HP Professional

THE MAGAZINE FOR THE BUSINESS & PRACTICE OF HEWLETT-PACKARD COMPUTING

OCTOBER 1987 ■ VOL. 1, NO. 5

- An HP/Macintosh Workstation
- Quick Prototyping On The 3000
- An Installation Nightmare

HP-UX

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GRAPHICS Inside the HP 350SRX

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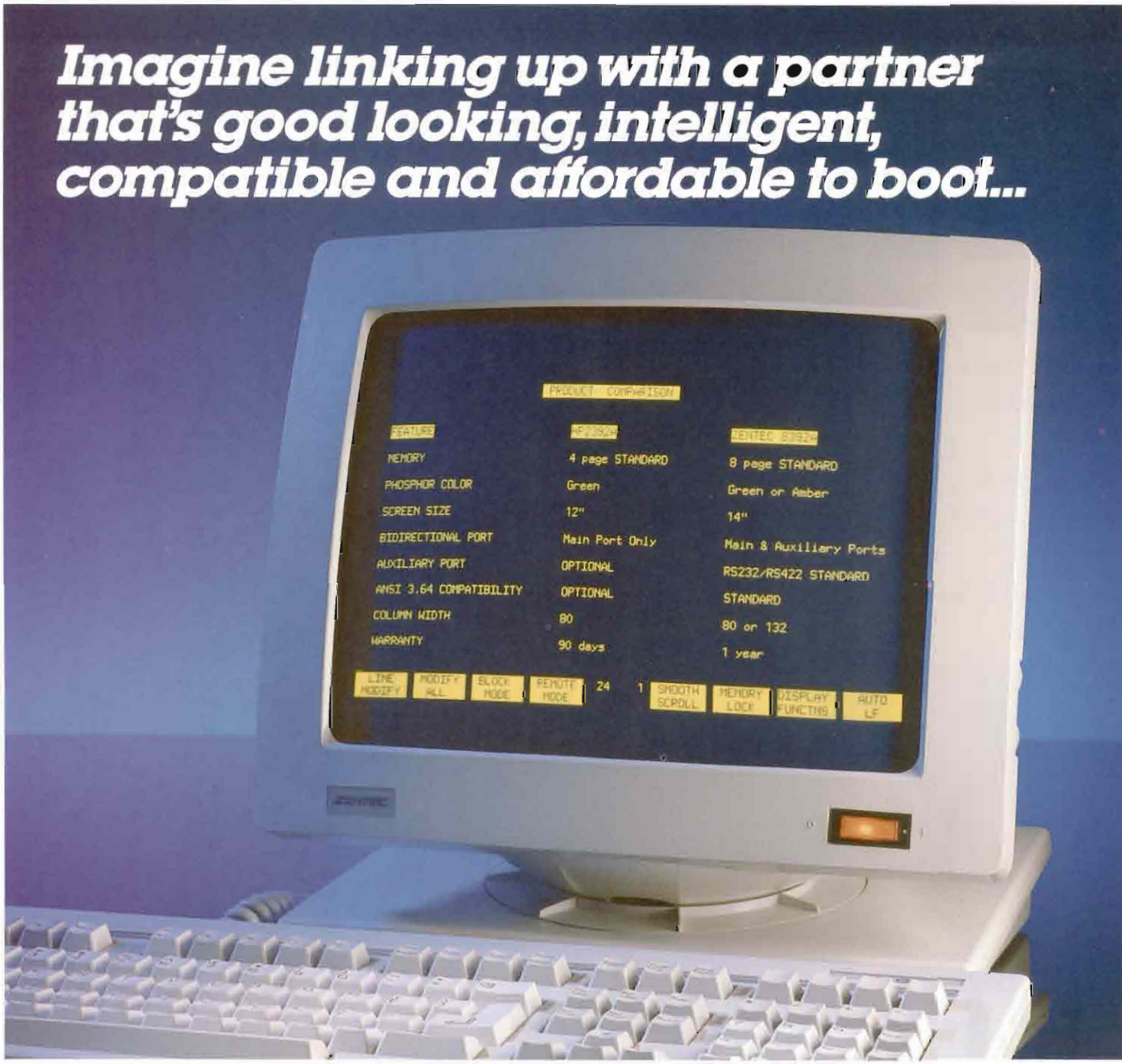

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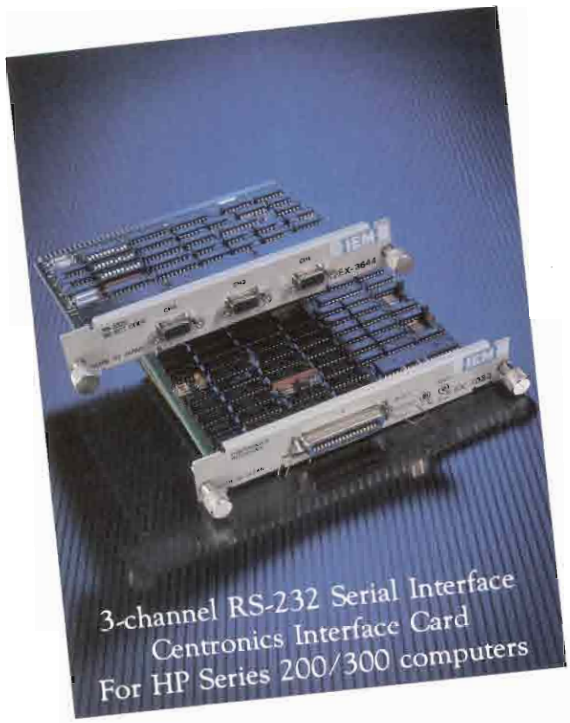

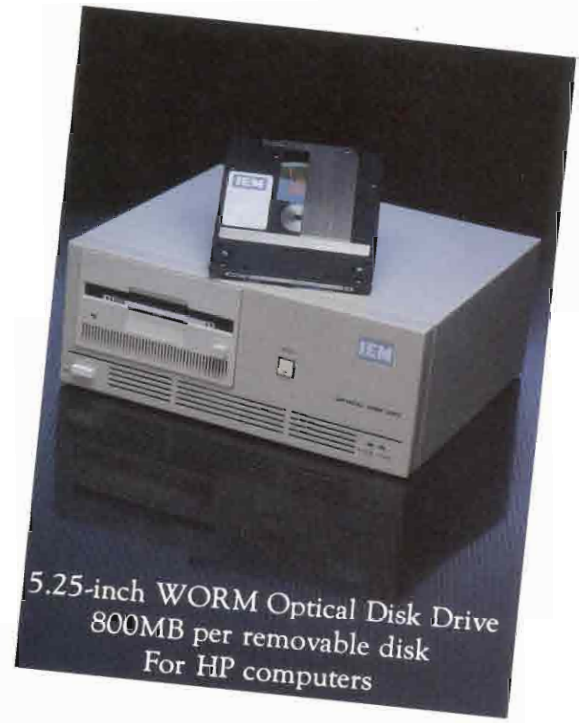

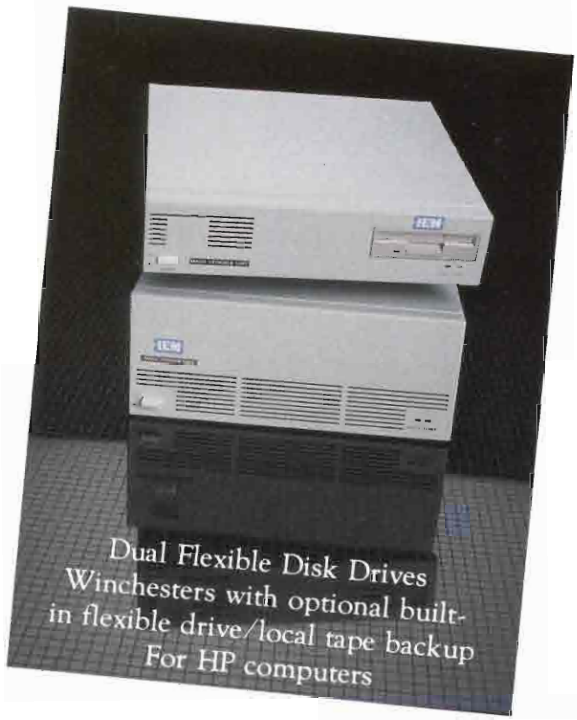

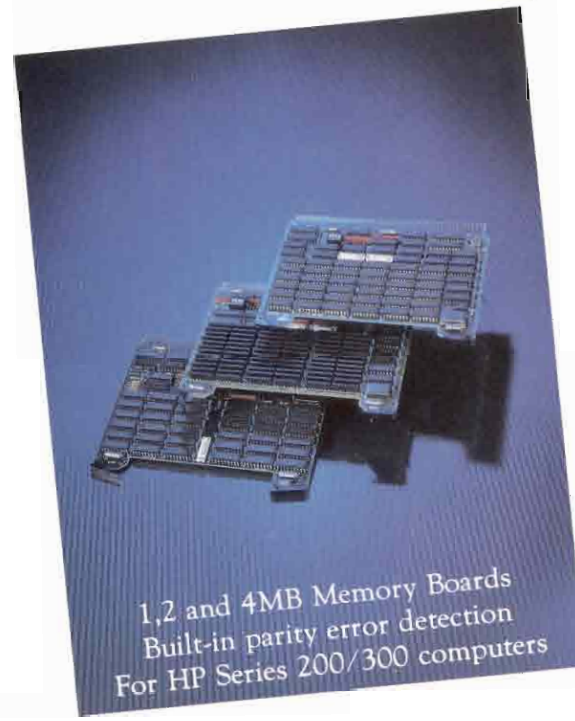

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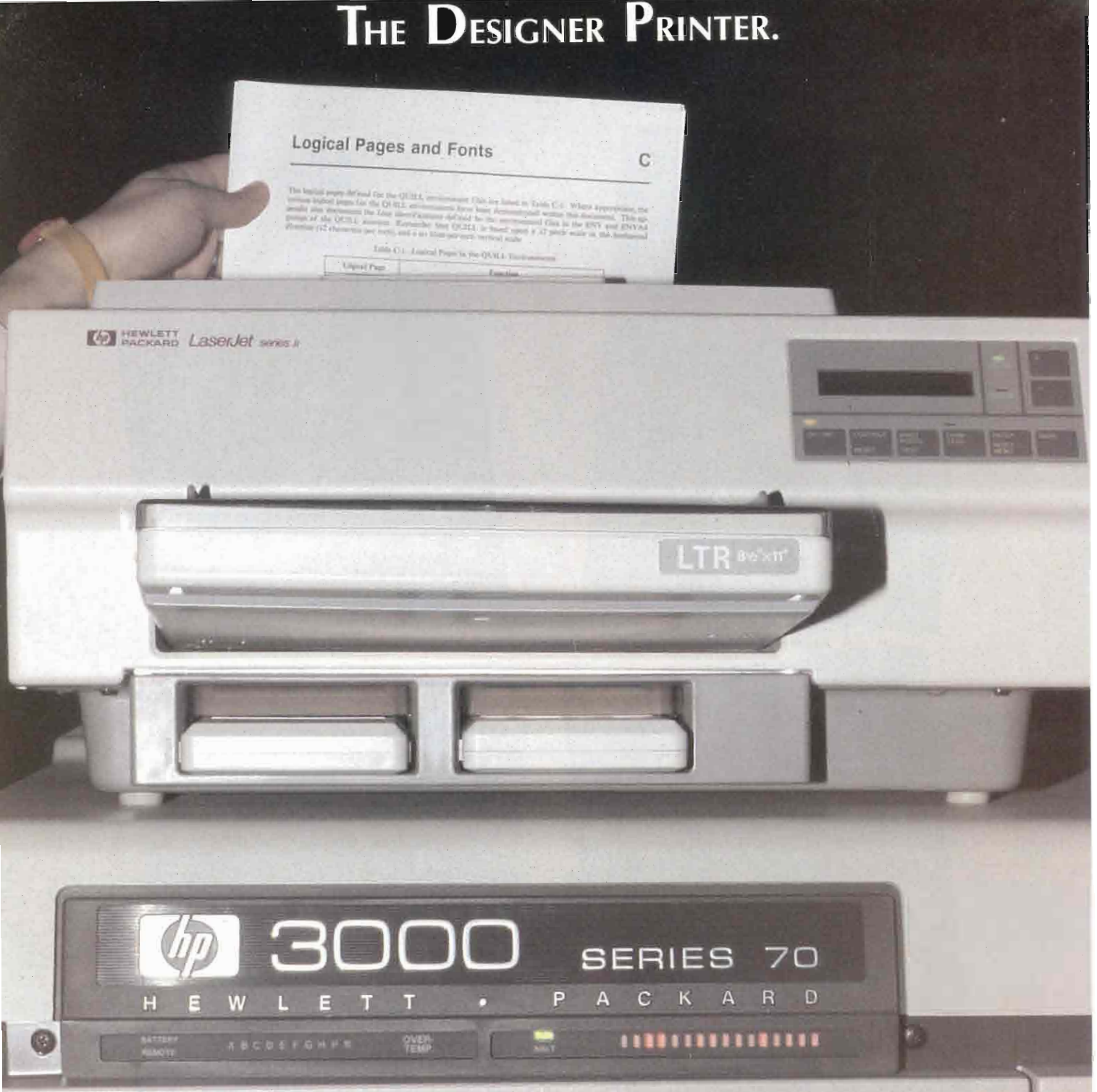

TDP and the LaserJet with PSP / Plus.

If you use TDP, you probably fall into one of two classes: you either have a laser printer, or you want one. If you already have a laser printer, you're probably used to producing high-quality illustrated documents at a whim. If you don't, you're probably working with a daisy-wheel printer regarded by its users as a faithful but aging pet spaniel.

PSP / Plus and the LaserJet can provide you with all the benefits of laser printing at about a quarter the price of the HP2688: full graphics capability, up to 31 fonts in a document, forms, borders, logos — in fact, almost everything that TDP can make a big laser printer do. It works with popular "front end" processors, too, as well as the TDP Mailer facility. In fact, with PSP / Plus, the LaserJet can be used with your own applications and with HP software: HPDraw, DSG, HPEasyChart, HPWord, IDS and IFS all work with the LaserJet, thanks to PSP / Plus.

So if you want to replace the aging daisy-wheel printer, or get to all the power that TDP *really* has, or just want to avoid walking four blocks to the data center's HP2680, try a LaserJet: with PSP / Plus, the LaserJet has joined the HP3000 family.

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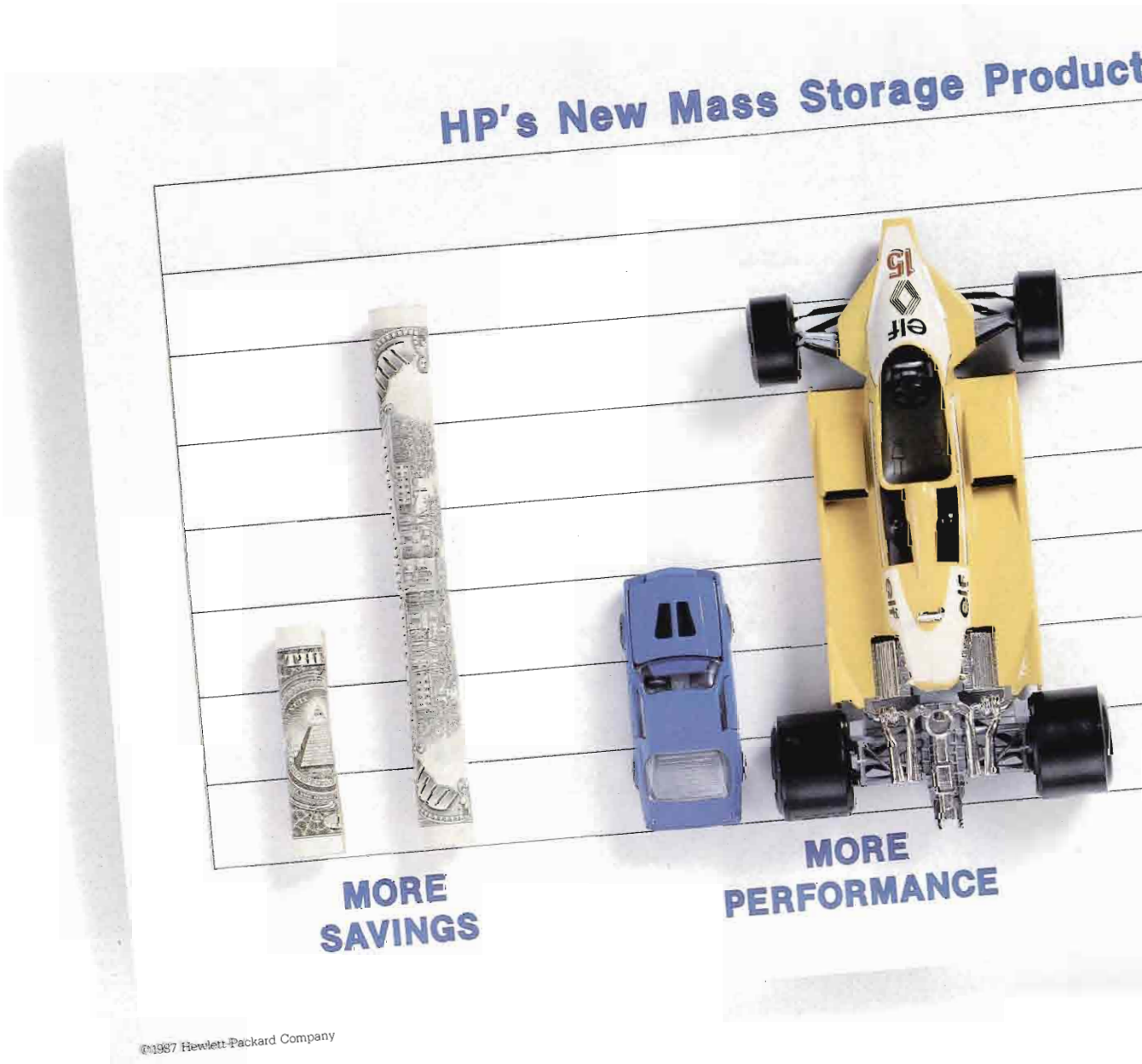

HP's new mass storage units feature a reliable space-saving design that cuts your maintenance costs in half.

Consider our new disc drives, the HP 7937H and 7937XP. When compared to the HP 7933H, the new 7937XP operates more than two and a half times faster while occupying only one-third the floorspace. Plus our new disc drives reduce your monthly computer utility bills by a hefty 80%. And their exceptional reliability cuts your maintenance costs in half. These savings make our new disc drives among the lowest cost per megabyte in the industry.

We give you more in tape drives, too. Our new HP 7980A operates at a fast 125 ips. It rewinds a 2,400-foot reel in 90 seconds flat. And its reliable design cuts your monthly maintenance costs by more than 50%. The HP 7980A features a sleek new casing that mounts horizontally into a 19-inch wide rack. So there's enough room left to add another drive on the bottom and double your capacity. Its new autoload feature makes changing tapes faster and easier than ever to save your operator valuable time.

Now with HP's trade-in programs you can get even more for your money. Call your local HP sales office or dial 1-800-752-0900, ext. 906A and ask for the HP More Pack.

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Puzzle

In my brief but highly intensive introduction to the breadth and depth of the HP product line, one thing has deeply puzzled me from the first moment: the HP-IB bus as applied to major peripherals.

As far as I can tell, this instrument bus has a bandwidth of 1 MB/sec. That's fine for an instrument (or at least, many instruments), but terrible for the disk farm on a major commercial dp machine, or for the disks in a big scientific data-reduction engine.

(Just for comparison, a competitor's lowly Q-bus can be coaxed up to 3 MB/sec. while their new BI-bus coasts along at 13.3 MB/sec.)

Such bandwidth limitations virtually guarantee that a 830/930, 850/950 doing anything but number-crunching will be terribly I/O-bound for most of its life. Now that's a waste of a wonderful (expensive) machine! One hundred plus users in an active commercial environment do generate data rates in excess of 1 MB/sec. No amount of caching on the CPU end will make the data move through the center of a thin hourglass any faster than it does. Once peak demand has drained a cache, the load must be met through the narrow path.

So, where's the bus?

Has marketplace demand for greater I/O bandwidth not surfaced yet, or is it getting dusty on wish lists? Does HP fear that a conventional bus will open the door to the third-party vendors too wide? I wonder how much hacking has been done to circumvent this problem. I wonder how much this deficiency has influenced database design over the years. It is always a loss to the community when it has to hack around restrictions that never should have been there in the first place. That's the heart of the problem with 16-bit machines.

I/O bandwidth in 1987 is a relatively inexpensive commodity. Many disk manufacturers are shipping drives that transfer at 3 MB/sec. (Transfer rate is simply the number of bytes on a track divided by the rotation speed. . . .)

Given machines of the raw power of the Spectrum, it is unforgivable to shackle them to such a low performance figure right in their heart.

Put a Falcon in your HP 3000 and watch it fly.

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The Falcon also lets you expand your storage without expanding your computer room. By combining 406MB or 812MB subsystem modules in a single cabinet, you can put up to 2.4 gigabytes of storage in the same footprint as an HP 7933/5 disk drive. That's 6 times the storage in the same space.

What's more, no one can give you a more reliable drive. With a MTBF of up to 30,000 hours, our sealed Winchester drive technology is 3 times as reliable as older removable drives. They give you more environmental flexibility too, since they require no special air conditioning or ventilation. And maintenance is not a problem. Your contract with HP remains unaffected. EMC offers you several maintenance plans designed to make your disk management simple and easy, and maximize your uptime.

To cap it all off, Falcon subsystems cost you less per megabyte than comparable HP units.

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An astonishing claim to make. But let's look at the facts.

Fact No. 1

In data base applications, "Performance" is measured by two criteria: 1) raw throughput and 2) fast access to needed information.

Everyone knows that a 10 MIPS IBM mainframe will significantly outperform even the best of HP's hardware in transaction throughput and large reports. But most data processing departments are asked to deliver much more. As increasing amounts of corporate data are stored on-line, DP must provide specific data to a variety of users on demand. Fast access to information depends not only on available processing power, but even more on the system's ability to quickly find and retrieve the needed records from a database.

Fact No. 2

Most data base applications can be improved only slightly by increases in CPU speed.

Most inquiries and reports require lengthy serial or chained reads of the data base even when only a small subset of records is of interest. The time required to accomplish these reports depends on disc throughput not CPU speed. And while CPU speeds continue to increase as semiconductor technology evolves, disc drives, because they are mechanical devices, are still limited to about 30 I/O's per second.

To obtain fast access to information, the number of I/O's required to "get the job done" must be trimmed to an absolute minimum.

IMAGE minimizes the disc I/O needed to retrieve records by a full key value. But IMAGE presents significant limitations for most applications:

1. Masters can have only one key.
2. Details can have up to 16 keys, but look-ups can only be accomplished by one key at a time.
3. No partial key or sorted access is allowed.

So, multi-field, multi-set selections on a standard IMAGE database require lengthy serial and chained reads—imposing massive I/O demands on your system. Even an IBM mainframe, with all its processing power, is limited by the number of disc I/O's that can be accomplished in a given time frame.

There is only one way to give users instant access to the information they need: sophisticated indexing of the data.

Fact No. 3

Sophisticated indexing is the only way to dramatically decrease the disc I/O needed to retrieve information—and increase performance.

Indexing allows users to locate a desired subset of records without exhaustively scanning the data files. With advanced indexing techniques, record selections by virtually any criteria can be accomplished using relatively few disc reads. Using OMNIDEX,™ the disc I/O required for a retrieval can be reduced by a factor of 100 or more, and the time reduced to seconds. Even a powerful and expensive database like IBM's DB2,™ which uses very sophisticated techniques to minimize disc I/O, can't come close.

Fact No. 4

OMNIDEX is the most powerful DBMS available today—on any machine—at any price.

OMNIDEX provides the most sophisticated indexing capability available today, giving users incredible performance on IMAGE

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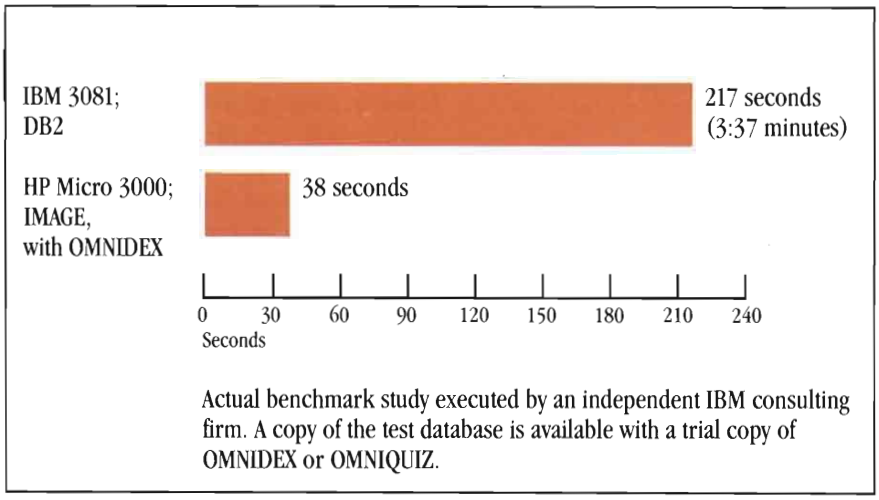

Actual benchmark study executed by an independent IBM consulting firm. A copy of the test database is available with a trial copy of OMNIDEX or OMNIQUIZ.

data bases. With OMNIDEX, users can access information in seconds by any combination of words and values across multiple fields and sets, regardless of the data base size. OMNIDEX features include:

- Record selection by multiple fields without serial reads
- Partial key retrieval and sorted sequential access
- Multiple keys in masters
- Keyword retrieval on textual data
- Easy interfacing to 3rd and 4th GL's.

For example, consider a sales support database containing a master set with 50,000 prospect records, 25,000 of which are in the USA. Linked to the master is a detail set of 500,000 activity records (e.g. prospect calls, etc.). A typical search might request all USA prospects that sales rep J. Young contacted in October of 1986. In a recent test, OMNIDEX took 7 seconds to qualify the appropriate records, and a total of 38 seconds to complete the report. Without OMNIDEX, the serial and chained reads required to accomplish the request would take at least an hour, even on a lightly loaded HP. The added horsepower of the IBM still can't match the retrieval speed of OMNIDEX. A recent benchmark executed on a dedicated IBM 3081 using DB2 required 3 minutes and 37 seconds to execute the same request—nearly *6 times longer* than OMNIDEX on the Micro 3000!

