also wanted a PC, you could buy a decent PC-XT clone for less than the price of MacCharlie and have *two* separate and uncompromised computers.

MacCharlie fell by the wayside, a curious footnote to Macintosh history. But it did have a use, as some discovered: moving files from the PC universe to the Mac environment.

Dayna paid attention, and when word of what would become the Mac SE and Mac II came along, it got to work on a much more sensible answer: an add-on disk drive for Macs that reads from and writes to IBM PC disks. But the DaynaFile goes well beyond that.

THE IBM STANDARDS The Dayna people acknowledged that there are three floppy disk standards in the PC world, with a fourth coming on fast. The 5¼-inch 360 K-byte disk rules the roost; 5¼-inch 1.2-megabyte disks look like good candidates for the dustbin of history but remain important, if only temporarily; and the 3½-inch 720K-byte microfloppy, IBM style, is the hot act. Number four? The 3½-inch 1.44-megabyte microfloppy—introduced by IBM with the PS/2 Models 50, 60, and 80—may well be the floppy disk format of the future.

PC MAGAZINE FACT FILE

DaynaFile
Dayna Communications
50 S. Main St.
Salt Lake City, UT 84144
(801) 531-0600
List Price: $695 (single drive), $849 (double drive); cables $45.
Requires: Macintosh 512E (with SCSI upgrade), Plus, SE, or II.
In Short: A superbly implemented Mac peripheral that allows reading from and writing to all IBM PC floppy disk formats.
CIRCLE **678** ON READER SERVICE CARD

So Dayna didn't limit the DaynaFile to just the predictable 5¼-inch 360 K-byte disks. Instead, it's a "two holer," and buyers can specify their choice of any two drives from that first group, with 3½-inch 1.44-megabyte drives coming soon. You can, of course, buy the DaynaFile with any one of those drives installed, and add another later.

The DaynaFile plugs into the Macintosh's SCSI (Small Computer Systems Interface) port, and like all other Mac SCSI devices, can be daisy-chained, with up to seven devices strung out from one Mac SCSI port. Installation's a snap and will make old PC hands wonder why it's necessary to go under the hood of the computer in the PC world to install yet another interface card for new add-ons.

The DaynaFile has quickly become my second-favorite Mac peripheral (after the LaserWriter Plus) and is the one Mac tool I won't work without. In my office there are two Macs and seven PCs, PC compatibles, and PS/2s; before DaynaFile it was chaos. All those problems are gone now: the DaynaFile puts the Mac in business instantly in a PC-dominated environment.

PC-originated files come up on the Macintosh screen looking just like they were hatched on the Mac. Users can open them under appropriate Mac applications and go to work. Files saved to floppy disks in the DaynaFile later appear as perfectly normal DOS files when those disk are inserted in PC disk drives.

Programs with common file structures—or at least those that already know about file formats in the other machine's world—can read and work with transferred files immediately. *Excel* and *Jazz* on the Mac, for example, can read and write *1-2-3* and *Symphony* files without separate conversion. *Microsoft Word*, Version 3.0, on the Mac automatically translates PC *Word* files and has a built-in Document Content Architecture conversion routine for programs such as *WordPerfect* and *DisplayWrite*, which can save files in IBM's DCA file format.

Though both Mac and PC versions of *Excel* make good use of keyboard alternatives to mouse clicks, mousing around with *Excel* on both machines showed the superiority of Apple's mouse.

Two-button mice such as IBM's make more sense and seem likely eventually to overcome the lame one-button design favored by Apple. But for now the ergonomics of the Apple rodent are vastly better than those of the IBM's design. And the variable mouse-movement velocity controls and mouse-click timing adjustments offered by the Mac II's system software point toward improvements needed in

PC *PageMaker* and Mac *PageMaker* can read each other's files directly. And *dBASE* Mac can read *dBase II* and *dBASE III* files from the PC world.

For programs with incompatible file structures and no built-in conversion routines, Dayna supplies conversion software with the DaynaFile, which can handle some (but not many) exchanges: *WordStar* and *MultiMate* on the PC to and from *MacWrite* and *MacWord*, Version 1.05, and Mac *Multiplan* to and from PC *Multiplan* and *1-2-3*.