Most inquiries that users really need and want require these multi-field, multi-set selections to complete. OMNIDEX can deliver the information users need in seconds, whether your database has a 1,000 or a million records. An IBM mainframe can't even compete.

Fact No. 5

The profitability and competitive stature of your company depend on management and staff having fast access to the information they need.

Companies worldwide are now using OMNIDEX to meet that need. Hewlett Packard uses OMNIDEX in its Response Centers world-wide. Consolidated Capital uses it on their million record financial securities database.

In Rochester, New York, KODAK, Inc., uses both HP's and IBM mainframes for their sophisticated data processing needs. After OMNIDEX was installed on the company's HP 3000, one user asked the DP Manager, "When can we get OMNIDEX for our IBM mainframes?"

Mark S. Trasko
President
Dynamic Information Systems Corp.

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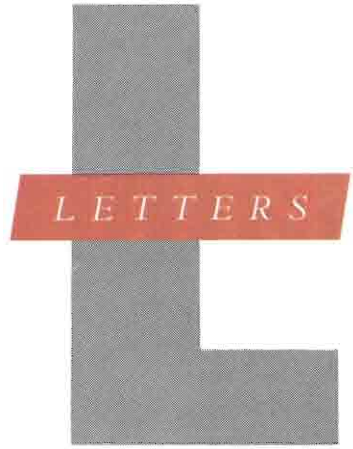

SERIES 80 SUPPORT

I sincerely enjoyed "HP Says Goodbye To Its Apple II" (p. 64, August 1987). I've closely followed Don Person's published articles over the years.

A few days before the magazine arrived, I was in the HP service center in Omaha, NE, with an HP 86A that had disk drive cable problems. I used some of the time to explore what my options were for "upgrading" from Series 80 machines. My conclusion was similar to his. I'm being pushed toward IBM-based computers on cost, software availability and service considerations. HP appears to be abandoning traditional engineering (small- and medium-sized) customers in more rural areas.

Personally, I'll continue to write programs for my 86s. We're purchasing several enhancements for our current 86A and 86B, and we're considering purchasing another 86B as a backup unit. As long as the 80 series computers do what we purchased them for, we'll probably attempt to keep them in service.

As for programming using Apple BASIC or IBM BASIC, I choose not to even try yet.

Keep up the Series 80 articles. We appreciate the information. If HP would release system information on the Series 80, my feeling is that the 80 will be around for a long time to come in engineering applications.

Rodney M. Nohr, P.E.
Nohr Engineering
Yankton, SD

Address letters to the editor to the *HP PROFESSIONAL* magazine, P.O. Box 445, Spring House, PA 19477-0445. Letters should include the writer's full name, address and daytime telephone number. Letters may be edited for purposes of clarity or space.

HIGH-VOLUME MARKET

Upon reading Don Person's article, "HP Says Goodbye To Its Apple II" (p. 64, August 1987), I felt compelled to comment on several points. I worked for HP for several years in the early 80s as a sales representative, and watched the introduction and marketing of the HP 86 and 87 from inside. As a sales rep, I knew many customers of these machines and their experiences. I also was one of the early Apple II owners in 1978. With this in mind, I believe I've earned the right to add to the picture Mr. Person described.

First of all, it's essential to realize that HP's customer isn't the end user, but rather the Fortune 500 company that user works for. If some small company or, heaven forbid, individual should find an HP product attractive, that's fine, provided not too many such customers appear. This is readily apparent in the marketing, distribution and pricing/discounting structure. With all due respect, HP has found that it understands the Fortune 500 customer's needs and desires best, understands how to do business, supports and maintains lasting relationships with these customers and makes a reliable profit with growth. Its ventures outside of this market generally have been less than profitable. The problem with personal computers HP ran into was that HP only wanted to sell them to big companies. To do this, it tried to make them attractive to big businesses (discounts, minicomputer support) and unattractive to individuals (expensive, difficult to buy and expand).

This "you-love-me/you-hate-me" approach led to problems for HP. It couldn't possibly support its large customers with an open-architecture machine with 500 independent, mutually incompatible software and hardware add-ons from 50 different manufacturers. In short, it would be unable to support its own products technically or have the profit margin to support them economically. There would be no way to control how everyone used and modified the operating system and hardware. Major projects based on multimillion-dollar purchases of HP machines would fail and HP would no longer be viable as a company with reliable, high-quality, high-performance products. This would hurt a lot of HP's non-computer business as well.

Keep in mind that this business and these large project customers are where Bill Hewlett and Dave Packard made their bread and butter for 40 years before PCs were a product. Thus, I con-

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tend that HP doesn't wish to be a high-volume vendor, with all that entails, for the above reasons.

Enter the Series 80, HP's first low-cost computer. With the above considerations in mind, it's clear why HP felt it couldn't open the machine up (i.e., provide documentation to its internals). At the same time, HP isn't stupid. It realized that it wasn't possible to provide a "single vendor solution" in a timely manner. That is, it couldn't write Lotus 1-2-3 in a month and release for sale a week later. It (the Corvallis Oregon Division of HP) seeked out and recruited numerous software houses to host their software (known as third-party software) on the Series 80, both in native mode and with the CP/M card. What I found most disturbing was what happened with this third-party software and eventually the entire Series 80 product line.

The Corvallis group understood its own market and limitations (probably more clearly than corporate HP) and proceeded to address its needs. It got Visicalc, Wordstar, dBASE II, and dozens of other specialized, well-known software packages (such as the Peachtree Series) hosted on the Series 80's unique hardware. It added value to some of these products by, for example, including graphics support to Visicalc or print buffering to CP/M. It got major local and mail-order retailers to carry the HP products and got all of these companies to invest non-HP funds to develop and advertise these products and services, all of which directly promoted the Series 80 product line.

To make a long story short, corporate HP in California didn't feel comfortable that it wanted to support the Series 80 in the environment where HP did business. The tools to guarantee success, such as conversion aids for data between these programs and larger computers are still in short supply. So, corporate HP took the charter to make personal computer products away from the Corvallis people and discouraged them from promoting the Series 80. This was a shot in the foot for Corvallis and the third-party businesses it recruited, all of whom had invested time and money and had built a bright future for the Series 80.

I believe that this thinking persists today. HP is very careful to keep its products just a little bit esoteric, expensive and not significantly advertised to ensure that it can continue to support the products it sells and remain profitable in this low-volume approach to marketing. To many people (HP people and customers), this explanation sounds crazy. One only has to look at the price of HP products, their market visibility and who buys them to see that it isn't crazy at all; in fact, it's quite real.

A good example of this is the HP Integral. Originally, in 1981, it was planned to be a UNIX portable for under $2,000. At introduction, it was $5,000, plus another $1,000 for enough memory to run any language and another $3,000 for a hard disk to make it a real UNIX machine. Its marketing of the machine suggested that it had no idea who needed a portable UNIX machine. Certainly very few individuals could afford $8,000. The few HP dealers were very unsuccessful with them. The direct sales force did, however, place a reasonable number of them into large accounts. Hence, HP introduced a commercially viable product, placed it out of reach of the bulk of the established UNIX community and certainly all end users.

I'll close with a comment on HP's strength, using the Integral as an example once again. I bought an Integral out of consignment several years after I would've had one at a reasonable price. The computer has been upgraded to system 5.2 UNIX. This machine exemplifies what I love about HP. The product is extremely high quality, well constructed and is clearly well designed. It's an exceptionally good implementation of UNIX with a lot of value added (e.g., a solid windowing system and graphics support device drivers).

I have used UNIX on DEC, AT&T, Fortune and Radio Shack machines for several years. None has been as well worked out and packaged as the Integral. The HP people who helped me buy the machine and supported me post-sale were extremely friendly and helpful. I'm currently trying to buy a second Integral from them. Although I love HP products and people, I hope that they'll reconsider targeting for the larger, high-volume market instead of crippling themselves and their installed base as they do now for marketing reasons.

Thanks for your fine publication. It's refreshing to see a positive and yet balanced coverage of HP computing.

Joe Bormel
Brooklandville, MD

HELPFUL NEW IDEAS

Thanks for publishing *HP PROFESSIONAL* magazine. I regularly find interesting articles and valuable pointers in each issue. The August 1987 issue which I just received provides an excellent example.

As the manager of a small HP 3000 installation, I am always interested in hearing about how other installations are handling various situations. James Dowling's article on Data Center Management in this issue addressed the issue of report management. While I use or have encountered many of the concepts Mr. Dowling discusses, I still encountered some new ideas which may be helpful in my shop. Mr. Dowling also tied together some fragments of information which I had acquired through the years very nicely.

I suspect that many installations will benefit from the variety of information to be found in *HP PROFESSIONAL*. Please keep up the good work and keep this valuable publication coming!

David Ray Fuller
Northview Corporation
San Diego, CA

Announcing the end of an error.

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NEWS & TRENDS

New Products, Prices Introduced In 9000 Workstation Line

Four Graphics Systems Use Enhanced Graphics Processor

HP has introduced a new line of graphics systems that offer performance previously unavailable without add-on accelerators. The company also lowered the list price of the HP 9000 Model 318M entry-level workstation to less than $5,000.

The new HP 9000 Models 330MH (monochrome), 330CH (color), 350MH and 350CH offer improvements in performance, resolution and display size compared to previous products in this range. All four systems use an enhanced graphics processor optimized for 2-D graphics applications such as ECAD logical and physical design, MCAD 2-D design and drafting, mapping, AEC, software development and artificial intelligence.

Direct hardware support is provided for features such as vector and circle drawing, patterned area fill and pixel replication. Support also is provided for bit- and byte-per-pixel addressing, high-speed block moves (commonly referred to as BitBLT) and future graphics accelerators.

The color-system versions provide eight color planes for up to 256 simultaneously displayable colors from a palette of more than 16 million colors and alternatively can be configured to provide four-plane double buffering. Two separately scrollable, overlay planes can be used for cursors, text or temporary storage.

With this enhanced graphics capability, Models 330CH and 350CH offer a balance of computational and graphics performance previously unavailable in this range of workstations.

A new, higher-resolution, 19-inch display is bundled into Models 330MH, 350CH and 350MH systems. The new display has a resolution of 1,280 x 1,024 pixels. Model 330CH comes standard with a 16-inch display and the same resolution as the 19-inch monitor.

The new HP 9000 Models 330MH, 330CH, 350MH and 350 CH (shown here) offer improvements in performance, resolution and display size.

The price of the HP 9000 Model 318M has been lowered 36 percent to $4,990. Model 318M is designed for engineering and design groups that run applications such as EE schematic capture, mechanical design and drafting.

Model 318M has a broad software-development platform. It includes a 16.6 7 MHz MC68020 microprocessor with MC68881 floating-point coprocessor, 4 MB of high-speed synchronous RAM, HP-UX operating system and a 17-inch, 1,024 x 768 bit-mapped monochrome display.

Model 330MH is $12,950 and Model 330CH is $17,250. Both Model 330s include 25 MHz MC68020 microprocessor; MC68881 floating-point coprocessor; 19-inch, 1,280 x 1,024 monitor; 8 MB RAM; and HP-UX operating system and networking.

A floating-point accelerator is available for all systems. An error-checking and correcting (ECC) RAM for the Model 350 is optional.

HP Announces FPA For 9000s

Offers Error-Correcting RAM

Hewlett-Packard has increased performance of the HP 9000s with a floating-point accelerator (FPA) for the Models 330 and 350 and high reliability error-checking and correcting (ECC) RAM for the Model 350.

The new FPA (HP 98248A) boosts the floating-point math performance of Model 330 and 350 workstations up to three times as measured by the full-precision Linpack benchmark.

Model 330 is rated at 97 full-precision Linpack KFlops without the FPA. With the FPA, Model 330 performs at 236 KFlops. Model 350 without the FPA performs at 123 KFlops, and 390 KFlops with FPA.

The FPA occupies one slot of the Model 330 or 350 CPU. In Model 350, the FPA connects directly to the "System Bus." This high-speed communication link between the CPU, RAM and FPA enables maximum performance of the FPA when used with Model 350.

The new RAM board set for the Model 350 provides error-checking and correcting (ECC). Single-bit errors are corrected without user knowledge of their existence, while double-bit errors are reported to the operating system and consequently to the user just as parity errors are reported today.

The expected mean-time-between-errors (MTBE) (a double-bit error, resulting in a visible problem to the user) is greater than five years. This high MTBE for ECC RAM allows users to configure very large RAM systems without fear of memory failures due to soft errors. RAM systems of 48 MB are now practical and are supported on the Model 350.

The new ECC RAM comes in 8-MB and 16-MB versions.

The HP 98248A floating-point accelerator is $5,800. It requires HP-UX 5.5 or later revision and, when used with Model 350, requires the HP 98570A expander.

The ECC RAM can be added to an existing Model 350 by ordering HP 98264A (an 8-MB ECC RAM) for $12,800, or HP 98264B (a 16-MB ECC RAM) for $20,000. ECC RAM is offered as an option to all Model 350 bundles and the standalone system-processing unit.

WAN Center Provides Network Planning, Implementation, Operations

HP Services To Maintain X.25 Private Packet Network

HP plans to open a wide-area network (WAN) center to provide network planning and implementation services and complete operation and maintenance services for companies using its X.25 Private Packet Network.

As a result, a company now may use HP's services to operate and maintain its HP X.25 Private Packet Network — on a full- or part-time basis — rather than having to hire and train its own network personnel.

Located in Atlanta and staffed by HP network specialists, the WAN center will be the hub for a range of HP Private Packet Network support services — from network design, planning and implementation to 24 hours-per-day, seven days-per-week network operations and maintenance.

"HP is the only major computer manufacturer committing such resources to X.25 WAN support services," said Willem P. Roelandts, general manager of HP's Information Networks Group.

"Many companies distributing information among remote functional areas have turned to our standards-based X.25 network because of the reliability, multivendor connectivity, cost efficiencies and network-management capabilities it offers," he said. "The new WAN center will enable companies to leverage from HP's worldwide support organization and networking expertise to design, implement and operate a company-wide network specifically suited to their business needs."

Network-planning and implementation services, offered via HP regional sales offices, now will be available through the central HP facility. An HP project manager will be assigned to each customer, overseeing all stages of planning and implementation — working with the local customer team, configuring pilot networks, and scheduling installations with local HP offices and vendors to assure

Systems Plus Signs With HP, Altos, CompuPro

Medical Manager Packaged With Micro Hardware

In a move targeted to provide its resellers with turn-key solutions, Systems Plus, Inc., (Mountain View, CA) has signed agreements with Hewlett-Packard, Altos and CompuPro (Viasyn) to package its vertical market practice management software, Medical Manager, with those firms' lines of microcomputer hardware.

The Medical Manager software is a leader in its vertical category with over 3,000 single-user, multiuser and networking installations nationwide. The program is flexible and compatible with operating environments such as PC DOS, Concurrent PC DOS, Novell NetWare, XENIX and UNIX.

the timely startup of the private X.25 network.

HP network operators in the Atlanta facility will be able to monitor remotely customers' HP Private Packet Networks, proactively manage and support the network and troubleshoot problems. In addition, the center will offer reports to customers on network operations and use.

In addition to the Atlanta facility, HP plans to open satellite WAN service centers in Europe and the Pacific Rim.

Service prices will vary depending on the complexity of the network and the variety of services requested. Network planning and implementation services are available now. Network operations services will begin December 1, 1987.

LaserJet Series II Users Get Postscript PDL Access

HP To Purchase JetScript

QMS and Hewlett-Packard have signed an international marketing and distribution agreement enabling HP LaserJet Series II printer users access to the PostScript page description language.

Central to this agreement is QMS's JetScript controller currently under development at QMS, with consultation provided by HP and Adobe Systems.

The JetScript controller is designed to give Adobe-licensed PostScript capabilities to any HP LaserJet Series II printer operating with an IBM AT or XT and compatibles, including HP's Vectra personal computer family.

Through HP's third-party vendor supplier program, the agreement designates QMS as an approved supplier for the JetScript product. QMS's subsidiary, The Laser Connection, will market and support the product to HP's authorized U.S. dealer network. HP also plans to purchase JetScript controllers for resale to their international dealers, domestic and international major accounts through HP's direct sales force.

HP StarLAN 10 Extends Telephone Wiring Technology

Considered For Possible Standard Status

A new high-speed, 10 Mbps StarLAN local-area network product from HP makes even greater use of standard telephone-wiring technology for office computer communications.

The new HP StarLAN 10 network product extends the capabilities of the twisted-pair telephone wiring specified by the current 1 Mbps StarLAN industry standard for multivendor computer communications.

With the growing acceptance of high-performance (386-based) PCs, users now can take full advantage of the transmission speed of current StarLAN industry-standard products, such as HP's 1 Mbps StarLAN offering, and integrate the new high-end HP StarLAN 10 family members when additional communications capabilities are required.

"While HP is the first computer manufacturer to introduce a 10 Mbps StarLAN product, the overwhelming decision by the IEEE 802.3 standards committee to review the higher-speed technology for possible standard status, seems to indicate the high-speed version of StarLAN will be as widely adopted as the current 1 Mbps StarLAN standard," said Willem P. Roelandts, general manager of HP's Information Networks Group.

The company said it will make the necessary technical changes to HP StarLAN 10 to ensure that, should the 10 Mbps StarLAN technology become an IEEE standard, it will maintain multivendor compatibility.

Using the new product, IBM and HP PC users can share and access information. Users can continue to use their familiar PC-based applications and transparently access HP 3000 peripherals

HP Visor/V: New Tool For 3000 Users

Works With HPSQL/V

A new software tool from HP calles HP Visor/V allows users to generate reports and ad hoc inquiries from relational databases on HP 3000 computers. It works with HPSQL/V, HP's relational database that conforms to SQL. Names of databases, tables and columns are supplied as menu options so users can produce custom reports.

SQL commands can be entered to initiate queries, create new database items, change rows of data and maintain the database.

Other features include online Help, the ability to view and modify a report before printing and the ability to save queries, reports and sequences of commands for future use.

HP Visor/V is $10,000 for the first copy and $7,000 for each additional copy.

and applications, such as HP's Personal Productivity Center office automation software.

HP's office automation software allows PC users on an HP StarLAN 10 network also to access IBM mainframe-based office applications such as DISOSS and PROFS.

HP StarLAN 10 runs HP OfficeShare networking software and is compatible with MS-NET software, supporting hundreds of application packages such as HP's Productivity Series software, Lotus 1-2-3 and Multimate.

Using unshielded twisted-pair cabling, the new product connects PCs in a standalone LAN to a StarLAN 10 hub. In an office, PCs can be connected as far away as 100 meters (325 feet) from the hub. The StarLAN hub provides further communications to a network of distributed HP 3000 systems linked via a coaxial LAN.

HP StarLAN 10 will be less than $1,000 for the user kit. It will be available in the first half of 1988 through HP's direct sales force.

CMC DDN Ethernet Gateway Approved For Use With HP Systems

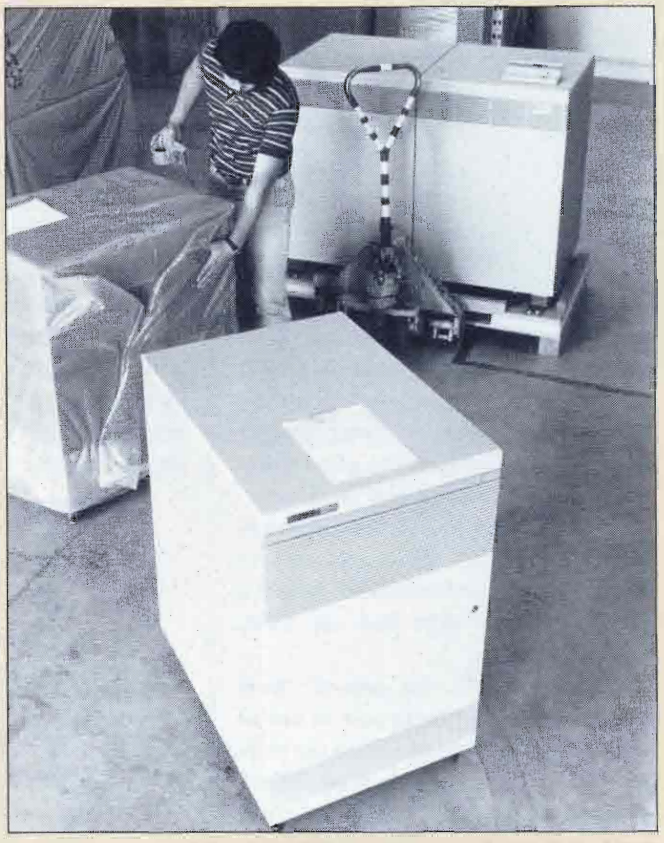
To Be Included In Information Networks Group List

CMC (Santa Barbara, CA) recently announced that HP has approved the CMC Distributed Resource Node (DRN) 3200 Defense Data Network (DDN) Ethernet Gateway for use with the HP 9000 UNIX-based technical workstation family.

The CMC product will be included in HP's Information Networks Group list of approved third-party products. The list, used by HP sales representatives, documents third-party products that have been compatibility-tested with HP systems by the company. Sales and support of the CMC product remains the responsibility of CMC.

The DRN-3200 DDN Ethernet Gateway is a high-performance network mode that gives Ethernet-Transmission Control Protocol/Internet Protocol (TCP/IP) users access to the resources of the DDN, ARPAnet or compatible networks. Messages from either the DDN or Ethernet are addressed to the DRN-3200, which reformats the communication for transmission over the other network.

CMC manufactures and markets a line of communications products including high-performance front-end processor boards, gateways, bridges, terminal servers and software, supporting TCP/IP and ISO protocols for host-to-host networking applications. CMC's products support Ethernet and the Defense Data Networks. The company markets its communications products to OEMs, systems integrators and sophisticated end users.



The first 930, ready to be shipped to ASK.

Spectrum Update

HP Ships First 930; Adager Offers Spectrum Software

The first HP 3000 Series 930 business computer was shipped in late August to ASK Computer Systems Inc., Los Altos, CA. HP will ramp up Series 930 shipments gradually, with volume shipments beginning in early 1988.

A more powerful HP 3000 Series 950 business computer also was delivered to a customer site as part of the test-and-evaluation phase before initial commercial shipments of that computer begin later this year.

Both systems, which are based on the new HP Precision Architecture, are the first in the minicomputer industry to capitalize on reduced-instruction-set-computing concepts to meet the price-and-performance needs of general business applications.

Coinciding with the shipment of the newest Spectrum machine, Adager (Antigua, Guatemala) began shipping Spectrum-compatible software in August.

This new version of Adager works on any HP 3000 computer running IMAGE/3000 or TurboIMAGE under MPE or MPE-XL. ■

INDUSTRY WATCH

Danielle Lanier-Shelly

A Challenge

Hang onto your keyboards, Wyse and Televideo. After 12 years of making premium terminals mainly for its own computer systems, HP jumped into the general terminal market in a big way with its recent announcement of a very inexpensive, full-featured ASCII model and two aggressively priced terminals designed specifically for IBM and DEC/ANSI environments.

Priced at $375, the new HP 700/41 ASCII terminal is "the lowest or one of the lowest priced terminals on the market today," according to Bob Puette, general manager of HP's personal computer business unit. Although the 700/41 doesn't operate in HP 3000 block mode, it looks like a very attractive choice for general-purpose HP 3000 applications as well as for many 1000 and 9000 users.

In line with this new competitive pricing, HP's VT220-compatible 700/22 terminal sells for 28 percent less than the target product from DEC, and the HP 700/71, for the IBM 3270 market, is priced 45 percent lower than IBM's 3191. HP also has replaced the popular HP 2392 and 2394 terminals used with its own computers with units offering more features at a lower price.

HP says the company has been able to maintain traditional quality even while slashing terminal costs by using simple designs, worldwide component sourcing and intelligent automation at the Roseville, CA, assembly plant. Because the five new Series 700 models are very similar inside and out, HP is able to pass manufacturing economies of scale on to the customer.

The company also hopes to keep down sales costs for the new products by using direct marketing as well as the existing sales force, providing next-day shipments and competitive discounts via HP's supplies and accessories catalog and 800 phone number.

WHY HAS HP DECIDED to tackle the IBM and DEC markets as well as the commodity-like ASCII terminal business? Quite simply, alphanumeric terminals are big business, with estimated 1986 world sales topping $3.6 billion (2.97 million units). Two-thirds of that dollar volume went to the IBM 3270 market, with ASCII equipment accounting for about one-fifth and DEC/ANSI terminals for the remainder.

But HP's 1986 market share, which the company reports has held fairly stable over the last few years, was only 4.5 percent of units sold worldwide. By expanding beyond its traditional marketplace, pricing aggressively and leveraging off proven expertise, HP feels the company can get a much bigger piece of that action, as well as maximizing sales to its established customers.

More than half the ports on HP's computer systems are occupied by terminals, a situation HP expects to continue. Together, terminals and personal computers amount to a large (at least one-quarter) and growing part of the average HP sale.

Puette says that HP wants "to be sure we get all of those workstation" sales by offering a complete line of terminals and personal computers spanning a very broad price/performance range.

Because terminals are the primary interface for so many users into their computer systems, HP feels that quality terminals are extremely important for the company's long-term success.

Because terminals are the primary interface for so many users into their computer systems, HP feels that quality terminals are extremely important for the company's long-term success. This is another reason why so much effort is spent on features such as screen clarity and touch, even on the inexpensive ASCII unit.

According to Puette, the increased emphasis on terminals goes along with HP's commitment to expanding its personal computer line in the same way. He adds (tantalizingly) that "over the next few months you can expect to hear more about personal computers." — *Danielle Lanier-Shelley is a free-lance writer based in Kensington, CA.*

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NEW PRODUCTS

Text Terminal Emulators For HP Workstations

Two terminal emulation products for the HP Series 200/300 BASIC and PASCAL workstations have been introduced by Optimation Inc., the HP 2627 Color Graphics and HP 2393 Text Terminal Emulators.