WHEN CHEAPER'S NOT BETTER There are simpler and cheaper ways to move data back and forth between the PC and Mac environments. Apple, for example, makes an add-on disk drive for the Mac SE and Mac II, which reads and writes 5¼-inch IBM-format disks. And you don't even need a disk drive if all you want to do is occasionally pump data back and forth: you can use a null-modem cable connected to the serial ports of the Mac and a handy IBM PC, with communications software—including special communications programs, such as *PC-to-Mac-and-Back*, made just for that purpose.

But none of those simpler answers make sense in a business setting, where you may need to go back and forth frequently, and where, for the Mac II user, dealing with IBM-format disks is a matter of daily routine. In other words, the typical corporate use of a Mac II, at least for the foreseeable future.

In that kind of mixed-hardware computing environment, you need a highly optimized, industrial-strength tool. Which is a good description of the DaynaFile.—**Jim Seymour**

Windows' facilities for customizing the underlying hardware to users' tastes.

Generally the Mac's response to mouse clicks is faster and more satisfying than mouse responses in *Windows*-based products on the PS/2 Model 80. Again, speed isn't everything in using a PC, but quick response to commands is always welcome; interposing *Windows* between the application and the system software takes the edge off the PS/2 Model 80's zippy performance.

MAC GENETICS The Mac II carries some innate advantages onto the field in a showdown with the Model 80.

One is the Motorola 68020 microprocessor, roughly equivalent to the Intel 80386 in computing power and speed but coming from a chip family always able to address memory as one giant, contiguous block (see the sidebar "Stacking up the Chips").

Programmers' efforts to deal with the segmented-memory limitations of the Intel 8088/80286 chip family and the 640 K RAM limit of PC-DOS have left us a body of software hobbled by memory size and memory-addressing compromises. Mac II programs avoid that syndrome—though very early Mac programs, that were designed to cope with the idiotic 128K bytes of RAM of the original Mac, show the symptoms of that same kind of imprisonment.

A second substantial advantage is the way the Mac handles pop-up programs, sometimes called TSRs (or "terminate-and-stay-resident" utilities) in the IBM world. The Mac allows access to what are called Desk Accessory programs directly from the menu bar across the top of the screen—at any time, from within any application, since these DAs are reached directly through the operating system. Mac users never worry about how to load three or four pop-ups last, as demanded by many PC pop-up programs.

Even better, users can selectively install up to 15 of these DAs on the Mac II—still without worries about conflicts in memory. Calling most DAs through mouse clicks also avoids the Alt plus something-or-the-other games and worrying about Alt-combination conflicts and shortages. A wonderful new Macintosh program called *Suitcase* allows users to install *thousands* of DAs on a single Mac—a good example of the Mac world's endearing tendency to go from the sublime to the ridiculous.

TALK TO ME A third natural advantage of the Mac is easier networking (see "No More Missing Links: Apple/IBM Networking"). Every Macintosh has inside it the circuitry needed to connect it to the AppleTalk network. Add a $50 cable-and-connector package, and you can link your Mac to mine.

At $50 per machine, we can keep going until we've built a very nice little workgroup network in about 15 minutes. Everyone on the net can use one or more LaserWriter printers connected to it, and we needn't dedicate a Mac as file-server. AppleTalk isn't very fast, but it's more than adequate for many uses.

Mousing around with *Excel* on both of the machines showed the superiority of Apple's mouse.

Need somewhat faster networking and want to hook some IBM PCs into the net? Check out Centram's TOPS network. Sun Microsystems recently bought Centram; look for even better mixed-hardware networking through combinations of TOPS and Sun's own NeWS network.

Want still more performance on a Mac-only net or a Macs-PCs net? 3Com, the Ethernet people, can build you a very high-performance, highly expandable mixed-hardware net.

BLUE POWER But the IBM PC, especially at the power end of the spectrum staked out by the PS/2 Model 80, also has some very substantial advantages. The overwhelming lead in applications software is one. While many superb programs are available for the Macintosh (see the sidebar "Mac Software Gets Serious"), vastly more are available for the PC.