For the first time, color graphics emulation is available to users of these workstations. Access is open to many applications on the HP 1000 and 3000 computers. The HP 2627 Emulator provides several area fill patterns, eight basic colors and allows the user to define many other colors. The Graphics also includes a Tektronix 4010 and 4014 command mode.

The HP 2392 emulator offers full block mode, 7- and 8-bit characters, scrolling and the complete HP 2622 feature set. This permits full text interaction with HP's 1000 and 3000 computers, providing access to editors, databases and important large scale applications.

All Optimation PASCAL Terminal Emulators will run on BASIC computers with the special OI PASCAL Environment Disk. Each emulator offers ASCII and binary file transfer using X-modem protocol.

Contact Optimation Inc., 299 California Ave., Suite 120, Palo Alto, CA 94306; (415) 326-1500, Fax (415) 326-1827.

Enter 913 on reader card

Graphicus Announces Data Analysis Software

Graphicus recently introduced Statit, a new modular data analysis system.

Statit provides a low-cost system for data management and statistical analysis that can be expanded with optional modules. It replaces the company's current statistical analysis offering, Stat80.

Statit runs on all HP 1000s and on HP 9000 computers operating under HP-UX, including the new Series 800. The price of the base module ranges from $1,200 to $8,000.

Statit is fully integrated with Grafit, the company's technical graphing system, to provide full graphical analysis capabilities. Statit's base module provides the ability to read binary and character data, basic descriptive statistical functions and a full graphical analysis library.

The Statistics module can be added to the system to provide more advanced capabilities. The Quality Control module provides statistical quality control procedures based on industry-standard specifications. A Procedure Writing module allows users to extend Statit's capabilities by writing customized procedures to make routine analysis easier and to build interfaces to application programs.

Additional modules to expand Statit's capabilities are on the drawing board and will become available the first half of 1988. They include a module for times series analysis and modules that provide an interface to IMAGE and SQL databases.

Contact Graphicus, 160 Saratoga Ave., Suite 32, Santa Clara, CA 95051; (408) 246-9530.

Enter 902 on reader card

dBARCODE Prints Bar Code With dBASE III Plus

dBARCODE, a PC-compatible bar code printing program, prints Code 3 of 9, Code 2 of 5, and UPC Version A using dBASE III Plus. dBARCODE supports dot matrix and HP LaserJet printers. It's practical for printing bar codes for part numbers or other information maintained in a dBASE database.

dBARCODE can print bar codes with descriptions or multiple columns of bar codes across a page, permitting adjustment of bar and space widths to suit various bar code readers. It also allows for variable bar code height and vertical spacing.

dBARCODE requires a PC or compatible and IBM Graphics-Compatible, or HP LaserJet printer and uses only 8K memory. The package also includes BARPRINT.PRG, a ready-to-use program allowing keyboard data entry and adjustment of height and spacing. Source code for BARPRINT is included and can be adapted easily to print bar codes from the user's dBASE files. dBARCODE is priced at $99.

dBARCODE from Timekeeping Systems supports dot matrix and HP LaserJet printers.

Contact TimeKeeping Systems, Inc., 12434 Cedar Rd., Cleveland, OH 44106; (216) 229-2579.

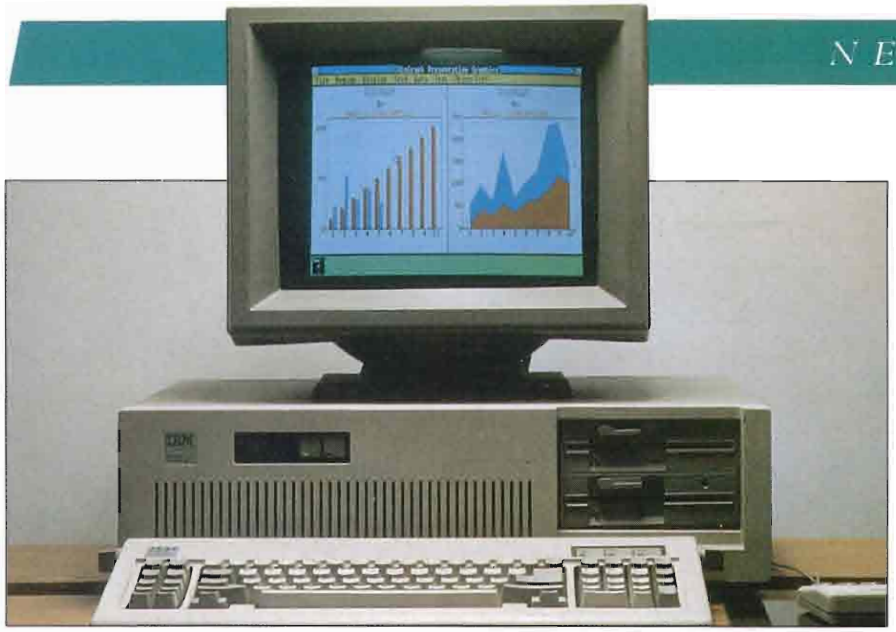
Enter 904 on reader card

AMT Offers HP Plotter Compatibility

The Hewlett-Packard Graphics Language (HP-GL) compatibility software has been introduced by Advanced Matrix Technology (AMT) for use with the AMT Office Printer Plus.

HP-GL software is packaged on a diskette and works in conjunction with the AMT Office Plotter, an IBM PC/XT/AT expansion card that converts plot data to AMT's native graphics language and provides a half-megabyte print spooler.

The AMT Office Plotter provides compatibility for the AMT printer with the Houston Instruments DM/PL plotter. The AMT Office Plotter Utilities Diskette, Ver-



Media Cybernetics' WinGraph business presentation graphics package.

sion 3.1, contains both the HP-GL and DM/PL drivers. AMT customers already using the AMT plotter can use the new software with their existing equipment.

In addition to the plotter language drivers, the Utilities diskette contains a run, terminate and stay-resident program that provides a pop-up control menu. This menu, accessible from within software applications, provides a convenient method for operators to control AMT Office Plotter operations and set printing parameters.

The AMT Office Plotter Utilities Diskette, Version 3.1, is available to current AMT Office Plotter users for $15. The AMT Office Plotter with the new Version 3.1 Utilities Diskette, retails for $595.

Contact Advanced Matrix Technology Inc., 1157 Tourmaline Dr., Newbury Park, CA 91320; (805) 499-8741.

Enter 903 on reader card

CPT LP-8GS Laser Printer For Technical Applications

CPT's new LP-8GS Laser Printer is designed to print text, scientific symbols and graphics in a single pass. Configured with the CPT Phoenix System, the LP-8GS provides high-resolution laser printing for educational, scientific, chemical and research professionals.

Twenty-four resident portrait and landscape fonts are standard on the LP-8GS, including four with CPT Scientific Symbols support. It also contains 2.5 MB dynamic RAM capacity, enough memory for an 8½″ x 14″ page at full resolution and 852K for optional downloadable fonts. Print speed is up to eight pages per minute (application-dependent).

The LP-8GS is compatible with any PC application software, and various emulations are supported. List price is $6,000.

Contact CPT Corporation, 8100 Mitchell Rd., P.O. Box 295, Minneapolis, MN 55440; (612) 937-8000.

Enter 900 on reader card

WinGraph Premiers At $99.95

In its premier showing of WinGraph, Media Cybernetics announced that the introductory price will be $99.95.

With nine available graph styles, the ability to read DIF, WKS and ASCII files and to write TIFF, CUT, DXF and HPGL, WinGraph sets a price/performance standard.

WinGraph is a business presentation graphics package that automatically generates charts and graphs from numerical data. It allows data to be entered manually, from files such as LOTUS 1-2-3, VisiCalc and dBase III, or from mainframe applications in ASCII file format. WinGraph also supports multiple graphs in a window and uses all fonts available under Windows.

A HALO CUT file format is included for those who want to use WinGraph in conjunction with other Media Cybernetics' products. In addition, a wide range of printers, plotters and film recorders are supported for colorful hardcopy.

Contact Media Cybernetics, Inc., 8484 Georgia Ave., Silver Spring, MD 20910; (301) 495-3305.

Enter 901 on reader card

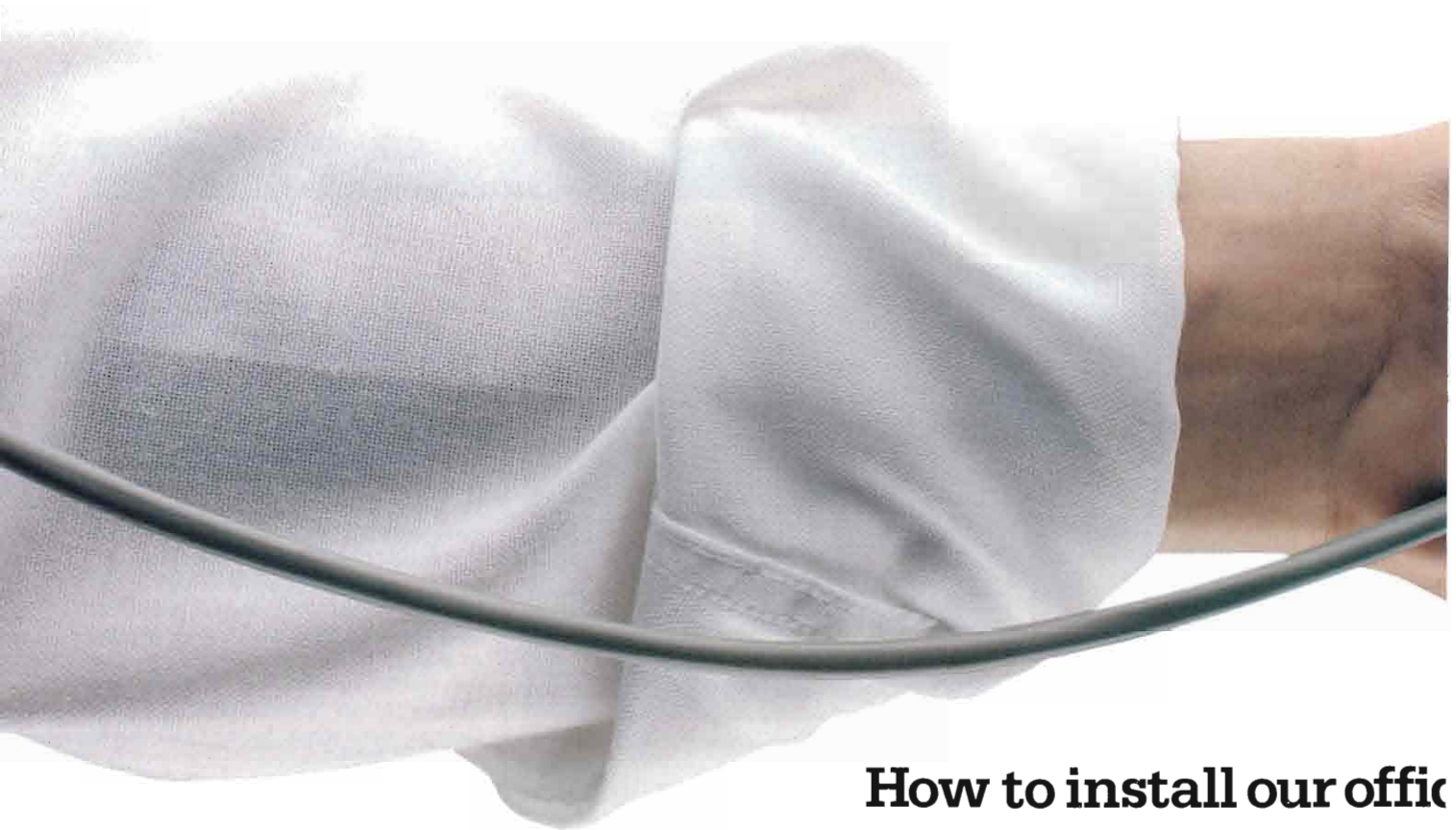
CAE Software Ports To 32-Bit Workstations

EEsof's CAE Software is now available on 32-bit computers such as the HP 9000 Series 300 computer, Apollo workstation, DEC VAX multiuser series and VAXstation II.

The Apollo, VAXstation and HP 9000 Series 300 computers have multitasking and advanced windowing capabilities created by 32-bit user interfaces which let the engineer work on several programs or design iterations simultaneously. In addition, the workstations can process complex microwave designs quickly and, due to their multitasking and windowing capabilities, allow ap-

Continued on page 88.

The new CPT LP-8GS is designed to print text, scientific symbols and graphics in a single pass.



How to install our offic

How to expand our offic

The Hewlett-Packard StarLAN office networking system works along the same lines as your existing phone system.

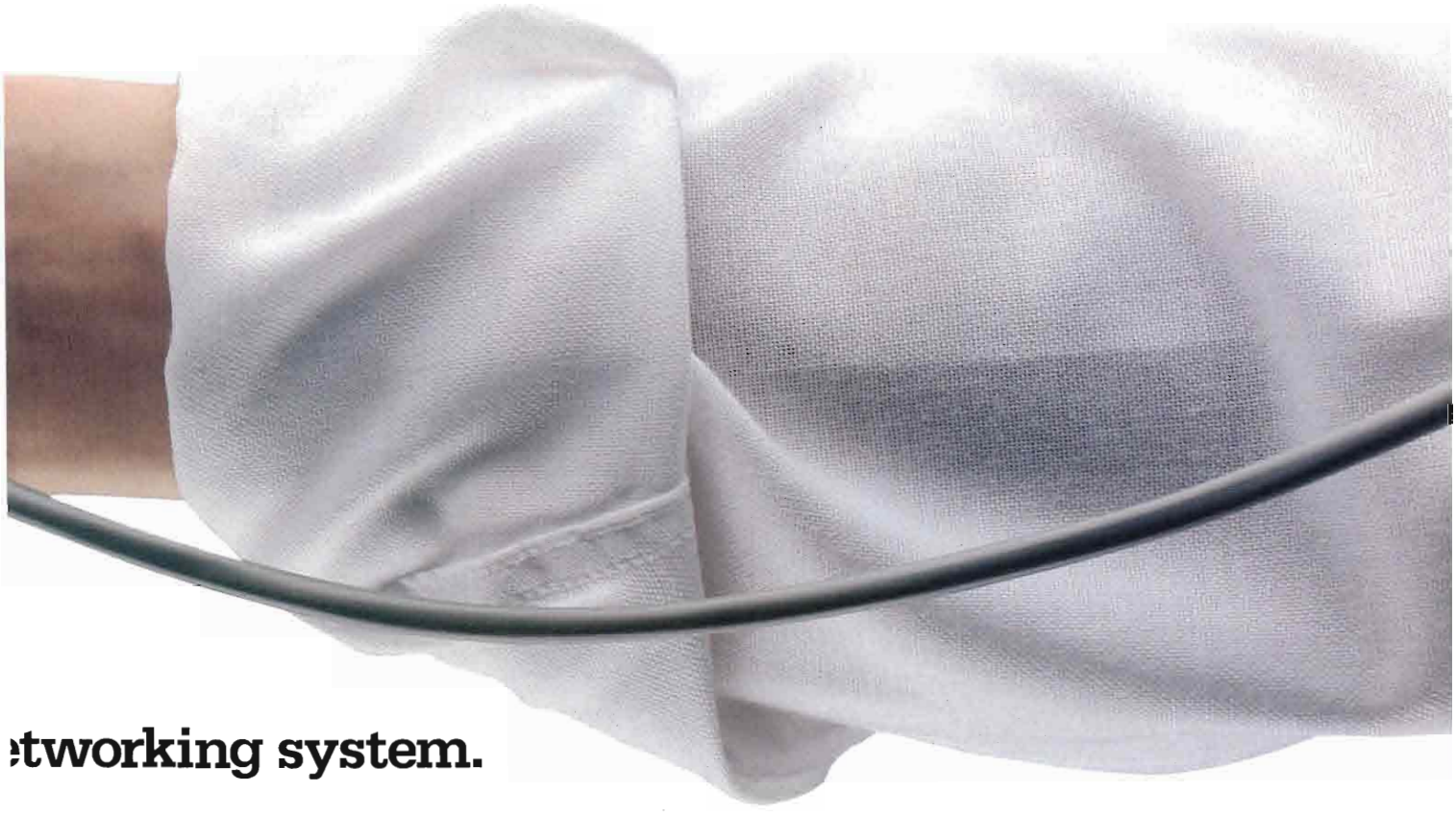
So where the phones go, your PCs can go.

It's a system with built-in flexibility, because the twisted pair wiring you need is often already in place.

So it's an altogether more accommodating and cheaper idea than coaxial PC networks, such as Thinwire Ethernet.

we never stop asking "What if..."

etworking system.



etworking system.

And, of course, it's based on the IEEE 802.3 industry standard.

As always, we asked a lot of "What if..." questions before we came up with HP StarLAN as part of Hewlett-Packard's total office systems solution. To plug yourself in, call 1 800 752-0900, Dept. 234C.

HEWLETT PACKARD

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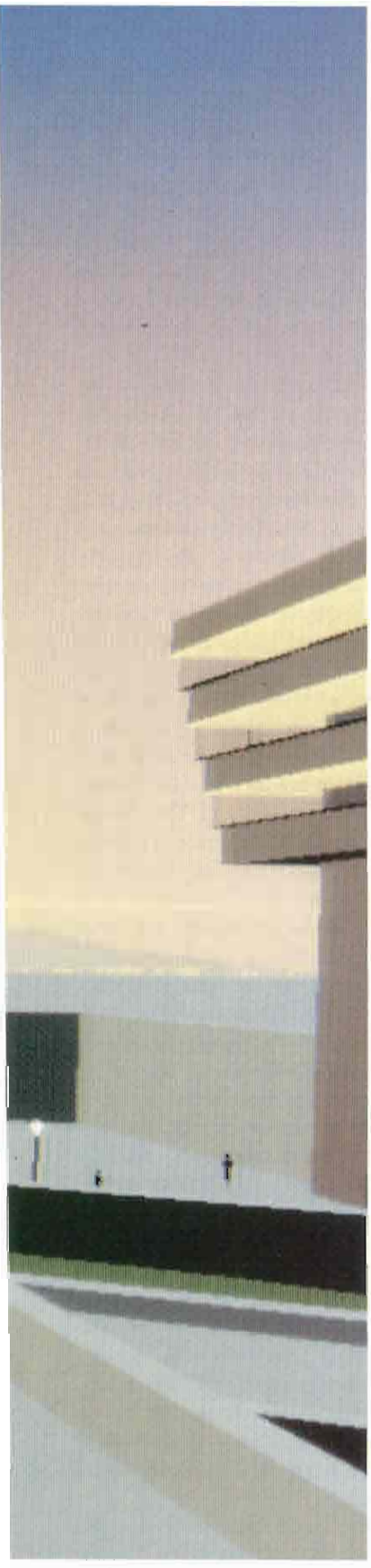


Optimizing Computer Graphics Workstations

MECHANICAL DESIGN

[BY ANDY GORIS]

There are many computer graphics workstations and terminals available today that provide a range of prices, performance and functionality. One of the faster growing markets for these workstations is Mechanical Engineering Computer Aided Design (ME CAD). It's for this market that the recently introduced HP 350SRX computer was developed.

ME CAD places many tough requirements on the workstation. Since the engineer is working in a predominantly 3-D world, cues to object geometry are essential. This includes perspective viewing transformations, hidden line and surface removal, depth cueing and advanced illumination models. The latter is also important in distinguishing objects made of different materials such as metal, plastic and rubber.

Another important feature for mechanical design is free-form curves and surfaces. Until recently, objects had to be created from simple primitives like boxes, cones, spheres and polygons. It's difficult to design a curved surface like the hood of a car from only these primitives; a more versatile primitive is needed. The emerging standard for representing curves and surfaces is Non-Uniform Rational B-Splines (NURBS). (See "Rational B-Splines for Curves and Surface Representation," *IEEE Computer Graphics and Applications*, Sept. 1983.)

Finally, most of these features wouldn't be useful if they took

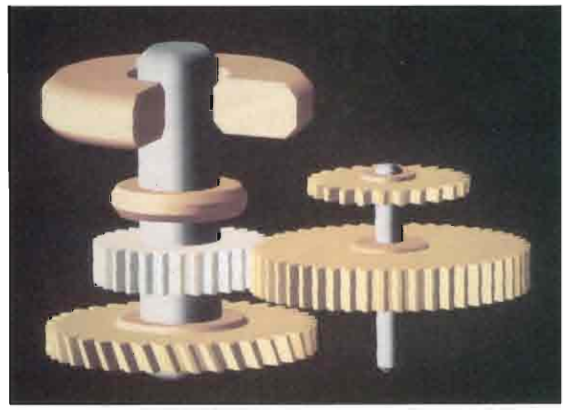
hours or even minutes to draw; the mechanical designer needs to be able to manipulate objects on the screen interactively. The HP 350SRX has been optimized to provide the capabilities required by the mechanical engineer. Many interesting aspects of the HP 350SRX hardware make interactive rendering of 3-D objects possible.

THE BLOCK DIAGRAM of the HP 350SRX looks similar to many high-performance graphics workstations (see *Figure 1*). There's a display list where user data is stored in virtual memory and traversed by a 68020; a transform engine that does 3-D modeling and viewing transformations, clipping, lighting calculations, etc.; a scan converter that takes screen coordinate vertices from the transform engine and renders lines and polygons in the frame buffer; a frame buffer where the image is stored; and a color map used to program the mapping of frame buffer data to colors shown on the screen.

This diagram is often referred to as the graphics pipeline and is described in many computer graphics texts.

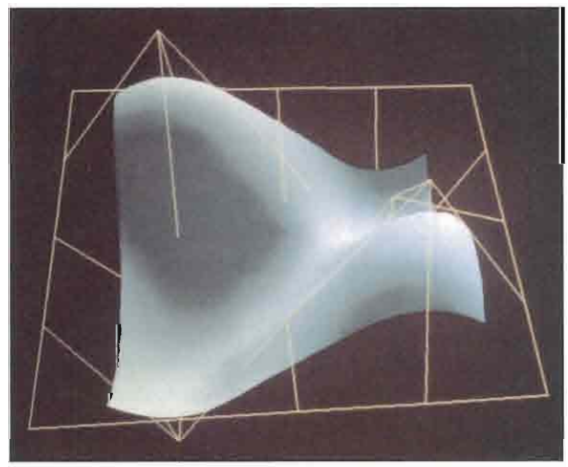
The things that distinguish the HP 350SRX from other graphics workstations are in how the individual blocks have been implemented, how they're connected together and the advanced features provided by each block. An important point is that the HP 350SRX isn't just a graphics terminal or peripheral — it's a complete standalone, high-performance workstation.

The first stage in the *graphics pipeline* is the display list and display list processor. The display list is where the user stores a graphical representation of the objects to be rendered. Depending on the application, the display list may be as small as a couple thousand bytes, or exceed several megabytes. If a dedicated memory is used to store the display list, there's a good chance that the user either won't have enough memory to store the entire object being rendered, or seldom use more than a fraction of available display list memory. In the 350SRX, it was decided that system memory is cheap ($/bit), fast, virtual and can be traded off against user program and data storage as needed by the application.



1: Shading models and Z-buffer turned on.

2: Different shade models possible on the 350SRX.



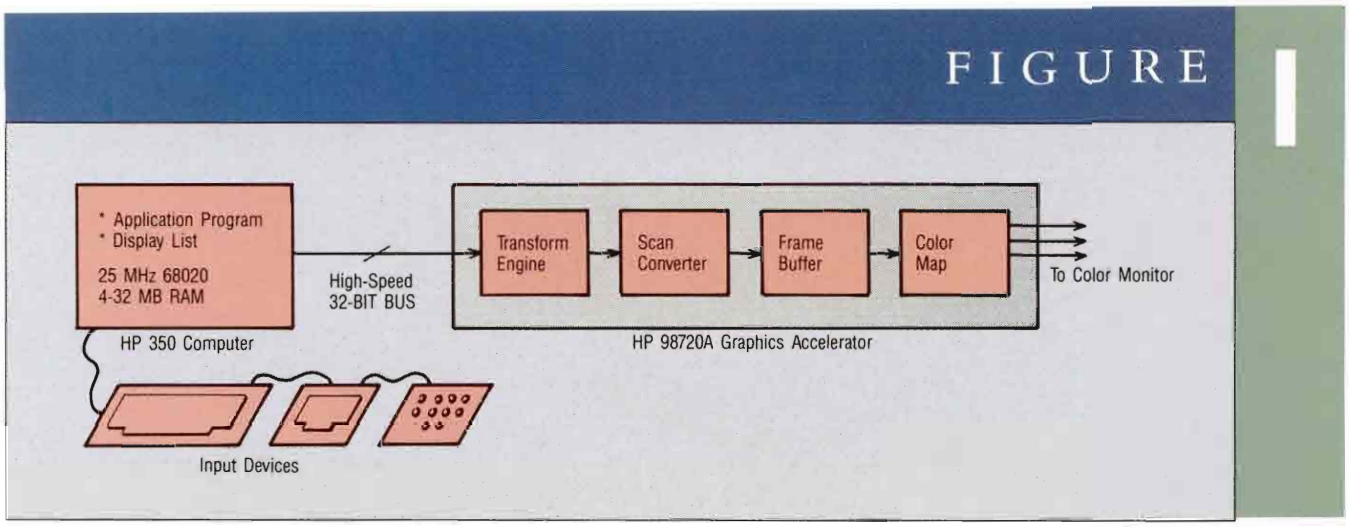
3: Trimmed B-Spline patch.

In addition to display list storage, a *processor* is necessary to traverse graphics commands stored in the display list and send them to the transform engine. Early analysis of the display-list-traversal problem led to two observations. First, the type of operations performed by the display list processor are general in nature; i.e., most operations consist of data movement, address calculations and simple integer arithmetic. Second, in typical applications, the application program is idle while the display list is being processed. The obvious conclusion was that the host 68020 would make an ideal display list processor.

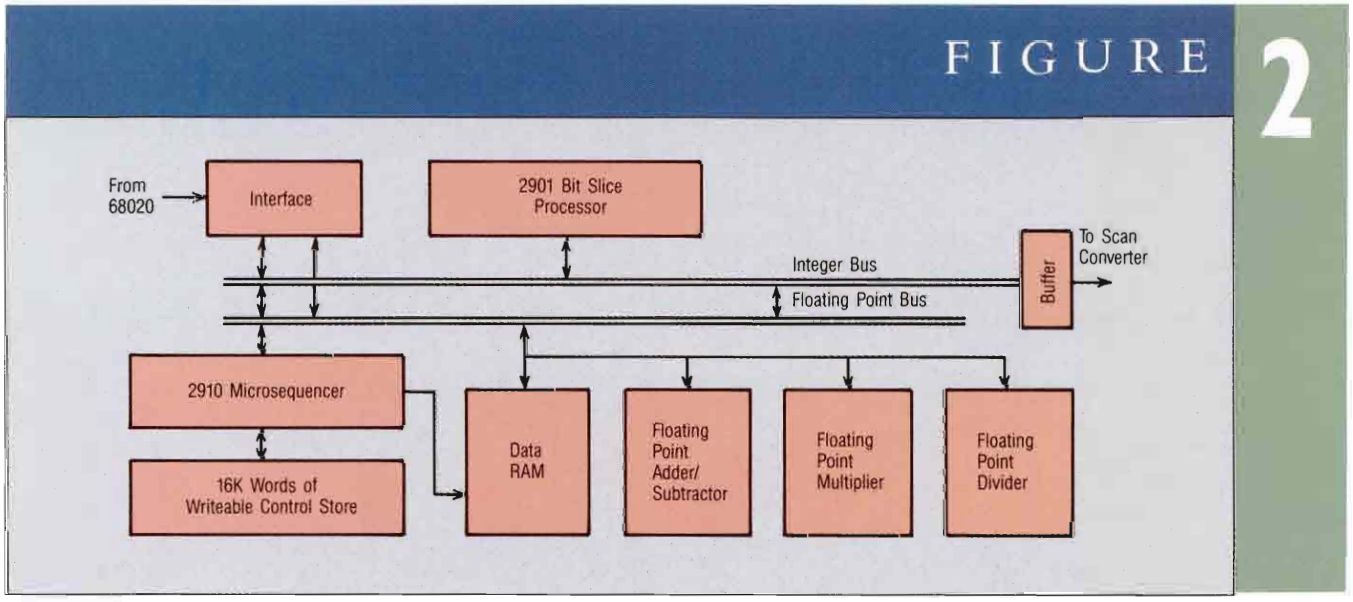
As the display list processor sends coordinates and commands to the transform engine, they must be converted from modeling coordinates to screen coordinates, clipped if necessary, and shading calculations must be made. All of these operations are performed using 32-bit floating point math. A block diagram of the transform engine used to accomplish this is shown in *Figure 2*.

The heart of the transform engine is a 2901-based bit slice processor and three HP custom floating point ICs. The floating point chips perform addition, subtraction, multiplication and division at rates of up to nine megaflops. Sixteen Kwords of writeable control store contain microcode for complicated shading algorithms and NURBS.

The output of the transform engine is screen-coordinate primitives like "draw vector" and "fill polygon." These



Block diagram of HP 350SRX.



Transform engine block diagram.

primitives are processed by the scan converter.

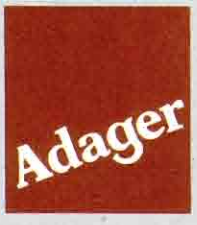
The scan converter takes commands from the transform engine and writes pixels into the frame buffer. The heart of the scan converter is a 150,000-transistor HP custom chip that draws vectors and shades polygons at bursts of up to 16 megapixels per second. This chip is unique because it simultaneously can interpolate 16-bit values for X, Y, Z, red, green and blue. There's no performance penalty for Gouraud shading of red, green and blue values simultaneously. The polygon rendering chip can shade convex or concave polygons with up to 255 vertices, crossing edges and holes. This chip is described in detail in "A Fast Shaded-Polygon Renderer," by R.W. Swanson and L.J. Thayer, *Computer Graphics* 20,4. A block diagram of the scan converter including the polygon rendering chip is shown in *Figure 3*.

External to the polygon rendering chip are circuits for dithering, transparency and patterning. Dithering is a technique of using a 4 x 4 pixel alternating pattern of two different colors to achieve a new color that's between the dithered colors. This allows users with only eight planes of graphics memory to still achieve full color rendering without severe mach banding. The eight planes are divided into three bits of red, three of green, and two bits of blue. This normally would produce only eight shades of red and green and four shades of blue; but with dithering, there are 48 shades each of red and green, and 32 shades of blue available. The only side ef-

Spectrum in sight?

Adager began shipping Spectrum-compatible software in August 1987.

This new version of Adager works on ANY HP3000 computer running IMAGE/3000 or TurboIMAGE under MPE or MPE-XL.



The Adapter/Manager for IMAGE/3000 Databases

Be sure to have Adager on site.

The only difference is performance: Adager really flies on Spectrum! For example, the BARUG Shootout Benchmark (which Adager runs in 2 hours 29 minutes on a Series 42) takes 46 minutes on a Series 930.

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fect is a slight graininess in the image.

When 12 planes are being displayed, the dither circuit can be used to dither four bits of red, green and blue, resulting in 256 shades of red, green and blue. The images produced with this technique look almost as good as images rendered in 24-plane mode (eight bits each of red, green and blue) when viewed from a distance of one meter. The transparency circuit simulates transparency with a programmable 4 x 4 repeating *screen-door* pattern. There are 16 different levels of transparency available.

One of the problems when designing the scan converter was that it could generate pixels faster than the frame buffer could accept them. In order to match the bandwidth between the scan converter and frame buffer, a pixel cache chip was implemented using HP's 1.6 micron CMOS process.

THE PIXEL CACHE accepts pixels serially (one at a time) from the scan converter and stores them in a buffer. Up to 16 pixels can be buffered at one time. Once the buffer's boundaries have been crossed, its contents are written in parallel into the frame buffer. The write to the frame buffer is overlapped with the filling of the next buffer, so the scan converter can continue sending pixels.

The Frame Buffer subsystem consists of a 2048 x 1024 memory of which 1280 x 1024 pixels are displayed. The depth of the frame buffer can be eight to 32 planes, plus an additional four planes for graphics and text overlays. A block diagram of the frame buffer subsystem including the pixel cache is shown in *Figure 4*.

The frame buffer is implemented with 256K video RAMs, so screen refresh (60 Hz noninterlaced) doesn't interfere with scan converter/pixel cache operations to memory. Of particular interest is the way the Z-buffer hidden surface algorithm has been implemented. Since only 1280 pixels of the 2048 frame buffer width are displayed, there's a significant amount of frame buffer memory left over. In an eight-plane system, ignoring the overlay planes, this amounts to 768 KB memory. In a 32-plane system in which only the first 24 planes are displayed, this amounts to 4.3 MB. In the 32-plane system, there's more than enough extra memory to store a 16-bit Z value for every displayed pixel on the screen.

For systems with less than 32 planes of frame buffer, there still may be enough memory to store all the Z values if the current graphics window is smaller than the full 1280 x 1024. A special Z-map circuit is used to map nondisplayed frame buffer memory into the appropriate place on the screen. In other words, no additional memory needs to be purchased to use the Z-buffer hidden surface removal algorithm.

So what happens when there's not enough extra frame buffer memory to store all the Z values? In this case, *strip-Z* mode is used. In strip-Z mode, there's only enough extra frame buffer memory to store Z-values for a fraction of the screen; for example, 1/2 or 1/3. The image must be rendered in multiple passes, or strips, where the strip-Z buffer is reinitialized before rendering each strip of the screen. This admittedly is slower than *full-Z* mode, but has the advantage that you can still render images with the Z-buffer hidden surface algorithm *even if you have only eight planes of graphics memory!* For example, in an eight-plane system, there are 768 KB of unused memory, so for a 1280 x 1024 image, it will take:

(1280 x 1024 x 16 Bits per pixel)/(768 x 1024 x 8) =
3.3333 —> 4 strips to render the picture.

Since Z-values are stored in the same RAM as RGB color values, the pixel cache was designed to accommodate both values simultaneously. Z-values are cached just like pixel intensity values, except they are read and written out of a different port on the pixel cache chip. In this way, Z-reads out of the pixel cache, Z-compares and pixel/Z writes into the pixel cache can be overlapped with accesses to the frame buffer.

The performance of this scheme is illustrated in *Photo 1*, which took less than 0.8 seconds to draw on the 350SRX.

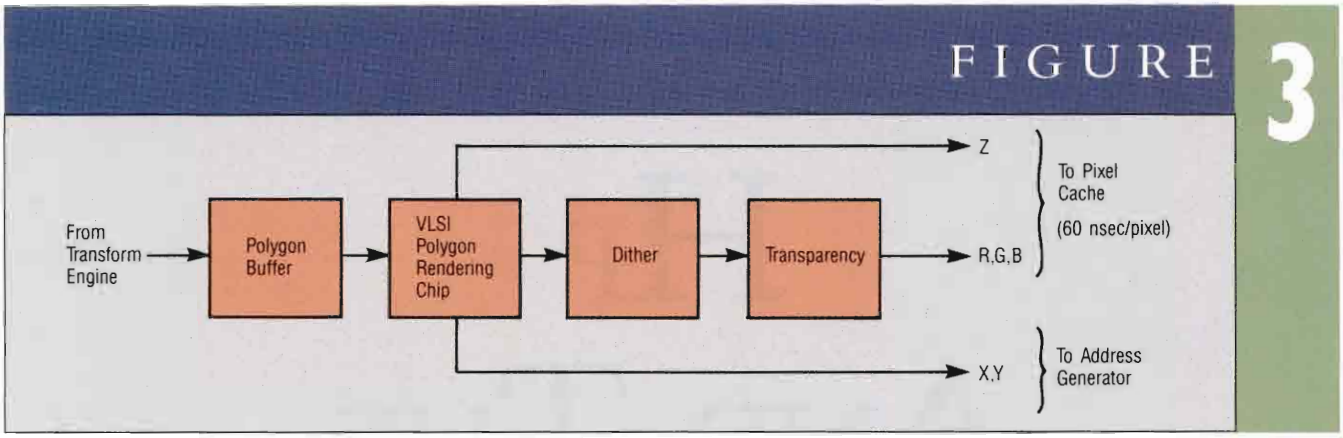
In addition to the graphics memory, there are four bitmapped overlay planes. Architecturally, the overlay planes look just like more frame buffer memory, so the scan converter can draw pixels as easily here as in the rest of the frame buffer. Normally, three of the overlay planes are used for the window system (text), and the fourth plane is used for graphics cursors, rubber-band lines, etc. Having a separate memory for text and cursors greatly simplifies management of the graphics memory.

The HP 350SRX color map is straightforward. Frame buffer data goes through three separate 256 x 8 lookup tables, one each for red, green and blue. The output of the lookup tables goes to three eight-bit 108-MHz DACs which drive the video input on a color CRT monitor.

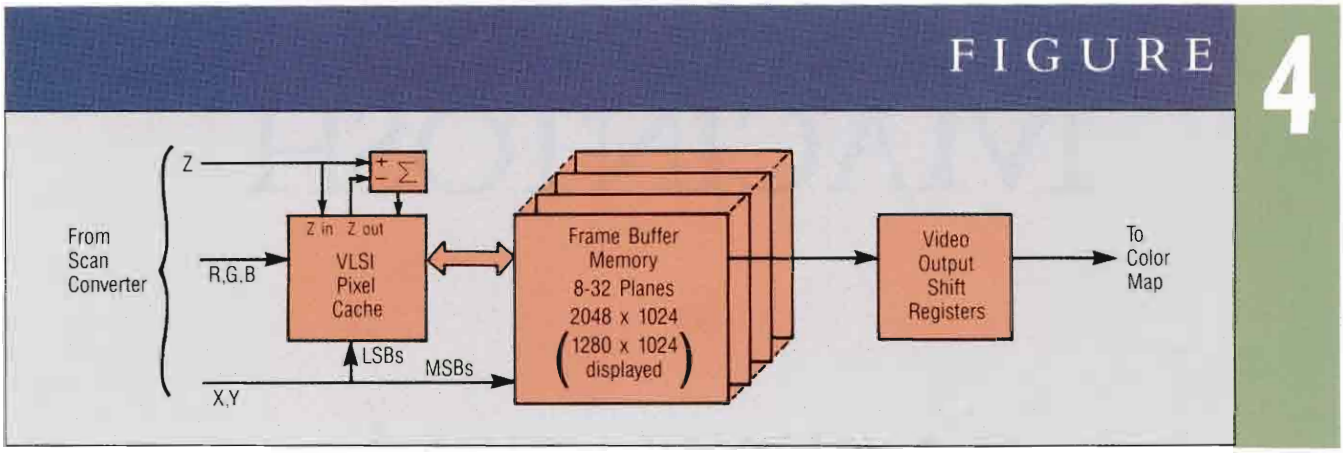
AN EXTENSIVE SOFTWARE LIBRARY called Starbase has been developed to simplify the job of writing applications for the 350SRX. Two features of the Starbase Library deserve special mention — the illumination models and the B-Spline routines. Both features are backed by an extensive amount of microcode in the transform engine to achieve interactive speed.

The illumination models consist of two distinct parts, lighting models and surface shading models. As you position objects in 3-D space, you also can position up to eight light sources which illuminate the scene. The lights can be colored and can be point sources of light, directional sources of light (all rays parallel), ambient light (comes from all directions) and spotlights. Spotlights have a programmable cone width and a programmable goniometric (light distribution function) across the cone.

Surface models allow objects to be diffuse (like rubber or cloth), shiny (like plastic), or even metallic. This is done



Scan converter.



Frame buffer subsystem.

using the Phong lighting model to calculate colors at each vertex of a polygon, then linear interpolation across the polygon. Some of the surface models available are shown in *Photo 2*.

There are three light sources in this picture — one ambient light and two directional lights. The directional light sources produce the specular highlights visible on the metal and plastic vases.

The most advanced geometric primitive on the 350SRX is the NURBS. B-Splines allow free-form surfaces to be represented easily and quickly and also provide significant data reduction, up to 75X, over brute-force polygon representation. A trimming capability allows B-Spline patches to have edges and holes cut or trimmed from them. *Photo 3* shows an example of a B-Spline with trimming.

The intersections of the yellow lines are the control points for the B-Spline surface. These can be turned off under program control. The trimming curves themselves also are B-Splines, which makes this a powerful tool for solids modeling and ME CAD.

The high performance and rich feature set described here were made possible by extensive use of VLSI throughout the product and specialized microcode in the transform engine. Application programs have easy access to the features and performance of the HP 350SRX through the Starbase graphics library. Starbase supports many advanced features such as double buffering, depth cueing, hidden surface removal, sophisticated illumination models and NURBS.

In the past, these features had to be implemented in the application program, which meant a lot of programming work and the feature ran slowly, if at all. In this respect, the HP 350SRX should improve the productivity of the mechanical engineer, but also the time it takes to write the application programs that the mechanical engineer will be using. *—Andy Goris is an electrical engineer in the R & D Lab of the Technical Workstation Operation at HP's Ft. Collins, CO, facility. He is the hardware system architect of the HP 350SRX Graphics Workstation.*

A Graphics Workstation For The Rest Of Us

HP AND THE MACINTOSH

[BY JAY MARTIN ANDERSON]

The search for a graphics workstation may have led you to explore possibilities as far-reaching as a microcomputer with a 300 x 200 pixel monochrome monitor attached to some host mainframe by an RS-232 connection (at a cost of perhaps $1,000), to a powerful microprocessor coupled to a monitor that displays a million or more pixels with thousands of colors, supported by a graphics engine as a coprocessor (at a cost of perhaps $50,000). . .

For those of us whose needs fall between these extremes, the search may be over: We can couple an Apple Macintosh to a Hewlett-Packard 3000 or 9000.

A premise: Hewlett-Packard consistently has demonstrated leadership in both hardware and software for graphics. HP's introduction of the gritwheel paper movement mechanism in the early 1980s was a major breakthrough in price/performance.

In vector graphics hardware, HP offers plotters that use paper sizes from A (8½ x 11) to E (34 x 44), with two to eight pens and with ever-increasing pen and paper speeds. HP CRTs include monochrome terminals with about 200,000 pixel graphics onto mega-pixel mega-color graphics monitors for CAD/CAM and other design applications.

HP's own 3000-based graphics software offerings include applications for charting, drawing and cartography; their 9000-based graphics offerings span a wide range of engineering design tools. The recent introduction of the HP 9000 Model 825SRX, a high-speed technical computer with graphics coprocessor, is proof of HP's leadership in computer graphics.

Another premise: The Apple Macintosh has demonstrated similar leadership in both hardware and software for microcomputer graphics. QuickDraw, the Macintosh's package for

graphics, is provided in ROM; this is perhaps the first example of a "graphics engine onboard" in any widely distributed microcomputer. QuickDraw provides bitmapped graphics for million-pixel multicolor as well as 200K-pixel monochrome monitors.

Apple's adoption of PostScript has permitted hardcopy output resolution from 300 up to several thousand dots per inch. The Macintosh's early use of windows, pull-down menus and on-screen controls has made its user-interface the easiest to use and most intuitive in the industry.

> The foundation of our graphics workstation is terminal emulation software resident on the Macintosh . . .

AppleTalk, a proprietary local area network, permits several Macintoshes as well as IBM PCs to share resources, such as an Apple LaserWriter or a file server. Apple recently strengthened its position with the introduction of the Macintosh SE and Macintosh II computers: The Macintosh II permits use of a range of high-resolution color monitors.

Whereas the second premise may find more reluctant acceptance in the Hewlett-Packard community than the first, the Macintosh's eminent position in professional desktop communications and graphics design can no longer be in doubt.

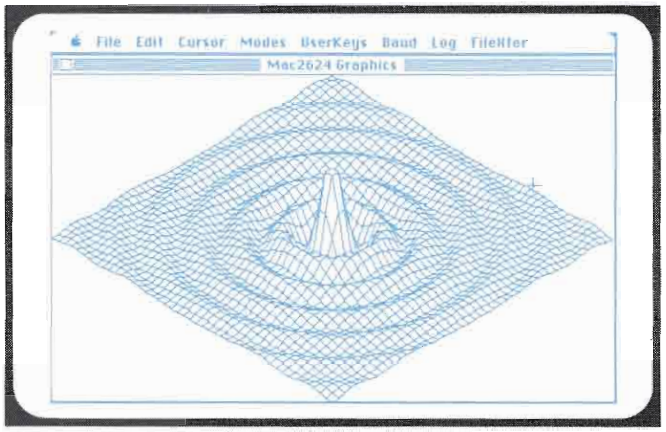
Therefore, if you accept these premises, we have before us the raw materials for a graphics workstation that meets the needs of a large fraction of the business and scientific community: We marry the Macintosh microcomputer to the HP minicomputer and capitalize upon the strengths of each. The cost of a Macintosh and requisite software is only a little more than a comparable graphics terminal, and the opportunities for coupling data and HP-resident software with software and devices attached to the Macintosh are legion.

The graphics workstation born of this marriage offers medium-resolution (from 200,000 to a million pixels) CRT displays in black and white or hundreds of colors and access to any HP plotters, and uses HP-based and Macintosh-based software. The cost of such a workstation might range from a little over $2,000 to as much as $10,000, depending on the Macintosh model, plotter (if any) and software selected.

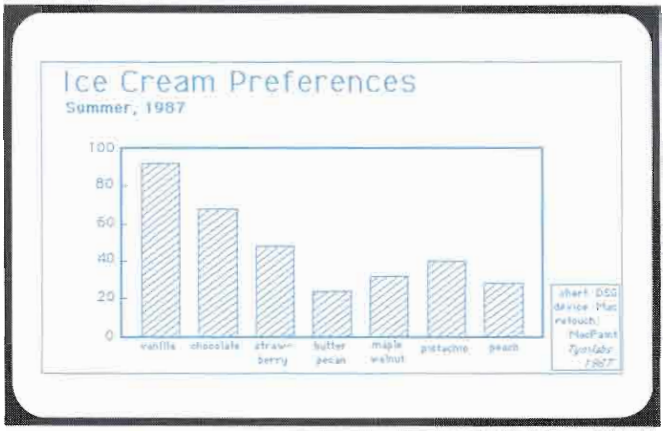
Let's take a look at some of the requirements of the Macintosh-HP graphics workstation "for the rest of us."

The foundation of our graphics workstation is terminal emulation software resident on the Macintosh which allows

Screen 1: A map produced by HPMap displayed on a Macintosh using emulation of the HP 2393A graphics terminal.

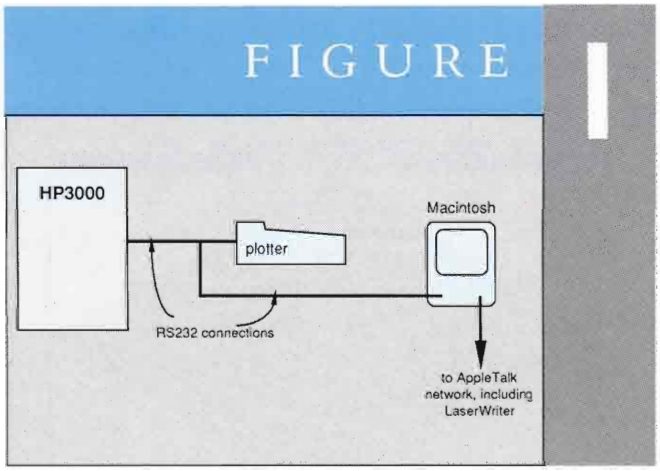


Screen 2: A calculation on the HP 3000 is displayed on the Macintosh using AGL (CGL) library procedures and HP 2393A terminal emulation.

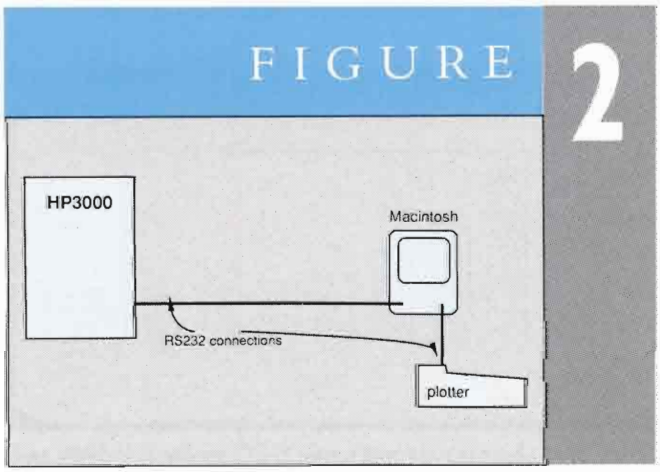


Screen 3: A chart is produced using DSG on the HP 3000 and displayed on a Macintosh using HP 2393A terminal emulation. It then is annotated and embellished using MacPaint on the Macintosh. DSG, for example, doesn't allow the bars to be labeled with two-line descriptive phrases.

it to emulate an HP block-mode graphics terminal, such as the 2393A (monochrome) or 2397A (color) terminals. At this time, there are three HP terminal emulators available for the Macintosh: ICC (Petaluma, CA) offers Mac-3000; Tymlabs Corporation (Austin, TX) offers Mac2624 and Walker, Richer & Quinn (Seattle, WA) offers Reflection for the Macintosh. The current releases of these products don't include emulation of HP graphics terminals. The illustrations in this article were produced using a graphics terminal emulator under development at Tymlabs, and are meant to be suggestive of possibilities for an HP-Macintosh graphics workstation. Tymlabs plans release of its graphics terminal emulator for the Macintosh, as a new version of its Mac2624 product, in the fourth quarter of 1987.



Graphics workstation configuration, showing an HP 3000 connected to a Macintosh, which is connected to an AppleTalk network. The plotter "eavesdrops" on the RS-232 connection between the HP and the Mac.



Graphics workstation configuration, showing an HP 3000 connected to a Macintosh. Plotter signals are passed through the Macintosh from one serial port to another. There's no connection to an AppleTalk network.

With the right software, the Macintosh Plus and Macintosh SE can fully emulate the HP 2393A or HP 2623A monochrome graphics terminals. However, the hardware, video controller and monitors available for the Macintosh II permit this newest member of the Macintosh family to exceed the capabilities of the HP 2397A or HP 2627A color graphics terminals by providing, for example, up to a million pixels in up to 256 colors chosen from over 16 million possible colors.

For the HP 3000 user, the first evidence in the proof of the Macintosh workstation concept might be successful use of HP's DSG, HPEasyChart, HPDraw or HPMap on the Macintosh. This is, in many ways, a difficult test because it combines the emulation of both block-mode features of the terminal and CRT graphics (see *Screen 1*).

Emulation of an HP graphics terminal requires that the Macintosh software handle escape sequences for display control, drawing modes, plotting, color composition and selection, and interactive status requests. Virtually all of these escape sequences are used in HP and third-party software. Although many of the HP graphics features can be readily translated into QuickDraw functions, some, such as HP's dot-dash line types, require emulation in software.

HP's 3000-based graphics products are based on its unreleased and unsupported AGL (A Graphics Library), which was contributed on two occasions to the Interex Contributed Software Library where it's known as CGL (Contributed Graphics Library). This library provides device-independent graphics primitives such as move, draw, polygon fill and text, and support for all HP graphics devices, including CRTs, plotters and dot-matrix printers. Similar graphics libraries are provided on the HP 9000. Because the low-level AGL routines emit CRT escape sequences when drawing to a CRT, the Macintosh graphics terminal emulator should deliver comparable output for any application built on AGL as well (see *Screen 2*).

The Plotter Connection

THUS FAR, WE'VE EXAMINED the issues surrounding emulation of an HP graphics terminal in our emerging graphics workstation. In addition to connection of the Macintosh to an HP 3000 or HP 9000 computer, we also must consider the connection of an HP plotter to the Macintosh. Four possibilities present themselves:

1. An RS-232 plotter "eavesdrops" on the RS-232 connection between the Macintosh (usually on the modem port) and the host minicomputer. This configuration is commonly used with HP graphics terminals that have only one port. You'll need a cable from the Macintosh modem port to a 25-pin RS-232 connection on the plotter and, depending on the HP plotter, you also may need a "Y" cable (HP part no. 17455A or custom-made). This configuration, shown in *Figure 1*, is probably the easiest to set up and leaves the second serial port (usually the printer port) on the Macintosh free for attachment to a printer

or to an AppleTalk network.