Among those PC-only programs are many good if obscure vertical-market programs and specialized packages; worrying if you can find the right software for your

STACKING UP THE CHIPS

Both the Intel 80386 and Motorola 68020 are state-of-the-art 32-bit microprocessors with long family traditions. The Intel 80386 retains part of its family resemblance with a virtual 86 mode that provides a virtual machine environment for the 16-bit 8086, along with a real mode that emulates the 80286. The 68020 is part of the 68000 clan, a group that unlike the Intel family, consists only of 32-bit microprocessors.

The main differences between the 68000 and the 68020 chips are related to special instructions and memory bus width: the 68008 has an 8-bit data bus, the 68000/68010 a 16-bit data bus, and the 68020 a 32-bit data bus.

The register view of each member of the 68000 family is the same. It consists of eight general 32-bit data registers and seven address registers. The data registers can manipulate 8-, 16-, and 32-bit values.

The 80386 chip is less regular in its design, but it includes a number of features not found in the 68020. The 80386 registers are few in number and are often dedicated to many instructions.

The other main difference between the 80386 and the 68000 family is the way the 80386 addresses memory. The Intel 80*x*86 family addresses memory via segments and segment registers. The segments used are implicit in an instruction, but they can be altered.

PHYSICAL LIMITS The maximum segment size for the 8086 is 64K bytes, while the 80386 extends the limit to either 1 megabyte or 4 gigabytes, which matches the 68020's maximum segment size. The two chips have the same physical memory limit, and the difference comes into play through the use of "virtual memory," which allows an operating system to provide a virtual view of more memory than physically exists. This trick is accomplished by swapping data from memory to disk and back as needed.

Segment descriptors are automatically loaded from either the Local Descriptor Table (LDT) or the Global Descriptor Table (GDT) when a program loads a value into a segment register. A program normally has an individual LDT, and the operating system supplies common memory and functions to all programs via the GDT.

The 80386 supports code and data segment descriptors, as well as a number of other specialized descriptors. The Task Register (TR) specifies the capabilities for the current task. The 68020 does not have this type of support.

THE PROS AND CONS The merits of segments and large contiguous memory spaces have been debated at length by computer scientists. The 80386 supports both segments and a large address space, while the 68020 supports only a large address space. Clearly, one important advantage of segments is their ability to have their size and location changed in-

PC MAGAZINE Microprocessors Past and Present: Summary of Features

(Listed by increasing size of addressable RAM)

These Intel and Motorola microprocessors have been listed by increasing size of addressable RAM rather than by date of release so that similar chips from the two families are adjacent. Note that throughout its history, the Motorola 68000 family has consistently offered chips with 32-bit internal buses. Intel's chips have evolved to that level, but it has taken time. Note also that the chips that drive the Macintosh II and the PS/2 Model 80 – the Motorola 68020 and the Intel 80386 – both address up to 4 gigabytes of memory and offer virtual memory capability.

	Year of introduction	Data bus bits	Internal bus bits	Max. speed (MHz)	No. of registers	Addressable RAM	Virtual memory
Intel 8080	1974	8	8	3	7	64K bytes	○
Motorola 6800	1974	8	8	4	4	64K bytes	○
Intel 8085	1978	8	8	6	7	64K bytes	○
Intel 8088	1981	8	16	8	7	1 Mbyte	○
Intel 8086	1979	16	16	8	7	1 Mbyte	○
Motorola 68008	1985	8	32	12.5	16	16 Mbytes	○
Intel 80286	1984	16	16	16	7	16 Mbytes	●
Motorola 68000	1980	16	32	12.5	16	16 Mbytes	○
Motorola 68010	1984	16	32	12.5	16	16 Mbytes	●
Intel 80386	1986	32	32	20	7	4 gigabytes	●
Motorola 68020	1986	32	32	25	16	4 gigabytes	●
Motorola 68030	1987	32	32	25	16	4 gigabytes	●

●—Yes ○—No

dependently of other segments.

The 68020 has the advantage of providing true "virtual machine" support. A virtual machine is essentially a logical microprocessor that executes most instructions normally, but a program will cause a nonmaskable software interrupt when a privileged instruction is executed. The "supervisor" program then processes the privileged instruction in the appropriate fashion and allows the applications program to continue. This trick can be repeated to any number of levels, allowing an operating system to run another operating system as an application that can in turn run its own applications.

The 80386 contains a limited virtual machine capability called virtual 86 mode. Unfortunately, the virtual machine appears to be only an 8086, not an 80286 or 80386. The rumored 80486 is said to provide complete virtual machine support.