2. The Macintosh passes plotter information received at the modem port to a plotter attached to the printer port. This configuration is often used with HP and other microcomputers that have two ports. You'll need a cable from the Macintosh modem port to a 25-pin RS-232 connection to the host minicomputer and from the Macintosh printer port to a 25-pin RS-232 connection on the plotter (*Figure 2*). Obviously, you won't be able to connect both a plotter and a printer to your Macintosh at the same time.

Some terminal emulation software takes advantage of the pass-through connection. SoftStyle (Honolulu, HI) offers a number of device drivers for the Macintosh, including drivers for serial HP printers and plotters; however, there's no software available that permits pass-through of plotter information from the host (modem port) to a plotter (printer port) on the Macintosh.

3. Serial plotter data arriving on the modem port could be transformed to parallel data and transmitted to an HP-IB plotter attached through additional hardware either to the printer port or the Small Computer Systems Interface (SCSI) port. The HP-IB interface generally is known as an IEEE-488 interface outside the HP world. This is the only interconnection possible for HP-IB plotters and is commonly used with HP's own personal computers or with IBM PCs and compatibles to which an IEEE-488 card has been added.

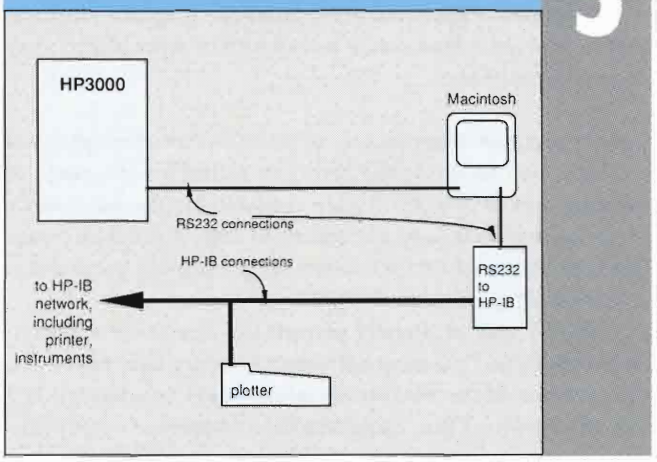
An HP-IB cable and additional hardware is required. IOtech (Cleveland, OH) offers Mac488A, an IEEE-488 bus controller which attaches to the Macintosh serial port (*Figure 3*). As with the second configuration, it isn't possible to use the printer port for both a printer and the HP-IB connection, although it may be possible to use the HP-IB connection for both an HP-IB plotter and an HP-IB printer. This configuration is considerably more demanding, since it requires both a hardware and a software solution. No presently available terminal emulation software includes an HP-IB driver.

In spite of the difficulties presented, this configuration offers additional opportunities beyond the connection of a Macintosh to an HP plotter. The HP-IB protocol permits daisy-chaining of several devices on the bus. Consequently, in a laboratory or testing environment, measuring and test instruments also could be attached to the HP-IB along with a plotter. The resulting workstation would afford the scientist or test engineer considerable power both in acquiring data from instruments and in the analysis of those data.

Although the only known hardware solution (from IOtech) provides for connection of the serial-to-HP-IB device to either the Macintosh modem or printer port, it's possible that some hardware supplier will consider transforming data at the Macintosh SCSI port to the HP-IB protocol.

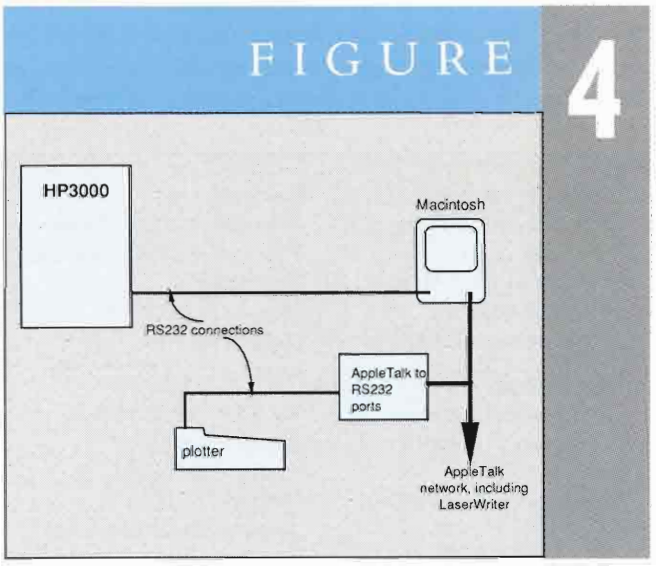
4. An HP RS-232 plotter can be connected to an AppleTalk network. This configuration also requires both hardware and software; Abaton Technology (Pleasanton, CA) offers MultiTalk,

FIGURE 3



Graphics workstation configuration, showing an HP 3000 connected to a Macintosh. Plotter signals are passed through the Macintosh from one serial port to another and converted from RS-232 serial to HP-IB parallel signals. Other HP-IB devices may be "daisy-chained" on the bus.

FIGURE 4



Graphics workstation configuration, showing an HP 3000 connected to a Macintosh, which is connected to an AppleTalk network. The AppleTalk network includes a device which provides RS-232 ports; a plotter is attached to one of the RS-232 ports.

a hardware device that connects to the AppleTalk network, and software that permits up to three RS-232 ports on each MultiTalk device to be named and configured (*Figure 4*).

This configuration has the advantage that many users on an AppleTalk network could share the same plotter, and it still

permits access to ImageWriters or LaserWriters attached to the AppleTalk network. No presently available terminal emulator product takes advantage of this configuration.

We should expect our HP-Macintosh graphics workstation to provide at least one, if not all four of these plotter connection possibilities.

ONE OF THE MAJOR advantages of the HP-Macintosh graphics workstation concept is the ability to utilize a wide range of painting and drawing software available for the Macintosh. To do so, we must have the ability to copy a graphics image from the emulated HP CRT screen for subsequent pasting into a Macintosh document.

The Macintosh already permits this operation within its own system and painting software. With a single keystroke, the contents of the Macintosh window are saved as a MacPaint document. Then, using MacPaint (Apple) or other painting programs, the screen image can be embellished or retouched. With this capability, it is extremely simple to incorporate graphics images from HP software into the full range of word processing or desktop publishing applications on the Macintosh.

The copy-and-paste concept can be extended to include copy of not merely the entire Macintosh window, but a selected portion thereof. Selecting just the chart portion of a DSG chart, for example, and pasting this into a Macintosh word processing document could eliminate the step of retouching the graphics image with a painting program before pasting it into a document (see *Screen 3*).

Similarly, our graphics workstation should permit direct and rapid copy of all, or a selected portion, of the graphics screen image to an attached printer. This is, of course, an important part of true terminal emulation, which permits the copy of either the alphanumeric or the graphics plane of the screen image to an attached or internal printer. In addition to emulating the terminal capability, we have the opportunity to copy a portion of the graphics image to a printer or to copy the overlap of both the alphanumeric and graphics images to a printer.

Graphics on an HP computer isn't a matter of mere images generated on the fly. Graphics images can be saved in a variety of file formats on HP computers. For example, on the HP 3000, the figure file is a common medium of storage that permits DSG, HPMap and HPDraw to use and share the same images, and the raster file is a bitmapped image prepared for use on HP's laser printers.

On the Macintosh, the PNTG file contains images in a bitmap format (painting) and the PICT file contains images in an object-oriented format (drawing). It's important in our graphics workstation to be able not only to transfer these files between the HP 3000 and the Macintosh, but to convert them into their useful counterparts on the other computer. That is, we should be able to convert HP figure files into Macintosh drawing files and vice versa, and Macintosh painting files into HP raster files and vice versa.

Interface Issues

WINDOWS AND MICE. HP graphics terminals present a single image that can be taken either from alphanumeric display memory or from graphics display memory. In the absence of windowing on a terminal, the user chooses to see either words or pictures (or both) on the screen. On a Macintosh, on the other hand, a robust windowing scheme is already provided. The worker at a Macintosh may choose to place graphics in one window and alphanumeric information in a second window, and then manipulate those windows so he sees what he wants or needs at any given instant. Both windows may be placed side-by-side, or one window may totally or partially obscure another.

What's visible in the graphics window may be the entire image of graphics display memory squeezed into a small window, or it may be only a portion of graphics display memory shown full-size in a small window which can be scrolled throughout the entire display. Much Macintosh software separates graphical displays from literal displays so that a dual-window mode may be more natural to the veteran Macintosh user.

Alternatively, the user may wish to view the superposition of both alphanumeric and graphics information in the same window, much as you might expect on a graphics terminal. A single window displaying both types of informa-

> HP graphics terminals present a single image that can be taken either from alphanumeric display memory or graphics display memory.

tion may be more natural to the veteran HP terminal user. A good graphics workstation on the Macintosh probably should provide both.

HP graphics terminals and workstations often are arranged with a variety of auxiliary pointing and drawing devices, such as a mouse or a tablet-and-stylus. No Macintosh is mouse-less; therefore, you'd expect that the Macintosh mouse would behave much like an HP mouse (if one is available). Tablets also may be attached to a Macintosh, and you'd expect that the user of a tablet with a Mac would experience the same operations as the user of a tablet with an HP terminal.

The challenge of the software designer is to fulfill the expectations of the software user, whether that user is a Macintosh veteran or an HP veteran (or both, or neither).

The forthcoming release of Tymlabs' Mac2624 will incorporate much of this design criteria and will be a major step towards the graphics workstation described here.

The facile use of computer graphics in both business and technical applications can be achieved with the combination of an Apple Macintosh on your desk and an HP 3000 or HP 9000 in your office or lab. High-quality graphics software is available for both HP minicomputers and for the Macintosh. The design and development of software and hardware to effect the connection between Mac and HP will permit highly functional and cost-effective graphics workstations for business, industry and research. — *Jay Martin Anderson is a software developer at Tymlabs Corporation, Austin, TX.*

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Laser Printing

An Analysis Of Graphic Output On The LaserJet

[By Martin Gorfinkel]

Printers often need to display material other than the letters, digits and punctuation used for normal text. The general rubric "graphics" covers a broad range of output on a printer, plotter, CRT or other output device. The range of graphic output extends from the simple matter of drawing one line to the complexity of displaying a 3-D object on a 2-D display from an arbitrary viewpoint.

Let's look at some of the most straightforward graphics applications, focusing on the ways to generate graphic output on the HP LaserJet printers. The various approaches to generating graphic output provide different balances between efficiency and flexibility.

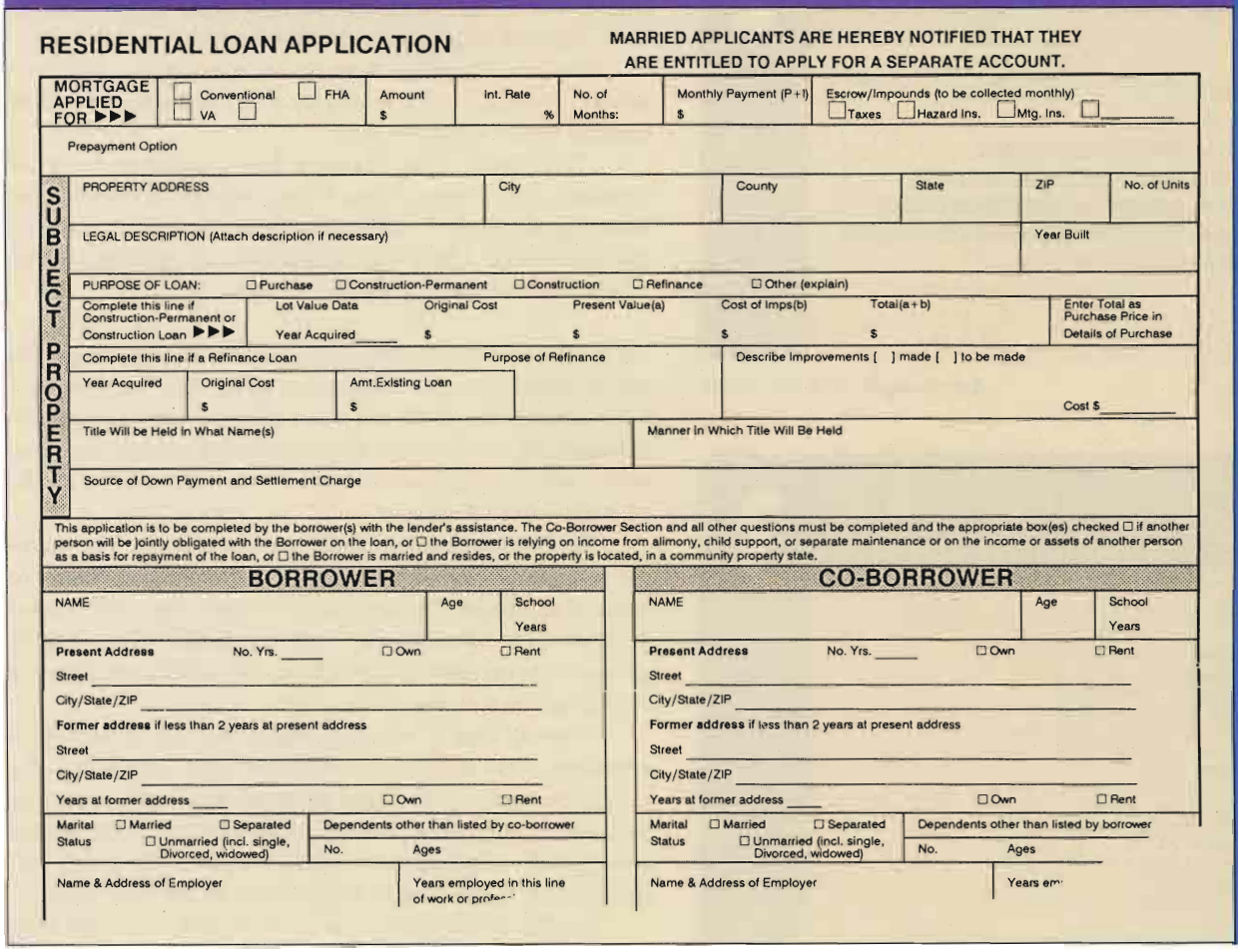
Traditional printers generate only the characters built into their hardware. A daisywheel printer, for example, can create only images using the shapes existing on its typewheel. Graphics with those printers are generated primarily with the vertical bar, the underscore for vertical and horizontal lines and a period with appropriate carriage movement to generate other lines.

The LaserJet series of printers offers three additional tools for generation of graphic output. Raster data can be sent to the printer indicating, dot by dot, which points should be black on the page. There's a facility for generating vertical or horizontal lines of any length and thickness. Finally, the user can use a font with characters specifically suited to the purpose. At least two such fonts are supplied by HP.

Raster data is the best method for generating graphic output if you want complete control over the printer. For some applications, it may be the only feasible method. However, there are many circumstances in which another approach will generate good results in significantly less time.

At LARC Computing (Los Altos, CA), we've created two fonts for use with our software. One is used to generate line drawings and the other is used for large block lettering. Block letters from 0.25 inch, 24 points, to one inch, 96 points, are created by transmitting about 100 bytes of data per letter. (There are 72 points in one inch; however, capital letters of a specific point size aren't as high as the point size. The height of capital letters is ⅔ of the point size. Thus, capital letters in 48-point type are 36 points or ½-inch tall.) The number of bytes transmitted to the printer for a line drawing may be as few as two percent of those required for

FIGURE I



RESIDENTIAL LOAN APPLICATION

MARRIED APPLICANTS ARE HEREBY NOTIFIED THAT THEY ARE ENTITLED TO APPLY FOR A SEPARATE ACCOUNT.

MORTGAGE APPLIED FOR ▶▶▶ ☐ Conventional ☐ FHA ☐ VA ☐ | Amount $ | Int. Rate % | No. of Months: | Monthly Payment (P+I) $ | Escrow/Impounds (to be collected monthly) ☐ Taxes ☐ Hazard Ins. ☐ Mtg. Ins. ☐ _____

Prepayment Option

SUBJECT PROPERTY

PROPERTY ADDRESS | City | County | State | ZIP | No. of Units

LEGAL DESCRIPTION (Attach description if necessary) | Year Built

PURPOSE OF LOAN: ☐ Purchase ☐ Construction-Permanent ☐ Construction ☐ Refinance ☐ Other (explain)

Complete this line if Construction-Permanent or Construction Loan ▶▶▶ | Lot Value Data: Year Acquired _____ $ | Original Cost $ | Present Value(a) $ | Cost of Imps(b) $ | Total(a+b) $ | Enter Total as Purchase Price in Details of Purchase

Complete this line if a Refinance Loan | Purpose of Refinance | Describe Improvements [ ] made [ ] to be made | Cost $_____

Year Acquired | Original Cost $ | Amt. Existing Loan $

Title Will be Held in What Name(s) | Manner in Which Title Will Be Held

Source of Down Payment and Settlement Charge

This application is to be completed by the borrower(s) with the lender's assistance. The Co-Borrower Section and all other questions must be completed and the appropriate box(es) checked ☐ if another person will be jointly obligated with the Borrower on the loan, or ☐ the Borrower is relying on income from alimony, child support, or separate maintenance or on the income or assets of another person as a basis for repayment of the loan, or ☐ the Borrower is married and resides, or the property is located, in a community property state.

BORROWER

NAME | Age | School Years

Present Address No. Yrs. _____ ☐ Own ☐ Rent

Street _____

City/State/ZIP _____

Former address if less than 2 years at present address

Street _____

City/State/ZIP _____

Years at former address _____ ☐ Own ☐ Rent

Marital Status ☐ Married ☐ Separated ☐ Unmarried (incl. single, Divorced, widowed) | Dependents other than listed by co-borrower: No. | Ages

Name & Address of Employer | Years employed in this line of work or profes

CO-BORROWER

NAME | Age | School Years

Present Address No. Yrs. _____ ☐ Own ☐ Rent

Street _____

City/State/ZIP _____

Former address if less than 2 years at present address

Street _____

City/State/ZIP _____

Years at former address _____ ☐ Own ☐ Rent

Marital Status ☐ Married ☐ Separated ☐ Unmarried (incl. single, Divorced, widowed) | Dependents other than listed by borrower: No. | Ages

Name & Address of Employer | Years em

A portion of a Residential Loan Application.

transmission of the same graph with raster construction.

The situation is reversed for another application. The LARC Laser Package creates Code 39 bar codes using the LaserJet facility for drawing vertical or horizontal bars. In this case, the LARC facility was designed to provide flexibility rather than efficiency. If a bar code font is used, only one byte is transmitted to encode one character. With the LARC method, 80 bytes are sent to create one bar-coded character.

A distinction must be made between programmers and end users. Although a number of ways exist to generate graphic output on the LaserJet, the end user shouldn't be burdened with the insertion of escape sequences for the laser printer.

PROGRAMS USED FOR TEXT and graphics formatting should be user-friendly. Details of generating output on the laser printer should be hidden, to a large degree, from the user while files are prepared for printing.

Those details may be important in the selection of software to work with the laser printer. Two criteria are important to anyone selecting a laser printer and software to drive it:

- *What can be done with the hardware/software package?*
- *How easily can it be done?*

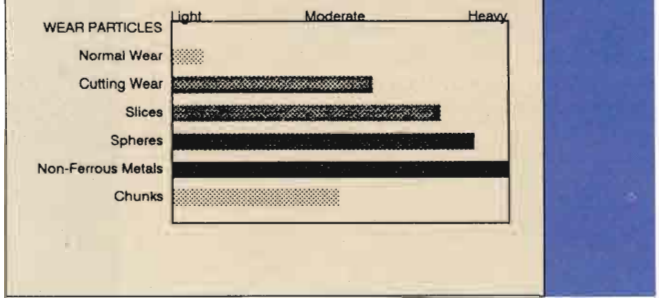
A third consideration will be important to some potential users:

- *How much machine resource is required to accomplish the task?*

The programmer and/or system designer is in a position to use the various laser printer capabilities to offer a wide range of applications in an efficient manner.

Horizontal and vertical lines and boxes can be constructed with the Line Drawing font provided by HP. They also can be constructed using the Printer Command Language (PCL) commands for lines and bars.

FIGURE 2



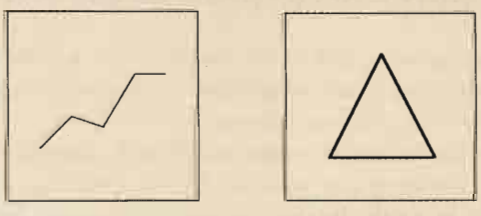
An example of a bar chart.

FIGURE 3

```
\tabset 5 0.9 2.0 r 6 2
\tabset 6 2.0 2.95 l 0 0
\tabcall 6;box 1.20
\font 67;spaceinch -0.08
^nj^Light Moderate Heavy
^h-30^^t5^WEAR PARTICLES
\shade 20
^t5^Normal Wear^tn^^w020^
\shade 50
^t5^Cutting Wear^tn^^w120^
\shade 50
^t5^Slices^tn^^w160^
\shade 90
^t5^Spheres^tn^^w180^
\shade 90
^t5^Non-Ferrous Metals^tn^^w200^
\shade 20
^t5^Chunks^tn^^w100^
```

LARC Laser Commands to generate a bar chart.

FIGURE 4



Two graphs from GRAPH1.LASERDEM.LARC.

If the PCL commands are used, a line of any length is created with a sequence of about 10 bytes. The Line Drawing font generates a variety of line segments and intersections. One character is 0.1 inch long and 1/6 inch high. The number of bytes required depends on the line length.

The Line Drawing character set is available on HP terminals. Graphics meant to display a formatted screen will be handled easily with that font.

The LARC Laser Package has commands to create horizontal lines, vertical lines, boxes and shaded bars. It takes advantage of the PCL commands rather than the Line Drawing character set. Using these commands, it's possible to create a form such as the one shown in *Figure 1.*

LET'S CONSIDER THREE TYPES of graphs: bar charts, line graphs and all others. Any of the graphs can be done by creating a raster image of the graph and transmitting it to the laser printer. Filling in arbitrary convex shapes probably requires handling with a raster image. Bar charts and line graphs can be handled with other techniques.

The PCL capabilities handle bar charts easily. The example in *Figure 2* was drawn using the laser printer ability to create shaded bars. The commands to draw that chart appear in *Figure 3.* The Line Drawing character set and PCL commands provide vertical and horizontal lines, but neither one has provision for lines at any other angle.

Drawing lines at arbitrary angles requires an alternative approach; there are three possibilities. One is to imitate the procedure used on traditional character printers: Use periods (or other characters) with appropriate horizontal and vertical spacing between characters to simulate a line. The result isn't likely to be of the quality expected from the laser printer.

Another possibility is to convert the graph to raster form and transmit that raster data to the printer. This can generate quality output that's as good as the printer will support. The problem with raster data is that it uses a lot of machine resource to generate and significant time to transmit. High-speed processors and transmission may avoid the problem if there is a small number of graphs to produce.

The final possibility is to generate a font for the purpose. A properly designed set of characters for drawing lines offers the efficiency of creating a line with characters while offering quality close to the raster image.

The two graphs shown in *Figure 4* were generated with the LARC Laser Package using its Line Drawing font. The two graphs, including the boxes around them, required transmission of fewer than 2,000 bytes of data.

Each box is a 1.8-inch square or 3.24 square inches. At 300 dots per inch, it requires 291,600 bits or 36,450 bytes of raster data for one square. The two graphs would require 72,900 bytes of raster data. If the printer is operated at 9600 baud, transmission of the two graphs would take about 76 seconds.

Some graphs do seem to defy any approach other than

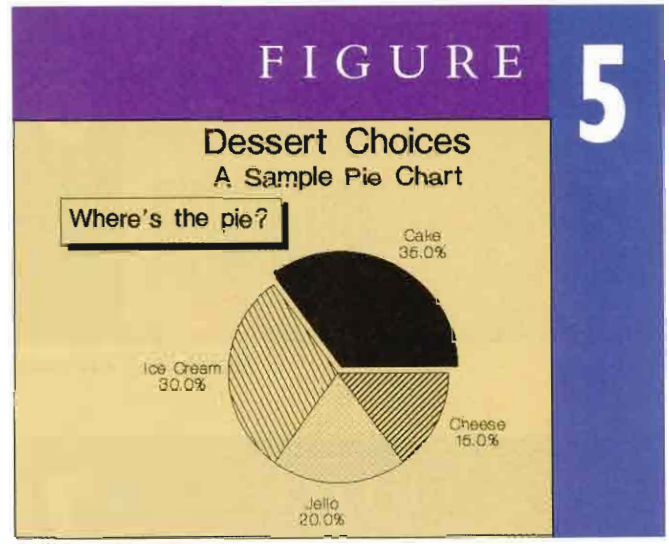
creation of a raster image. *Figure 5* is a pie chart drawn with Harvard Graphics, published by Software Publishing (Mountain View, CA). The raster image was created on a microcomputer and then transferred to the HP 3000 for printing on the LaserJet Plus.

BAR CODES AREN'T A GOOD illustration of graphic output. The discussion is included because the handling of bar codes offers a good example of balancing efficiency against flexibility.

Bar codes can be created with a font or by drawing lines using PCL commands. (The HP Bar Code font cartridge isn't available at this writing; it's expected back on the market soon.) The use of a font is the best method if the application can use an existing font.

The LaserJet printers won't allow a mixing of landscape and portrait orientation on one page. If text is to appear at right angles to the bar code, a font won't work. Similarly, if bar codes are required in a size not available in the font, the ability to draw the bar code allows the user to pick an appropriate size.

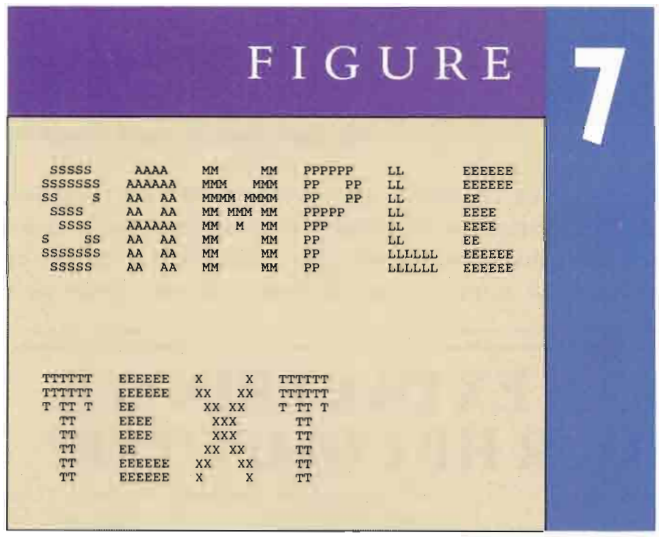
The two bar codes shown in *Figure 6* were drawn with LARC software. Either could be used on the same page with text in either portrait or landscape orientation.



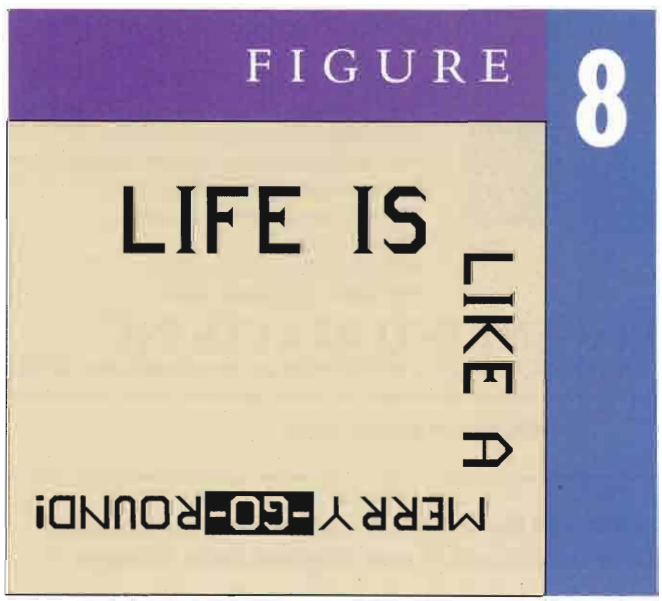
Pie chart from Harvard Graphics.

LARGE BLOCK LETTERING has been generated on computer printers for many years. Printers with one fixed character set use those characters to build large characters. An example of that type of output appears in *Figure 7*. It was printed on a

Examples of bar codes.



Large letters from FUN program.



Lettering with LARC font.

LaserJet Plus, but the same output could be printed on almost any printer.

Font cartridges, built-in fonts and downloaded fonts generate lettering up to 30-point, 0.28-inch high capital letters. That limit can be expected to increase with future versions of the printers. Larger lettering can be generated with software.

Complete graphics packages generally include appropriate labeling in the raster image created for the laser printer. The labels in *Figure 5* were constructed by the Harvard Graphics package (An early version was used. The quality and range of options for lettering has improved with a July release) and are included as a part of the raster data.

This feature is convenient for several reasons. The words are positioned properly in the graph, letter style is consistent across graphs and there's no dependence on other fonts available in the laser printer.

Lettering also can be done by creating a font of building blocks and designing an alphabet from those blocks. If the alphabet is designed with bold, clean lines, it can be expanded and contracted without suffering aesthetically.

With this approach, letters are constructed with software by selecting pieces of the letter and transmitting them to the printer. The image can be reversed, generating white letters on a black background. The image also can be printed sideways, giving landscape block lettering on a page with other type in portrait orientation.

Figure 8 shows a portion of the alphabet designed at LARC. The LARC Block Letters represent a small step in the direction taken by several other vendors who offer algorithmic means of generating lettering. This solution works with any printer capable of downloading fonts. No additional hardware is required. Letters can be scaled up or down to any size supported by the underlying building blocks. Transmission of copy to the printer is slow compared to regular text, but fast compared to a raster image of the characters. *—Martin Gorfinkel is president of LARC Computing, Los Altos, CA.*

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Ways To Graphically Explore Statistics For Science And Technology

Techniques In Data Analysis

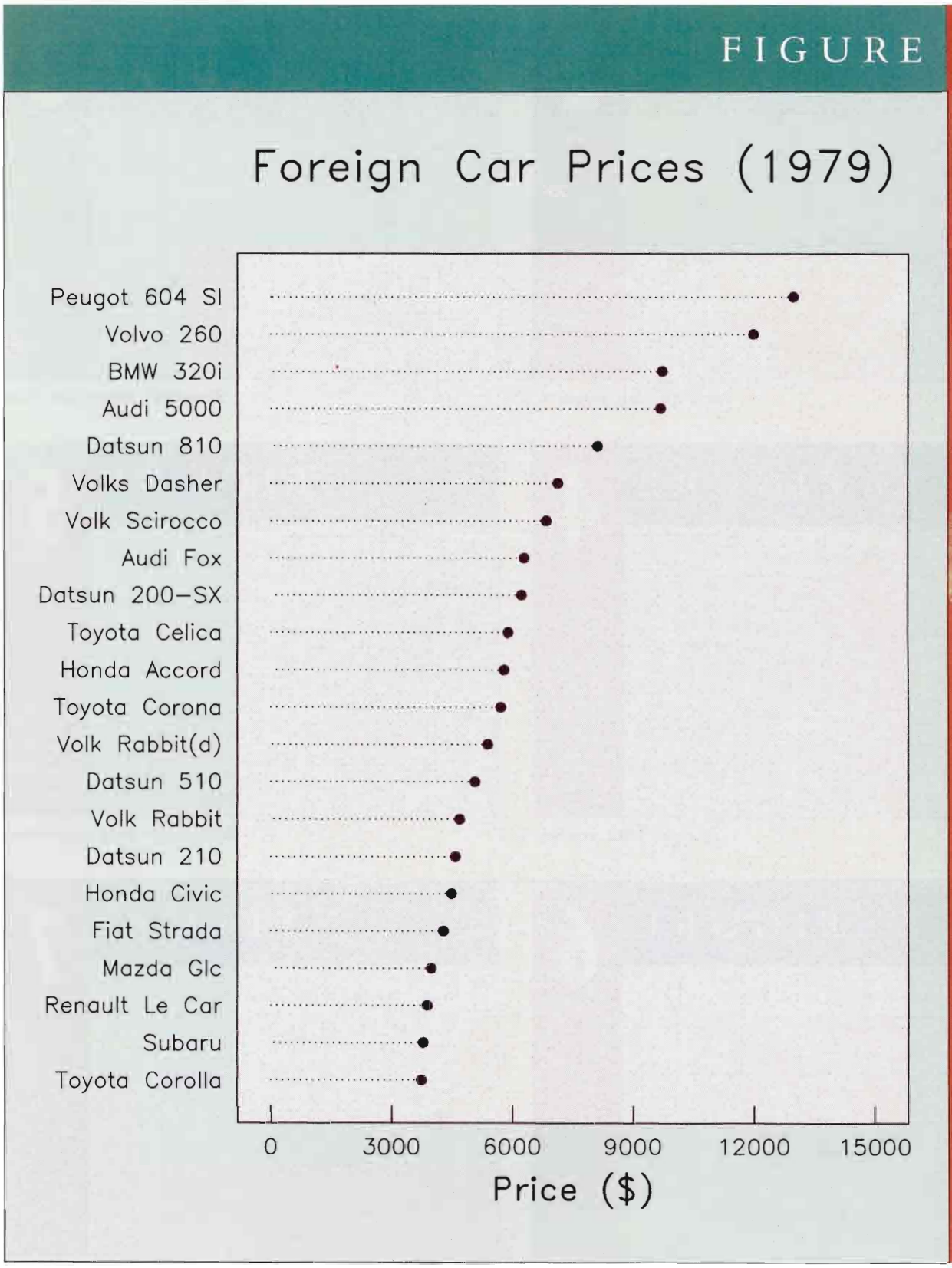
[By Bill Carson]

Graphically portraying data provides a clearer and more penetrative understanding of it. It tends to show data sets as a whole, allowing us to quickly summarize the general behavior as well as study detail. Until now, books on graphical techniques were either too incomplete, stopping at a histogram or pie chart, or were too technical and not readily available in computer programs. Furthermore, many graphical techniques were just appearing in statistical journals and thus weren't yet accessible to the statistically unsophisticated data analyst.

With the recent rapid proliferation of graphics hardware accompanied by a steady development of software, this is no longer the case. Therefore, this article will give an overview of various old, but not widely known, and new methods of graphically portraying data. The graphical techniques presented are relevant in all areas of science and technology.

THERE'S NO STATISTICAL TOOL that's as powerful as a well-chosen graph when we want to understand the basic characteristics of a set of data. In short, we need to understand the distribution of the set of data values such as where they lie along the measurement axis and what kind of patterns they form. This often means asking additional questions. Are any of the observations outliers, that is, values that seem to lie too far from the majority? Are there repeated values? What's the density or relative concentration of observations in various intervals along the measurement scale? Is the data symmetrically distributed? What kind of relationships exist between the observations?

FIGURE



Dot chart.

FIGURE 2

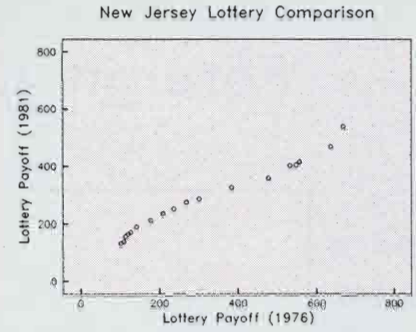
Car Prices (1979)

Valid Cases = 74
Lower Quartile = 4245.5
Median = 5091.5
Upper Quartile = 6322.5

Price ($1000)	Count
3 : 33778889	8
4 : 00011122223444555566777789	27
5 : 01122244778889999	16
6 : 2233358	7
7 : 18	2
8 : 18	2
9 : 77	2
10 : 44	2
11 : 45	2
12 : 0	1
13 : 056	3
14 : 5	1
15 : 9	1

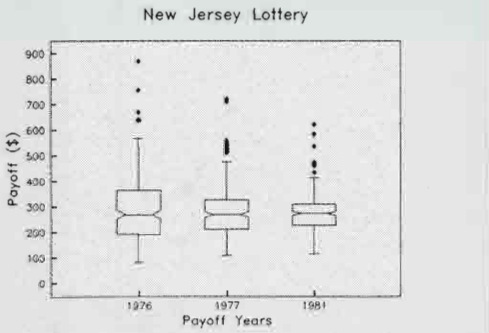
Stem-and-leaf diagram.

FIGURE 3



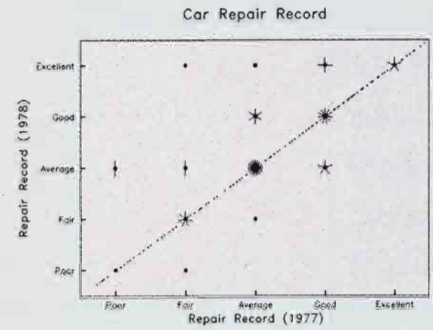
Percentile comparison plot.

FIGURE 4



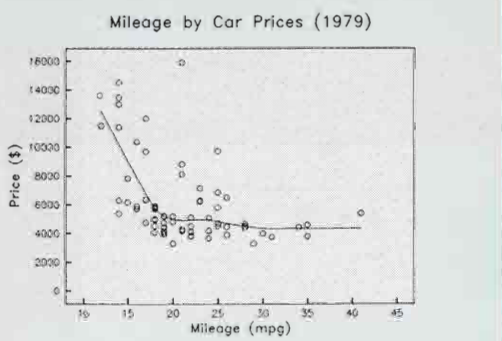
Box plot with notches.

FIGURE 5



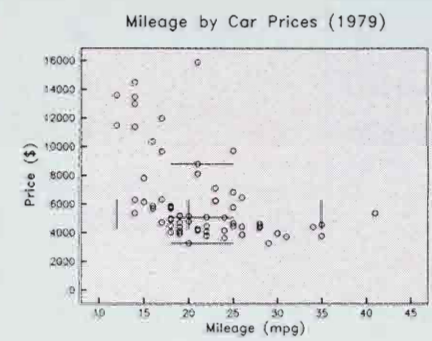
Scatter plot with sunflowers.

FIGURE 6



Scatter plot with locally weighted smoothing.

FIGURE 7



Scattter plot with a box plot.

One way to represent a set of data is to present the data in a table. Many questions can be answered by carefully studying a table, especially if the data has been ordered.

However, many distributional questions are difficult to answer just from peering at a table. Plots of the data can be far more revealing, even though it may be harder to read exact data values from a plot. In the following sections, I'll show some graphical techniques that can be used to explore shapes and patterns of a set of data.

The analyst often needs to display measurements of a quantitative variable in which each variable has a label associated with it. The most common way to do this has been with a pie or bar chart. These techniques are widely used and understood by nontechnical people, however, each has some drawbacks.

The major drawback with a pie chart is that it can be very difficult to make angle judgements. This leads to difficulty in interpreting the relative sizes of each slice in the pie, especially if most of the slices are about the same size. The major drawback with a bar chart is that it requires a meaningful baseline if the length and area of the bar are to be meaningful. Since a meaningful baseline value is usually zero, the bars waste space and degrade the resolution of the values if the values are large.

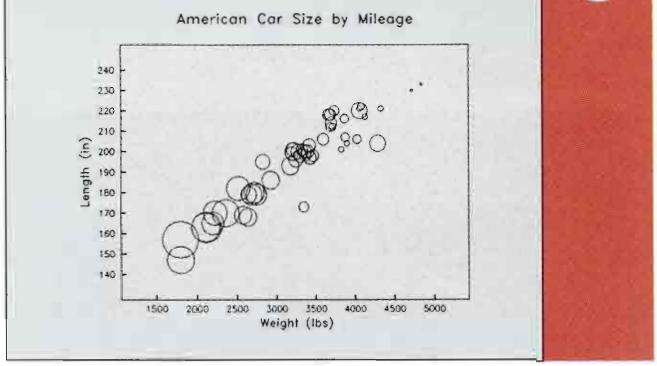
A technique that's used without these drawbacks is called a *dot chart*. Each data value is represented on the chart by a dot and is plotted in order from smallest to largest. Each dot is connected with its label by a dotted line. This method allows the analyst to make judgments along a common scale rather than angle judgements. Data that can be portrayed in a pie chart always can be portrayed in a dot chart.

When there's a zero on the scale of a dot chart, then the dotted lines can end at the data dots. The dotted lines should go across the graph when the baseline value has no particular meaning, because when the dotted lines stop at the data dots there are two aspects to the plot — the lengths of the dotted lines and the relative positions of the data dots along the common scale. This gives the visual appearance of a bar chart. However, if the baseline has no meaning, then the lengths have no meaning. The dotted lines should go all the way across the graph so they're visually de-emphasized against the data dots.

Figure 1 shows a dot chart of the prices of 22 foreign cars in 1979. The chart shows that 17 of the cars have prices ranging from just over $3,000 to just over $6,000. The prices of the last five cars then increase rapidly to over $12,000.

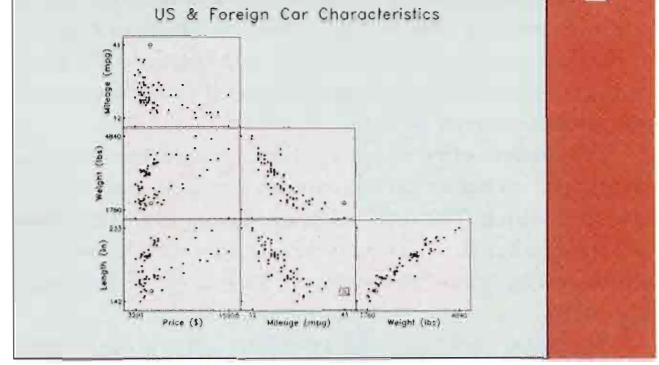
For a visual impression of the distribution, a histogram is commonly used. The problem with a histogram is that the visual impression depends on the fairly arbitrary choice of the number and placement of the intervals. When a histogram is made, the interval width generally is greater than the data inaccuracy interval, so accuracy is lost. As we decrease the interval width of the histogram, the accuracy increases, but the appearance becomes more ragged.

FIGURE 8



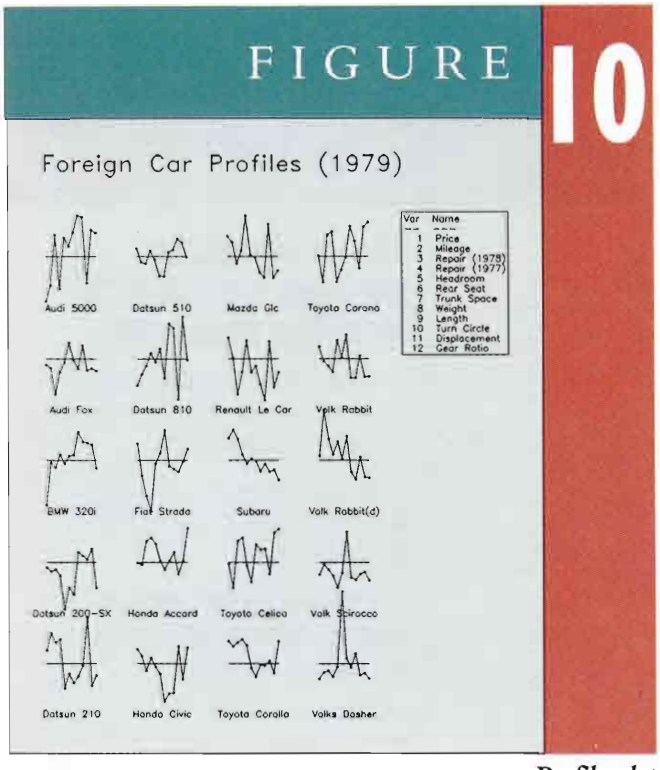
Scatter plot with a third variable.

FIGURE 9



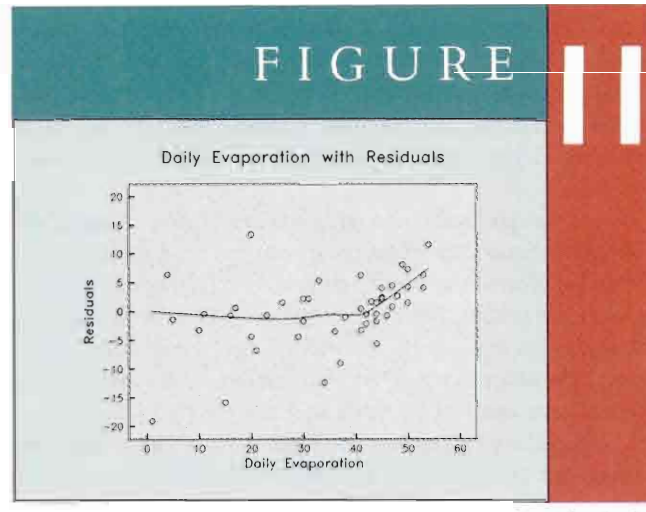
Pairwise scatter plot.

FIGURE 10



Profile plot.

FIGURE 11



Residual plot.

The stem-and-leaf diagram is a compact way of recording the data. Instead of having a separate table listing the data and a histogram to show the distribution, the stem-and-leaf diagram combines both sources of information into one plot.

The diagram is used in much the same way as the histogram. It gives the analyst information about the symmetry and skewness of a distribution. *Figure 2* shows a stem-and-leaf diagram for the prices of 74 car models sold in 1979.

While the techniques described above usually are good for looking at one distribution of data, they're relatively poor when trying to compare more than one but similar distributions. Two simple but not as commonly used techniques are the *percentile comparison plot* and the *box plot*.

When distributions are compared, the goal usually is to rank the categories according to how much each has of the variable being measured. The most effective way to investigate which of the two distributions has more is to compare the corresponding percentiles. The percentile comparison plot graphs the percentiles of one distribution against the corresponding percentiles of the other. The advantage of a plot like this is that not all the data has to be plotted to characterize the differences between the two distributions. Data distribution can be complicated; a percentile comparison plot can reveal just how complicated it is.

Figure 3 shows a percentile comparison plot where the payoffs from the 1976 New Jersey lottery are plotted against

the payoffs from the 1981 New Jersey lottery. Typically, the percentiles that are plotted are 1,2,...,5; 10,20,...90; and 95,96,...,99. If the distributions are similar, then the points should lie near the 45 degree reference line. From the plot, the analyst can conclude that the two distributions are similar when the payoff is small, but they're very different when the payoff is large. The 1976 lottery seems to have higher payoffs more frequently.

> Box plots have many strengths. For one, they can show the symmetry of a distribution.

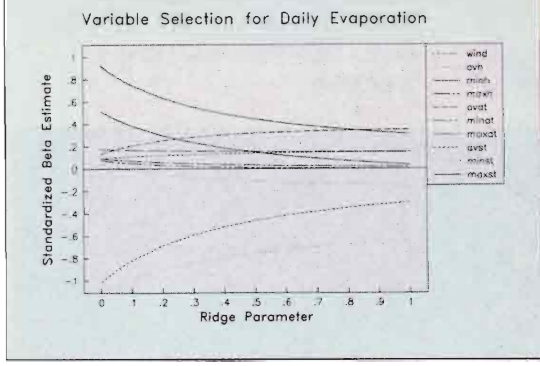
While the percentile comparison plot is a good way of looking at all the data, there are stages in the analysis procedure when it's useful to summarize the distribution. The box plot gives a quick impression of the locality, spread and skewness of a distribution. The upper and lower quartiles of the data are portrayed by the top and bottom of the rectangle and the median is portrayed by a horizontal line segment within the rectangle. The lines that extend from the ends of the box show how stretched the tails of the distribution are. The individual values outside the lines give the analyst an opportunity to consider the question of outliers.

Figure 4 shows a box plot for the payoffs of the New Jersey lottery in 1976, 1977 and 1981. From the plot, the analyst can see that the median payoff for each lottery is about the same, but each spread of the payoffs is different. There were more high payoffs during the 1976 lottery than either the 1977 or 1981 lottery.

Box plots have many strengths. For one, they can show the symmetry of a distribution. If the distribution is symmetrical, then the median cuts the box in half, the upper and lower lines are about the same length and the outside values are at the top and bottom, if any are about equal in number, and symmetrically placed. Another strength is to be able to compare distributions by comparing corresponding percentiles.

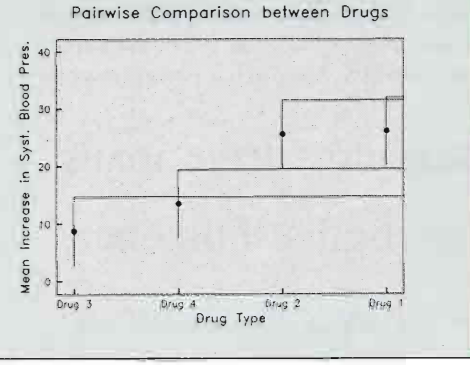
In applications where comparing locations is important, box plots can be drawn with notches in their sides to help guide our assessment of relative location. A suitable informal interpretation of the plot with notches is that, if the notches for any two boxes don't overlap, the analyst can regard it as strong evidence that a difference in their medians exists at the .05 level. The notches provide an approximate 95 percent test of the null hypothesis that the true medians are equal. In *Figure*

FIGURE 12



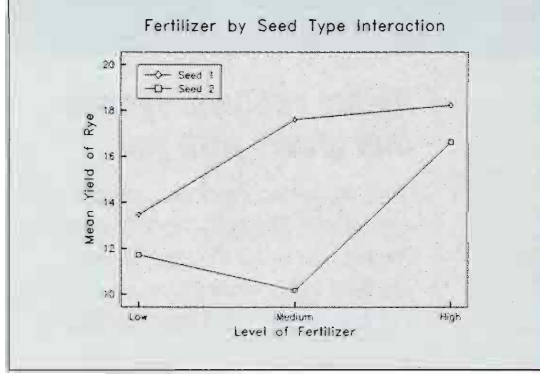
Ridge trace.

FIGURE 13



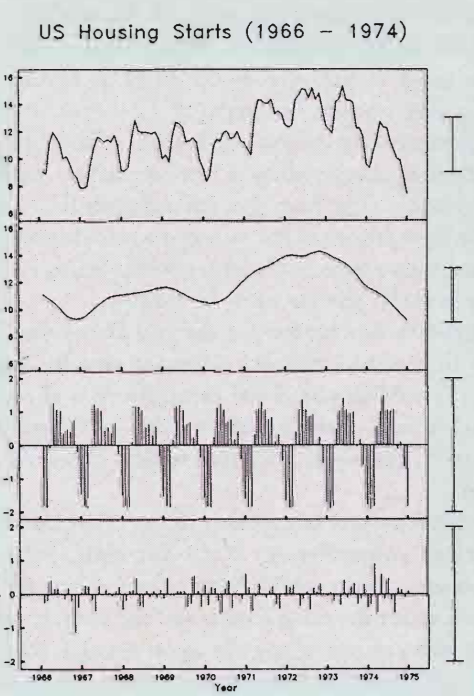
Pairwise comparison plot.

FIGURE 14



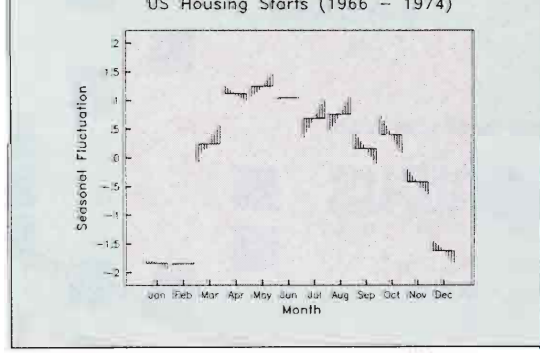
Interaction plot.

FIGURE 15



Seasonal decomposition plot.

FIGURE 16



Seasonal subseries plot.

4, the notches overlap each other, leading the analyst to conclude that there's no difference in their locations.

This plot is a useful guide for comparing median levels even when the requirements for the hypothesis test aren't strictly met, which is very frequently the case. However, the

analyst should be careful when comparing more than two sets of data because the notches aren't adjusted to take into account that several hypothesis tests are being carried out simultaneously. This is the so-called "multiple comparison" problem. Technical adjustments are possible, but generally unnecessary, as long as the notched box plots are used informally.

OFTEN THE RELATIONSHIP between two categorical variables is represented in a two-way frequency table. Each cell of the table contains the number of observations, and row, column and total percentages. The problem with looking for a relationship from a table like this is that it's difficult to pick out densities from the numbers in the table.

Typically, the most powerful way to look at a relationship between two quantitative variables is with a *scatter plot*. The scatter plot also can be used to look at the relationship between two categorical variables. This has one inadequacy: There's a large number of overplotting of points because of the discrete data. Each plotted point could represent more than one point in the table, which would mislead the analyst about the density of the data in different regions.