What does this all mean to a programmer and a user? A programmer will probably prefer the 68000 register and instruction set because of its regularity. The 80386's virtual 86 mode offers one possible way of running DOS applications under *any* operating system, but the lack of a full virtual machine mode prevents an operating system like OS/2 from running as a "guest" operating system. The 68020 has the virtual machine capability, but there is no corresponding 68000-based operating system that commands the same huge following as MS/PC-DOS.

Of course, users don't really care about such considerations as long as the applications run. The 80386 runs DOS and the forthcoming OS/2, and DOS can also be run using the virtual 86 mode with additional operating system support. Since the overall performance of the 80386 and the 68020 is about the same, the debate over their respective virtues remains one for the programmers.—**William G. Wong**

William G. Wong is director of PC Labs.

needs isn't on the agenda of IBM buyers.

In some areas, such as business graphics applications, PC software is way ahead. There's nothing in the Mac world even close to *Harvard Graphics* and Micrografx's *Windows Graph*, the two best graphing programs available for PCs—and dazzlers both on the Model 80.

And you can find a PC program to emulate almost any terminal you can imagine, from DEC VTs to HPs and Tektronix units. Terminal-emulation software is far behind on the Mac, though Apple's attention to connectivity, especially connections to mini and mainframe computers, should close that gap in the near future.

A second huge advantage in the IBM universe is that it's not *just* IBM's universe. The availability of good PC compatibles from a number of vendors—and inevitably, PS/2 clones from many of the stronger players in the compatibles game—gives buyers choices unknown to Apple customers. Indeed, the relatively high prices of Macintosh hardware are sustainable only as long as Apple has no competition from Mac clones. Competition in the IBM world also forces progress on a calendar not set by IBM; complacency in the PC market means Chapter 11.

How important is that monopoly on Macintosh hardware to Apple?

In a quick, witty and revealing *bon mot* at Esther Dyson's Personal Computer Forum in Phoenix last February, Apple president John Scully gave us a hint. Gordy Campbell, head of Chips and Technologies, whose chip sets have made it easy for many vendors to introduce PC-compatible hardware, was sitting next to Scully on a panel. As an afterthought to an answer to a question from the audience, Campbell turned to Scully and asked, "How'd you like a clone, John?"

"How'd you like a lawsuit?" Scully snapped. And he wasn't smiling.

As easy and cheap as connectivity is on the Mac, *better* connectivity is available—if more expensive—on IBMs. Novell's *Advanced NetWare*, the IBM Token-Ring Network, Ungermann-Bass's Net/One and other industrial-strength networks are built around the idea of connecting IBM PCs. When Macs get added to the list of products that can be connected to those networks, they're afterthoughts.

SCOREBOARD So how do the Mac II and the top-of-the-line PS/2 model stack up? On raw power they're very close, with the Model 80 slightly ahead. On availability and overall quality of software, the Model 80 edges out the Mac again, though narrowly—and the best programs for the Mac are the equals or betters of the best PC programs. On connectivity, IBMs are ahead, if only briefly and at greater cost in price, complexity, and grief at installation time.

On ease and pleasure of use, the Mac's

In some areas, such as business graphics applications, PC software is way ahead.

on top. Maybe the graphics interface of OS/2's Presentation Manager (and until then, *Windows* 386) will close the gap, but Macs, and especially the Mac II, are simply easier and more enjoyable to use.

On innovation, the Mac wins again. IBM deserves credit for the Micro Channel bus design—but the NuBus found in the Mac II is already a standard and capable of similar performance. Hatching a new, incompatible, and proprietary bus isn't always an occasion for celebration, as the PC world is discovering while it worries and wonders what the PS/2s and the Micro Channel Architecture really mean. In other areas, from display graphics to the user interface to support of PostScript and truly integrated systems, Apple has led the way.

Not so long ago, Mac versus IBM was an easy question to answer: Mac for home, IBM for work. We're not in Kansas anymore, Toto; the choices have gotten a lot tougher. The Mac II is no more going to displace PCs and PS/2s than BMW is going to put General Motors out of business.

But those Beemers do have a lot of appeal. And a lot of loyal owners. And a heck of a future. PC

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