One solution to the overlap problem is to take the number of points in each cell and portray the counts by symbols called *sunflowers*. A *single* dot is a count of one, a dot with two line segments is a count of two, a dot with three line segments is a count of three, and so forth. *Figure 5* shows a scatter plot with the repair record rating of 74 car models in 1977 against the repair record rating of the same 74 car models in 1978. Since the ratings are on a scale of one to five, there were only a few places to plot 74 points. The plot shows the highest density of points along the 45-degree line. The analyst concludes that the ratings usually stayed the same from 1977 to 1978. The most frequent combination was "average, average" (19 times), and since there are more points above the line than below, the ratings that did change from 1977 to 1978 were for the better.

Sunflowers, since they provide a portrayal of counts of points in different regions of the plot, are a type of two-dimensional histogram. Thus, their use extends beyond portraying overlap to any situation in which seeing count information is helpful.

Scatter plots often are used to judge whether there's a dependence between two quantitative variables. This might not always be an easy judgement to make from the scatter plot if a large number of points are plotted. Often a line is drawn through the points to represent the dependence between the variables. The classical method for fitting a line to the data is to use polynomials, usually straight lines or quadratics. The problem with polynomials, even those with degrees higher than two, is that they're neither flexible nor local. What happens on the extreme right of the scatter plot very much can affect the fitted values at the extreme left. Also, polynomials have difficulty following patterns on scatter plots with abrupt changes in the curvature. A better "smoothing" procedure needs to be used.

By smoothing we mean computing and plotting another set of points. A smoothing technique called *lowess* (locally-weighted scatter plot smoother) gives the analyst an accurate impression of whether the data is linear or non-linear. Lowess has a robustness feature in which, after a first smoothing is done, outliers are identified and then downweighted in a second smoothing.

Figure 6 shows a scatter plot with the miles-per-gallon of 74 car models in 1979 against the price of the cars. The fitted line shows that the higher priced cars don't get very good mileage, but the lower priced cars range across all the mileage figures. This shows that the relationship between these two variables is definitely not linear.

The amount of smoothness is controlled by a parameter that ranges from 0 to 1. The closer this parameter is set to 1, the straighter the line through the points. The closer this parameter is to 0, the more the curve goes through the individual points. In most applications, this parameter is usually set between .5 and .8.

Another way to give the analyst summary information from a scatter plot is to superimpose a *rangefinder box plot* on the graph. This plot is particularly helpful in the exploratory stages of an analysis when the analyst is on the lookout for unusual values and combinations of values.

The rangefinder box plot contains precisely the same information as the box plots described earlier. The two central line segments intersect at the cross-median values. *Figure 7* shows that the median car model is about $5,000 and gets 20 miles to the gallon. The vertical line segments cover the interquartile range of the price and the horizontal line segments cover the interquartile range of the mileage. The length of these lines correspond to the size of the box in a typical box plot. The plot shows that two-thirds of the cars range between $4,200 to $6,500 and 18 to 25 miles per gallon. The lower and upper lines (both vertical and horizontal) correspond to where the whiskers of a typical box plot end. Here the plot shows that almost all the cars are within the range of 12 to 35 miles per gallon, but many of the cars fall outside the $3,500 to $9,000 range.

When the third variable on the scatter plot takes on only discrete values, the plotted points can be replaced by multiple letters or symbols. One advantage of the letters is that it's easy to remember the groups they represent. The disadvantage is that they don't provide high visual discrimination with each other. Using symbols such as circles, squares and triangles all filled and unfilled provide a better visual picture.

When the third variable on the scatter plot is on a continuous scale, then the plotted points can be replaced by the size of a plotted symbol (with some conveniently chosen largest and smallest size). The diameter of the circle is drawn so that it's proportional to its size. *Figure 8* shows the weight

of 74 car models against length. Miles-per-gallon is encoded in the size of the circle, with the large circle denoting high mileage. Generally speaking, the analyst can conclude that the longer and heavier cars get poor mileage while the shorter and lighter cars get good mileage.

Usually, an unfilled circle is the best symbol to use because it can tolerate substantial overlap and still maintain its individuality.

> It's good practice to look closely at the raw data to get as much insight as possible . . .

Science and technology would be far simpler if data always stayed in two or three dimensions since there's a wealth of plotting techniques for portraying data. Unfortunately, data can live in four, five or any number of dimensions.

One simple method to look at multidimensional data is to create a *scatter plot matrix*. The idea behind it is to arrange the graphs so that every two variables in a matrix has shared scales. This means that the analyst can scan a row or column and see one variable graphed against all other variables. This makes it easy to track an interesting point or group of points from plot to plot.

Figure 9 shows four variables plotted against each other. The tick labels correspond to the minimum and maximum values for that plot. The point of interest, the small car with the high mileage, is denoted with a box around it. The corresponding point is then highlighted in the other plots. It's found that this car is short, light, gets good mileage and is inexpensive.

When it's important to identify relationships between observations instead of between variables, then the *variables* can be portrayed simultaneously in the plotting symbol. One such method is called a *profile plot*. A profile symbol is created for each observation in the data set. The profile consists of all the variables plotted in the "favorable" direction across a line that represents the average. For example, "high" mileage would be considered favorable, whereas "high" price would not. The price variable would need to be multiplied by -1 before being plotted.

The purpose of this technique is two-fold. First, the analyst should be interested in profiles that have most of their points above (below) the center line. *Figure 10* shows profiles for 20 foreign cars from 1979. The profile for the Volkswagen Scirocco is interesting because all the points but one (trunk space) is below average.

Second, the analyst can look for pairs or groups of symbols with similar shapes. Alternatively, the analyst may want to identify observations that are very different from the rest. *Figure 10* shows that the Volkswagen Scirocco and Dasher have similar profiles.

It's good practice to look closely at the raw data to get as much insight as possible before carrying out a multiple regression analysis. The objective is to discover any interesting relationships, unusual behavior and exceptional points that can help guide the choice of models and fitting procedures. It's especially important for the analyst to become familiar with the raw data because he's likely to fit the regression with a computer program that's blind to many anomalies in the data.

There are many questions to answer: Are there any outliers? Do variances appear constant? Do functional relationships look linear or curved? Would transformations help? Are there repeated values in some of the variables? Does the data cluster in interesting ways?

Answers to some of these questions can be solved by using the scatter plot methods talked about earlier to see possible relationships between variables. Let's look at two other methods.

RESIDUAL ANALYSIS is of vital importance in any regression analysis. Residual plots are used for identifying any undetected tendencies in the data, as well as outliers and fluctuations in the variance of the dependent variable. In all residual plots, the pattern that indicates an adequate model and well-behaved data is a horizontal band of points with constant vertical scatter.

Because the interpretation of the residual plot is very subjective, a smooth curve, such as the one described in a previous section, could be drawn through the points that might show some systematic pattern. If the smooth curve is nearly horizontal and close to the baseline, then random scatter of the residuals can be assumed. *Figure 11* shows the residuals from a regression analysis that estimated the daily amount of evaporation from the soil. The residuals were computed from the four variables that composed the fitted regression line.

The plot of the residuals shows that regression fit works well for low values of soil evaporation, but shows a curving trend at the higher values. This curvature suggests that a transformation of the explanatory variable(s) may be needed or that some of the variables could be dropped from the model.

A meaningful regression analysis requires a high correlation of each of the other explanatory variables $x\_\{1\}, x\_\{2\}, \ldots, x\_\{p\}$ with the dependent variable y, while at the same time having a low correlation with each of the other ex-

planatory variables. Very linearly dependent explanatory variables are termed collinear. This leads to unstable regression coefficients being computed and erroneous inferences about the model being made.

A graphical method called a *ridge trace* can be used to eliminate the variables that might be causing the multicollinearity. Estimators of the standardized regression coefficients are computed for different ridge parameters in the interval (0,1). Each estimator is then plotted against various values of the ridge parameter.

The variable selection is done by examining the ridge traces on the graph. The rules for elimination are:

1. Eliminate variables whose coefficients are small (usually less than .2). Since the method is applied to standardized data, the magnitude of the various coefficients are directly comparable.
2. Eliminate variables with unstable coefficients that don't hold their predicting power, that is, unstable coefficients that tend to zero.
3. Eliminate variables with unstable coefficients where the coefficient changes sign.

The variables remaining from the original set are used to form the regression equation.

Figure 12 shows 10 variables that were used to form the regression equation. Using the rules stated above, *wind, maxh, minat* and *maxat* would be eliminated under rule 1, *minh* under rule 2 and *minst* under rule 3. The four remaining variables, *maxst, avat, avh* and *avst* would compose the regression. This can be verified by doing a backward stepwise regression procedure.

It should be noted that the variable selection procedure is a mixture of art and science, and should be performed with care and caution. It must be emphasized that variable selection shouldn't be performed mechanically as an end in itself, but rather as an exploration into the structure of the data. The explorer should be guided by a combination of theory, intuition and common sense.

THE AIM OF ANALYSIS of variance is to determine whether the means of several populations differ from one another. The different populations are usually associated with different treatments which are carried out independently of one another on some experimental units. Two commonly asked questions are: Where's the difference between treatments coming from? Is there a significant interaction present? These can be answered graphically with the *pairwise comparison plot* and the *interaction plot*.

It's often desirable to isolate the sources responsible for a significant treatment effect. There are a number of tests available in computer programs to help determine the sources. These tests include Newman-Kuels test, Duncan's test, Tukey's test and Scheffe's test. Each of these tests has its advantages and disadvantages.

A graphical method for determining whether a significant difference is present between treatments is to plot the ordered means. Next, compute the critical range between treatments from one of the tests listed above and draw a perpendicular line through each point so that the center of each line goes through the mean. Last, draw a horizontal line to the right border of the plot from the top of each interval. Any pair of treatments for which the intervals are *not* joined by a common horizontal line differ significantly.

For example, the analyst has completed an experiment of how the use of four different drugs controls the increase in systolic blood pressure. The ANOVA table shows a significant difference between the drugs, but where? *Figure 13* shows that Drugs 3 and 4 are significantly different from Drugs 1 and 2, because the horizontal lines from 3 and 4 don't cross the vertical lines of 1 and 2.

When the analyst finds that an interaction is present (by looking at the ANOVA table) it's usually a good idea to plot the results of the experiment. The interaction plot has the dependent variable along the y-axis, one independent variable along the x-axis, and a curve drawn for each level of the second independent variable. The shape or form of the interaction will become apparent. An interaction will be revealed by nonparallel or crossing curves for the variable plotted within the body of the plot.

Figure 14 shows a significant interaction effect, because the difference between *Seed 1* and *Seed 2* at the medium level of fertilizer is not the same as at the other two levels. The two lines would be parallel if the interaction wasn't significant.

A time series is a special case of the broader dependent-independent variable category, where in this case, time is the independent variable. One important property of most time series is that for each time point of the data there's only a single value of the dependent variable; there are no repeat measurements. Futhermore, most time series are measured at equally spaced or nearly equally-spaced points in time.

There are a number of ways to graph a time series. A line graph is appropriate when the time series is smooth or when the interest is in the shape of the series instead of individual values. A vertical line graph is appropriate when it's important to see individual values, when the analyst needs to see short-term fluctuations and the time series has a large number of values.

A *seasonal decomposition plot* uses two line graphs and two vertical line graphs to show the breakdown of the time series into components. The breakdown consists of trend, seasonal and irregular components. The sum of these three components is equal to the original series. The decomposition is robust to outliers, helps to choose a transformation for the data that assists in the decomposition and can be adjusted for calendar effects.

The line graph is used to plot the full time series and trend components since it's only important to see the shape. *Figure 15* shows the number of housing starts from 1966 to 1974. The trend is reasonably constant until a sharp drop starts in 1973. The vertical line graph is used to plot the seasonal and irregular components since it's important to assess behavior over short periods of time. *Figure 15* shows that the seasonal fluctuations are reasonably constant from year to year, while the irregular component (or noise) is a random scatter, as it should be.

A *seasonal subseries plot* is used to study the behavior of a seasonal time series or the seasonal component from the *seasonal decomposition plot*. This plot most often is used to look at the behavior of a time series for each month graphed for successive years. However, it could be used for any two spans of time (day and week, week and month, etc.).

For each monthly series, the mean of the values is portrayed by a horizontal line. *Figure 16* shows that not many housing starts are done in January, February and December as compared to other months of the year. The yearly values of each of the monthly subseries are portrayed by the ends of the vertical lines. March, May, July and August show an increase in housing starts from 1966 to 1974. January, April and September through December show a decrease in housing starts. Therefore, this graph allows an assessment of both the overall monthly pattern as well as the overall yearly pattern of the data.

The intent of this article was to show graphical techniques for the most commonly occurring types of data in all areas of science and technology, so each of the techniques presented couldn't be explored in detail and many specialized methods had to be omitted. Refer to the references listed for a more detailed discussion.

The graphs in this paper were generated using the Statit and Grafit software packages from Graphicus on an HP 9000/320 computer running HP-UX. These packages are currently available on the Hewlett-Packard technical computers running HP-UX and RTE-A. Statit, a general purpose statistics package, was used to prepare the data, perform the computations (some of which were very computer-intensive), and send the plotting commands through an interface to Grafit. Grafit, a general-purpose graphing package, took the commands and output the graphs on a LaserJet Plus printer. Each of the graphs were generated using simple commands available in Statit. These commands have many options that allow the graph to be customized to the specifications of the analyst. *—Bill Carson is customer support manager at Graphicus, Santa Clara, CA.*

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System Development Disaster

Overcoming A Near Tragedy With Determination And Teamwork

DEVELOPMENT

David Rubinstein

Today there are 14 people in the department — two operators on every shift, including weekends, and an array of programmers and analysts. The size of the department isn't even close to the department profile that one of the "Big Eight" consulting firms envisioned almost three years ago. Then, when the "state of the art" distribution system went into production, we had two operators (in a 24-hour shop), one programmer and two former Big Eight consultants.

The shop has experienced considerable growing pains since, but the pains are the right type of pains. This is the story of a near disaster, of every data processing person's nightmare, of our own combat zone, of our determination to succeed, and of teamwork.

IN FEBRUARY 1984, I was fortunate enough to be assigned to a consulting engagement that consisted of the installation of an HP 3000 Series 68, three disk drives, two tape drives, over 40 terminals and 17 printers. The software was a distribution package written in the Powerhouse languages. (Keep all these facts handy.)

Our project team consisted of novices at every level. All programmers were entry level, the analysts had little distribution experience, and the manager and partner were new to their roles. As a Big Eight trained consultant, I was taught to handle every installation the same. I had no reason to believe that it was this thinking that would lead to disaster.

By September we were to have designed, coded and tested a Purchase Order, Order Processing, Inventory Control, Sales Analysis, A/P, A/R, G/L and Container Return system. Add five IMAGE databases on top of this, and you easily can believe that our goals weren't reached, not even to this date.

We weren't dealing with a typical distribution company; we were involved in liquor, wine and beer distribution. Three distinct distribution functions under one roof. But in the infinite wisdom possessed by our consulting firm, the client was going to change to fit the system, to operate as "all other distribution companies operate." The system *should've* been designed to fit the client or, at the very least, a compromise should've been met.

By May, the fun was under way. "Design-on-the-fly" is the term most commonly used to describe the situation. I'd also add, "training-on-the-fly." Our entry-level programmers were introduced to the concept of a record complex, one of the most important fundamentals of a fourth-generation language. The analysts were introduced to "creative project management" or "How to make the estimates fit so your manager can tell the client the project is going smoothly." The analysts and programmers were setting work-hour records, the highest chargeable ratios in the office. Some people are proud of this, especially those who don't enjoy summertime. The manager and partner also set records for least amount of hours worked on a project, and lowest hourly ratio versus staff hours.

Around June and July, management noticed that we were working too many hours. "No one can work more than 50 hours a week," we graciously were told. This lasted one week. The problem was we were naive. We wanted to produce the best product on time. Unfortunately, we didn't realize that the project goals were absolutely unattainable.

By the end of July, we scrapped the P/O system and most of Sales Analysis and Inventory Control. At the same time, we had a training session on the functionality of distribution systems. It appeared at this point that the horse was being led by the cart.

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AUGUST CAME AND WENT, and in late September we went for a full user test. (At this point, we obviously passed the deadline and a new conversion date hadn't yet been set.) I had the distinct pleasure of visiting a branch office for the user test.

I had only two embarrassing experiences that day, about an average day for this project. The first was when I saw the production printer for the branch. I don't recall the model number, but daily transaction registers of over 50 pages took an entire business day to print. People laughed as they saw the printers work. The next shining moment occurred when we went to enter orders and the system took a sabbatical. That was the day I matured and finally realized I was in quicksand.

The finger-pointing began. How could these problems be occurring? It was Powerhouse, it was HP, but of course it wasn't the consulting firm that recommended the hardware and software, as well as the configuration. How could we be at fault?

The battle of accusations had only started, but at least some of the parties involved were more concerned with solving the problems. HP and Cognos (Powerhouse) should be congratulated for their support. HP brought in their finest performance analysts. We ran all the monitors, including tools that still were being tested in Cupertino. Cognos analyzed our code and sent in the author of Quick to help improve the product. The work we did on Quick helped produce version 5.01E.

There's a right way and a wrong way to utilize any tool, whether it be computer hardware and software or a hammer and screwdriver. The project was staffed with entry-level programmers (and this should be no reflection on their valiant efforts and quality of their work) who had never been exposed to a 4GL. Much of the Quick, Quiz and Qtp (Powerhouse languages) were written into COBOL. We still write and install systems written in Powerhouse because it's a highly flexible, productive development tool that, when used properly, creates a nice clean system. The key is to understand the complete functionality of the applications under development.

Between September and January the project became extremely political and problems within the software began to arise. The application package purchased was no longer a system. It had been cut and slashed beyond recognition. The hardware configuration had more than doubled. System testing wasn't near completion. The client was running on DG Novas that were made over 10 years ago, were held together by spit and sawdust, and were very close to death. The client management began to approach the analysts as opposed to the project's management for answers and for what they called "the truth."

In January, we had to bring the system up for two of the branches due to the death of the DG Novas. At this point, two of us left the consulting firm, incorporated our own practice, and our former client became our present client once again. Part of the reason we left was because we felt management never listened to the people in the trenches. We never got support and we were the people who had to support their outrageous promises. We also wanted to start our own practice, but we committed ourselves at least 100 percent to the client for at least one year. We knew this wasn't any way to start a consulting practice, but had to get out of that Big Eight environment and get back to people.

Our former employer thought it was a good idea that we left. After all, our expertise remained on the project, but at someone else's expense. This backfired. We knew their tricks, how project overruns are blamed on client personnel, skimping on system test, and a lot of double talk. It got to the point where they were afraid to sit down in a meeting with us lest they find out how messed up the project really was.

Our function with the client was to help manage the data processing department. We had two operators, one programmer and a DP manager who said, "I don't need a day operator, I can watch the system lights from my office." This man didn't last long at that job. So our next task was to develop a department, which we set out to do, while continuing to develop the system, answer midnight phone calls, feed invoice paper through the printers, program and program and program and . . .

Life wasn't a bowl of cherries. We answered phone calls all day, and even worse, all night, for at least eight months. This program aborted, the system locked up, a head crash, and "where's my report?" We heard it all. As one person wrote, "Inventory was hibernating in the warehouse." This conjures up visions of Johnny Walker and Jim Beam hiding as users had no integrity in their inventory balances and couldn't ship goods. Even worse, dollars were hiding in customers, bank accounts as A/R balances were wrong and customers were going elsewhere for liquor, beer and wine.

Piece by piece we attacked the system. We sniffed out the bugs and killed them. On hand, open balance, they all began to have meaning. We identified performance bottlenecks and attacked them with COBOL rewrites or Powerhouse rewrites, utilizing the 4GL to its fullest. The consulting firm felt COBOL wouldn't help us, but we felt that Order Entry had so much exception processing and I/Os that COBOL made sense.

At that time, the Series 68 could handle only 25 online order-entry clerks. After the COBOL rewrite, we had 40 OE users, 20 additional online users doing inquiries and simple transactions, and three batch jobs for report requests.

BY THE SUMMER OF 1985, the department began to stabilize. We had a new DP manager and the staff was beginning to

grow. We could take vacations! What a concept. Our attention began to turn towards the future. We left the security of a large consulting firm and started to think of a business plan. The owner of the liquor distributor called us into his office. Not only is it an honor to be in this gentleman's presence, it's a true pleasure. The *Boston Globe* once wrote, "If a charity is in trouble in the city of Boston, this is who they turn to . . . If it weren't for him, Walter Brown would never have had the money to keep the Celtics in Boston."

At the start of the conversation, we reviewed the progress of the system and the status on system bugs. The owner then got up, put his arms around us and said, "Fellas, you have shown me more loyalty than anyone could expect. Show me a business plan, tell me what it's going to cost and I'll sign."

Well, I can't think of a higher compliment one can receive from a client. This helped put us in motion as a viable business. It's given us the chance to practice systems consulting the way we always wanted to, and fortunately we have our Big Eight experience, which wasn't all that bad to draw upon. The textbook training was great, perhaps the best available. The client/worker relations were the pits, and this is the part we feel we excel at. All of our workers truly enjoy their work.

So, this three-year ordeal had its ups and downs. I believe it points out many problems that can occur during systems development, or any project.

■ *People*. There's never been a more important resource, which is overlooked in every methodology binder, textbook and system resource manual. People are the key to the product. I don't believe people work *for* me, they work *with* me. I require people in my organization or at the client's to understand the functionality behind what they're working on. When dealing in business systems, never forget the business.

■ *Functionality*. Robot programming is outdated. If the programmer, analyst, project manager and client don't understand the functionality behind the product, the project is a useless exercise. All the players involved need to understand their functions and the functions of what they're doing. After six months on the project, we finally had training on distribution concepts. Six months. Do you know how many programs were in left field, the wasted testing time, because management didn't care to ensure that we were all properly trained? Don't ask people to work on something they don't understand, unless you want to fail.

■ *Project Management*. This is a necessity. Ours is a detailed business. Testing, design, program. Too many estimates and target dates are interdependent upon each other. This piece must be taken care of properly. To take this a step further, be truthful to yourself. If it's not within your budget, admit it, or it'll bite you in the long run. One last thing, don't forget to clue the client or management in on these details. They'll appreciate it.

NOW THERE ARE 14. There also are two Series 68s, 10 disk drives, four tape drives, over 100 terminals, 20 printers and many more acquisitions ahead. There are still many bugs left. The inventory allocation balances are still out of wack, but it's manageable. The liquor distributor is growing, the Big Eights never stop growing, and we're growing too!

Fortunately, this is one of those stories we can look back at and smile, knowing we've survived. I hope this is the type of story none of you will ever be looking back at. By telling this story and living through the experience, we hope we can help a few people avoid ever experiencing the "Ultimate system development disaster." *—David Rubinstein is executive vice president of Innovative Information Systems, Inc., Norwood, MA.*

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GETTING THE JOB DONE

Building A Desktop Publishing System

DESKTOP PUBLISHING

Ashley Grayson, Carolyn Meskell, John Vornholt

Desktop publishing sounds too good to be true: professional-looking documents at the touch of a button, the ability to make changes up to the last minute, total control of the publishing cycle. The only question is which system to buy and what to do first — a brochure, the revisions to that tech manual, or the company newsletter.

The reality is that DTP is still evolving, and many tools from different vendors are needed for even the most minimal publishing job. Hewlett-Packard provides a hefty number of hardware and software tools for the aspiring desktop publisher, but even the best tools don't eliminate the need for potential users to know what they're doing.

For a computer application, desktop publishing is remarkably unautomated and free-wheeling. Layout programs do much of the work but very little of the decision-making, and "trial-and-error" is the order of the day. Unlike a database, which once set up runs consistently, DTP requires constant creative input to deliver its promise. Frankly, we at ADG (San Pedro, CA) didn't know what we were getting ourselves into when we committed to desktop publishing, but now we can offer a few tips to save others needless bewilderment.

We had a couple of advantages. ADG is a marketing organization that develops brochures, manuals and other product and sales support materials. We were familiar with the publishing cycle before we began with DTP. We looked to DTP as a more effective way to deliver our products, preferably as camera-ready setups. With an HP Vectra and LaserJet Plus as the core of our system, we'd tried almost every combination of computerized word processing and classical paste-up. From this perspective, the value of many of the tools were clear to see, yet there were many surprises.

A GOOD WORD PROCESSOR is the first ingredient of any publishing project, and Microsoft Word (Microsoft Corp., Redmond, WA) has many advantages. It works well with HP LaserJet printers, offering complete control of both downloadable and cartridge fonts. If graphics and boxes aren't required, then for ease of use, features and versatility, Microsoft Word compares very favorably with some of the so-called desktop publishing packages we've seen. We've published several manuals using it alone. Because it allows the user to define the look of the document — margins, indented paragraphs, justification, combinations of typefaces, etc. — by specifying these parameters in a separate file, called a style sheet, it's relatively easy to change the look of the document completely by attaching a different style sheet.

One of the real beauties of MS Word is that it reformats the document automatically for correct margins, etc., if you add a sentence, attach a new style sheet, change the HP Laserjet cartridge or download fonts (provided you specify the appropriate printer driver).

Furthermore, by dividing the format of the document from the text, writing and design can be performed by different people. This ability to divide the labor is a crucial feature not shared by other word processors such as WordStar (MicroPro International Corp., San Rafael, CA) and WordPerfect (WordPerfect Corp., Orem, UT). If the writer isn't attuned to document design (this is why book designers and graphic artists have jobs), he's allowed to focus only on the words, with-

out having to worry about style types, or spend time guessing at how many spaces ought to make these lines line up and bashing the word processor into compliance. It's especially useful in designing a visually-appealing document to allow another person to view the document as a whole and then decide how to enhance its readability.

To date, Word has run slowly on floppy systems, but the newest versions are much faster. However, although we've run manuals off on IBM XTs attached to LaserJets, we wouldn't attempt to do page makeup desktop publishing on anything less than an 80286 machine with a hard disk, like the Vectra.

When we moved to a WYSIWYG layout program to combine text and graphics, we chose to augment the Vectra with two faster computers, the PC's Limited 286-12, an 80286 machine which runs at 12 MHz, and the Tandy 3000HD, an 8-MHz 80286-machine with a faster hard disk than the Vectra. The faster speeds are especially useful when manipulating graphic images with Ventura Publisher (Xerox Corp., El Segundo, CA), our preferred layout program, because each image can run a couple hundred thousand bytes in size. We're looking forward to trying out the HP 80386 machine when it's available.

Images have to be created before they can be manipulated, and one hole in every vendor's DTP package is a truly integrated drawing program. We experimented with quite a few drawing, painting and charting programs, including AutoCAD (AutoDesk, Inc., Mill Valley, CA) and PC Paintbrush (Apple Computer, Cupertino, CA) before deciding on HP's Graphics Gallery as our main vehicle for creating line drawings used in technical manuals and the charts often used in sales materials.

Graphics Gallery does virtually everything we need and is extremely efficient to work with under deadline. Painting programs, like PC Paintbrush, are specialized for art and, consequently, for artists.

Relatively few of our manuals or brochures have required free-hand drawings, but when they do, we've found it easier to assign the task to an artist to complete in pen and ink than to devote a computer to the artist for hours. Digitizing the image with a Canon Scanner (Canon U.S.A., Inc., Lake Success, NY) and Halo-DPE (Media Cybernetics, Silver Spring, MD) is much more efficient for this type of art.

At the other end of the drawing spectrum, a "line drawing" program like AutoCAD is too hard to learn and complex to use for creating the type of illustrations found in most brochures and manuals. We used AutoCAD to draw some computer timing diagrams, but the client didn't like the "look" of the drawings. It turns out that some "technical drawings" contain a significant "art" element. After several tries, we found MAC DRAFT from Innovative Data Design (Concord, CA). This Macintosh program produced beautiful timing diagrams that pleased everyone.

The HP Graphics Gallery represents a happy medium. Drawing

Images have to be created before they can be manipulated, and one hole in every vendor's DTP package is a truly integrated drawing program.

Gallery has an exceptional user interface and produces both "line drawings" and "image files" in a variety of formats which can be used by Ventura Publisher. Charting Gallery is just as good and produces excellent charts from raw data; the charts can be further massaged with Drawing Gallery to produce professional results painlessly.

While lacking free-hand drawing capability, Graphics Gallery proved to be the most versatile graphics package we encountered. We really don't know why it isn't on everyone's MS-DOS machine. Next to Microsoft Word, we consider it to be an under-promoted value in the DTP field.

A cautionary note: Graphics Gallery isn't fully integrated into the DTP community of programs. While it will write files both in Paintbrush (PCX) and line draw (HPGL) formats as well as in TIFF format for PageMaker (Aldus Corp., Seattle, WA), considerable experimenting is required to select the right "look" for a drawing in a particular document.

WE KNOW HP IS PROMOTING PageMaker as part of a DTP system, but PageMaker is simply harder to use than Ventura Publisher. Ventura is document-oriented, while PageMaker is page-oriented. That may seem like a subtle difference, but it isn't. Ventura uses style sheets, much like Microsoft Word's, to define the entire look and feel of the publication. Using this overall approach, Ventura does most of the layout work itself, requiring the operator to jump in only to lace specialty items within user-defined frames. Ventura is much more efficient at producing multi-page manuals, where a unified look is required across the entire document. That's not to say that every page needs to have the same margins, columns, etc., but most naturally will.

Ventura has an additional superb feature that's a great boon to a team working on a large project, especially when the team's members are using different word processors. It not only accepts text from MS Word, WordStar,

(MicroPro, San Rafael, CA), WordPlus (Software Systems, Inc., Spanish Fork, UT) and a half-dozen others, it continues to save the text in those formats even after changes have been made with Ventura's own editor.

With PageMaker, the operator must place text, columns, headlines, etc., on each page separately. This is the elec-

". . . PageMaker is simply harder to use than Ventura Publisher."

tronic equivalent of the paste-up process that a layout artist goes through in creating a multicolumn newsletter with photos, for example. And it helps if the operator is able to visualize the layout like an artist.

Pretend that you're placed before a blank sheet of tabloid-size paper and surrounded by two articles in three-inch strips of typeset text, four photos and a waxer. You must decide where to place the photos and whether to put the articles vertically side by side, place one in a box, put one on the upper half of the page and one on the lower half, etc. If you don't like where you put a column or a photo, you peel it up and stick it down again. We'll pick PageMaker for complicated brochures and newsletters when flexibility is required, but we wouldn't dream of using it for manuals. (The newest release of PageMaker comes with "templates" to help the user get going. We haven't reviewed this release, but plan to do so in the near future.)

This brings us to our most important working rule: *Don't start the layout process until the content is set and approved!* There's a great temptation with DTP to start making the document look pretty right away, especially if you want to see in a first draft what the final document will look like. However, if lots of changes are required (move this para-

graph to the end of that section, move this drawing to that chapter and renumber the tables and illustrations, add these three paragraphs, etc.), they can be done in the DTP system, but are much more easily performed in a plain old word processor, not to mention the savings in time printing the document out. Pages produced by DTP methods, containing graphic elements such as boxes, can take minutes per page to print.

Hewlett-Packard is dangerously close to providing a unified set of desktop publishing tools through its internal corporate resources (Vectra PC, LaserJet Printers, HP Graphics Gallery) and through strategic marketing partnerships with vendors like Microsoft (Word) and Aldus (PageMaker). In areas where they haven't ventured or we just didn't have the HP product to evaluate, competitive products fit in well and worked with the HP products.

Products we discovered that worked well together included both software and hardware. For example, bitstream font libraries for the LaserJet family distributed by HP install easily on Ventura Publisher. Halo DPE (Media Cybernetics, Silver Spring, MD) using a JLASER board pulled quality images from the Canon Scanner with little effort. (In a future story we'll compare the Canon to the HP ScanJet.)

Our Vectra PC has been customized with a Video-7 Vega Deluxe and NEC Multisynch monitor, and together they form perhaps the best extended EGA available for almost every PC application. Nevertheless, the single product we would have given our eye teeth for is any high-resolution, full-page (or two-page) monochrome display for page layout. Approximately 30 percent of the time spent in Ventura was spent in flipping from one view to another. The speed of the PC's Limited 286-12 made this less painful, but a large format monitor on the Vectra would've reduced the need for speed.

No DTP package provides an environment for tracking different versions of its component files, whether text or hints.

NO DTP PACKAGE provides an environment for tracking different versions of its component files, whether text or images. You're on your own with no hints. This is no problem for the little one-, two- or four-page brochures they use as examples, but it can become acute in a 50-page technical specification with 23 figures and a dozen tables. Make lots of notes on paper. Documenting the document may be the most important element not provided by any DTP package.

Maintaining a uniform "look" is crucial to producing a professional quality publication. Choosing the right drawing program to use for the illustrations in a manual, brochure or newsletter is a process of trial and error. Line weight, typefonts, and scaling may vary widely across illustrations done with the same drawing package, so allow time to finesse the appearance of the final document once the content is perfected.

As in most adventures, deciding where to go is required before picking equipment and supplies. Good Luck.

—Ashley Grayson is president and founder of ADG, a San Diego-based high technology marketing firm. Carolyn Meskell and John Vornholt are project managers at ADG.

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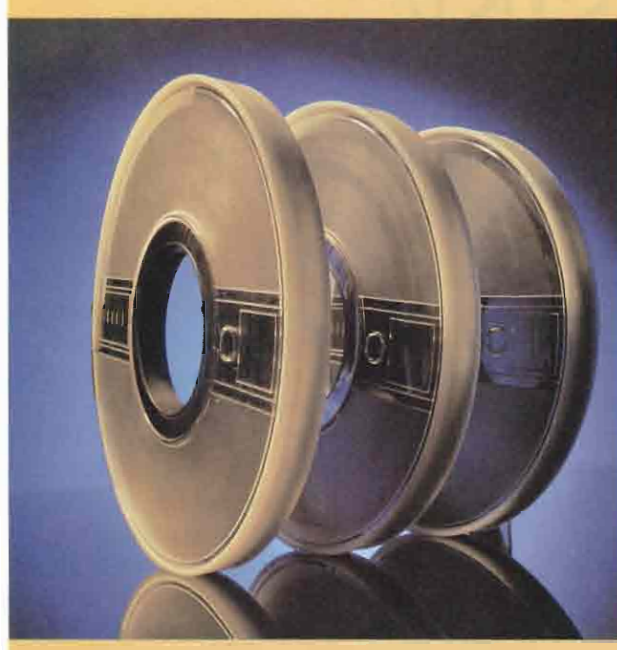

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BYPASSING RECONFIG

Configuring A Graphics Line Printer Under UNIX Can Be A Nightmare. This Information Might Help System Operators Sleep Better.

UNIX

Miles O'Neal

The problems of interfacing computers and printers are old, generally well-known, mostly solved and occasionally documented. While mating a computer and printer from the same manufacturer is usually straightforward, trying to mate a computer and printer from different manufacturers can be an experience even the most cunning systems guru won't wish to repeat.

Once UNIX enters the picture, however, all bets are off. The difficult is made simple, the simple is made difficult, the mighty are humbled, and the humble are made mighty. UNIX is meant to be all things to all hardware. After a fashion it succeeds at this, yet portability exacts a price. That price, oddly enough, involves customization, even in the allegedly noncustomized UNIX world.

Hewlett-Packard, however, foresaw many of these problems and provided most of the customization effort, resulting in an easy-to-use system interface called reconfig. Reconfig, among other things, takes care of most of the details involved with line printer installation.

Hewlett-Packard did a good job with reconfig. For most purposes, it provides a quick and easy method of defining a printer and configuring it into the spooler. Assuming the printer will be used only as a line printer, the process works. If you were to use the HP-UX graphics capabilities (which aren't part of any standard UNIX), graphics printing could operate with printers created with reconfig.

Our application at Process Instrumentation & Design Inc. involved porting 1.5 MB of C source code from another UNIX-based system. Approximately half of this code generates simple graphics printouts. The code was designed to be ported easily for different printers, even though graphics printing is about as nonportable as applications get.

The package already supported HP plotters, PostScript and an Okidata serial, dot-matrix printer. The code was ported fairly quickly to meet the specs for the HP 2564B HP-IB-based, dot-matrix printer. Unfortunately, although the code produced a good raster dump, only garbage showed up on the 2564B.

After a week of phone calls to HP and experimentation on our system, we finally were able to configure the printer, spooler and HP-IB so they all worked together with our code. We learned that writing graphics (essentially binary) data to a raw graphics device on a 9000 Series system under HP-UX requires bypassing HP's online assistance program (reconfig) and doing all configuration work at the standard UNIX level.

System V UNIX, upon which HP-UX is based, has a fairly sophisticated print spooler. Data spooled for printing passes through a filter, which may transform most of the data en route to the output device or pass the data straight through to the output device.

The filter also is responsible for generating headers and trailers, pagination, command line option handling and other housekeeping details. A model filter for each printer type is kept in a model's database and copied onto a printer's configuration database when that printer is configured into the spooler.

To the spooler, a printer name is another name for a device in the /dev directory with an associated filter, queue and status information scattered throughout the spooler's directory structure. See the sample spooler direc-

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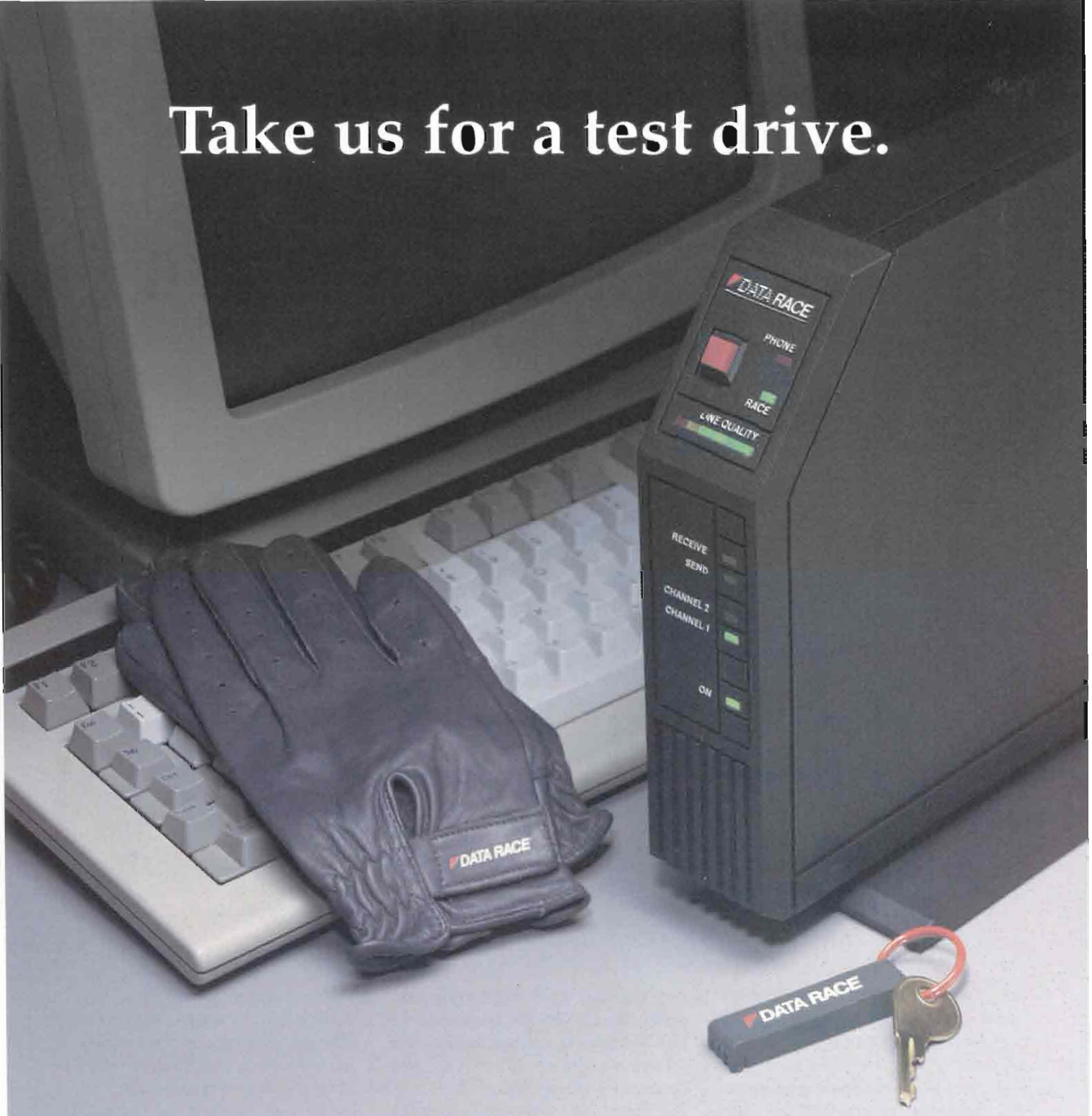

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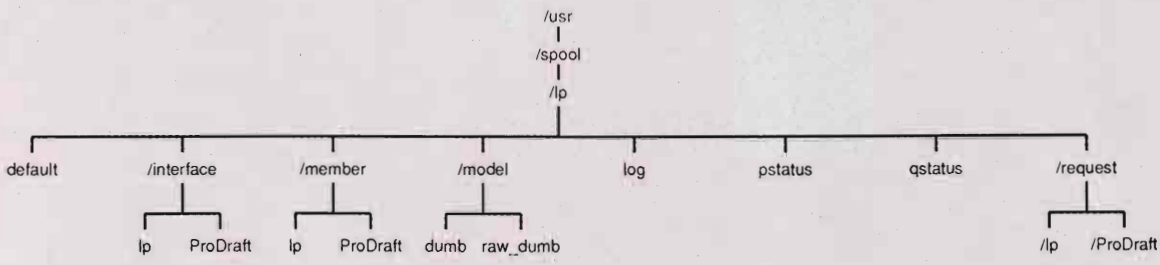
FIGURE



Name	Type	Description
default	*file*	*Contains name of default printer, often lp*
interface	*directory*	*Contains interface (filter) for each printer*
lp	*file*	*Copy of model/dumb filter*
ProDraft	*file*	*Copy of model/raw_dumb filter*
member	*directory*	*Contains device definitions for each printer*
lp	*file*	*Contains pathname of device associated with lp*
ProDraft	*file*	*Contains pathname of device associated with ProDraft*
model	*directory*	*Contains models of printer filters*
dumb	*file*	*Model of "dumb" printer filter (supplied with HP-UX)*
raw_dumb	*file*	*Modified dumb model for raw graphics printer*
log	*file*	*Spooler log file*
pstatus	*file*	*Contains current status (enabled/disabled) for each printer*
qstatus	*file*	*Contains current status (accepting/rejecting requests) for each printer's queue*
request	*directory*	*Contains queue directory for each printer*
lp	*directory*	*Contains spooled files for printer lp*
ProDraft	*directory*	*Contains spooled files for printer ProDraft*

Sample spooler directory with attendant file descriptions.

tory with attendant file descriptions given in *Figure 1.*

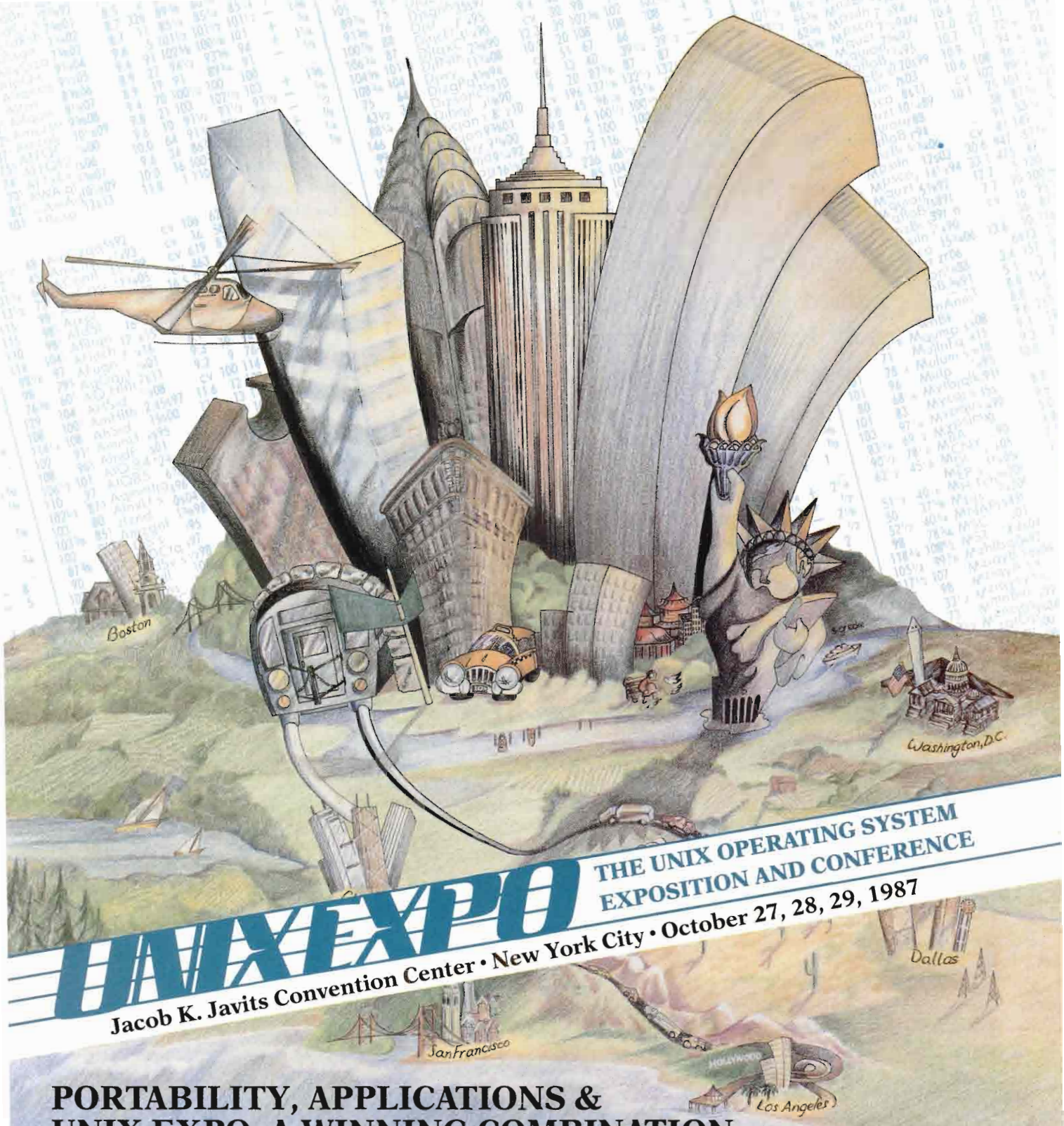
All I/O under UNIX is either treated as "cooked" or "raw." Raw I/O is sent directly through the operating system to the designated device with no data transformations. Cooked data, however, can be modified by the operating system. A typical step in the cooking process consists of converting newline characters (ASCII LF) to a newline/carriage return character pair (ASCII NL CR).

Normal text printing is to a cooked device. Binary data printing, however, such as a raster dump used for the 2564B printer, requires use of a raw, spooled device with an appropriate filter.

The reconfig command generates a cooked device, reconfig, and a raw device using the same name prepended by the character "r." For example, using reconfig to generate the default line printer lp creates a cooked device named lp and a raw device named rlp. Reconfig then performs the appropriate UNIX commands necessary to make lp a printer under control of the spooler.

Unfortunately, the raw device, while owned by the spooler, isn't considered to be a spooled printer, nor is it accessible to the user. Thus, reconfig has given us the raw device, but has taken away any chance of using it.

CONFIGURING AND USING a raw, spooled printer under UNIX isn't really hard once all necessary documentation has been collected and digested. UNIX documentation is known for its lack of tutorials and plethora of information



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spread throughout various sections of manuals. The *IHP-UX Peripheral Installation Guide* section on "Printers" gives the low-level data required, the major and minor device numbers. This data is required even for reconfig.

> *Configuring and using a raw, spooled printer under UNIX isn't really hard once all necessary documentation has been collected and digested.*

Program 1 contains a shell script that will create a new HP-IB raw printer and integrate it into the spooler. (All shell listings in this article have a blank first line.) This script shuts down the spooler and then is restarted by **/etc/restart_lp**, which is shown in *Program 2*. The shell script in *Program 2*, or its equivalent, also should be executed at system startup from the **/etc/rc** file.

The **slp** command, as found in the last line of *Program 2*, defines the printer, ProDraft, as an HP-IB printer and configures it accordingly. Familiarity with the UNIX **stty** command predisposes one to expect to have total control over a device; **slp** has only limited capability to modify device control, resulting in slightly more programmer effort to make the printer behave properly.

The result was a C program, **crlf**, used in the filter to change newlines to newline/carriage return pairs to enable the header portion of the filter to function correctly since the device was no longer a cooked device.

The filter, a modified version of the "dumb" filter that comes with HP-UX, is shown in *Program 3*. It doesn't perform any checks for flags or options as mandated by the UNIX documentation because the graphics printers are invoked solely under applications program control in a controlled manner. If you're interested in models, refer to the **lpadmin** manual entry and peruse the models found in **/usr/spool/lp/model**.

The **slp** command and its documentation also have some flaws. The **-n** flag doesn't seem to work as

Program 1.

```
#       restart_lp
#
#               shutdown spooler, restart scheduler & set up printer handshaking
#
#       Copyright  1987 by P & I Design, Marietta, Ga. All rights reserved.
#       Coded    : meo/pid/atl 2/1/87
#       Location : /etc/restart_lp

/usr/lib/lpshut > /dev/null 2>&1

if [ -s /usr/spool/lp/pstatus ]
then
        rm -f /usr/spool/lp/SCHEDLOCK
        /usr/lib/lpsched
        echo line printer scheduler started
fi

slp -d -i0 -l1700 -a > /dev/ProDraft
```

Program 2.

```
#       newlp <device name> <printer name> <model>
#
#               create raw Graphics printer on HPIB
#
#       Copyright  1987 by P & I Design, Marietta, Ga. All rights reserved.
#       Coded    : meo/pid/atl 4/1/87
#       Location : /pid/upr/maint/newlp

DEV_NAME=$1
PR_NAME=$2
MODEL=$3
#
#       create the device with appropriate ownerships & permissions
#
/etc/mknod /dev/$DEV_NAME c 26 0x070701
chown lp /dev/$DEV_NAME ; chgrp bin /dev/$DEV_NAME ; chmod 600 /dev/$DEV_NAME
#
#       shut down the spooler, add the new printer, restart the spooler and
#       get the printer completely online
#
/usr/lib/lpshut
/usr/lib/lpadmin -p$PR_NAME -m$MODEL -v/dev/$DEV_NAME
/etc/restart_lp
/usr/lib/accept $DEV_NAME
/usr/bin/enable $DEV_NAME
```

Program 3.

```
#       modified from UNISRC_ID: @(#)dumb       27.1    84/07/19
#
#       raw_dumb - lp interface for RAW dumb line printer
#
#       invocation :
#               <printer_name> <job_id> <user_id> <banner_text> <#_copies> [<file_names>]
#
#       Copyright  1987 by P & I Design, Marietta, Ga. All rights reserved.
#       Coded    : meo/pid/atl 2/1/87
#       Modified : meo/pid/atl 8/5/87
#       Location : /usr/spool/lp/model/raw_dumb

CRLF=/pid/util/bin/crlf

# Print the standard header

x="XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"
(
        echo "\014\c"
        echo "$x\n$x\n$x\n$x\n"
        banner "$2"
        echo "\n\n"
        user=`grep "^$2:" /etc/passwd | line | cut -d: -f5`
        if [ -n "$user" ]
        then
                echo "User: $user\n\n"
        else
                echo "\n\n"
        fi
        echo "Request id: $1    Printer: `basename $0`\n\n"
        date
        echo "\n\n"
        if [ -n "$3" ]
        then
                banner $3
                echo "\n\n"
        fi
        copies=$4
        echo "\014\c"
) | $CRLF

# The remaining arguments are files

shift; shift; shift; shift; shift
files="$*"

# Print the spooled files

i=1
while [ $i -le $copies ]
do
        for file in $files
        do
                cat -u "$file" 2>&1
                echo "\014\c" | $CRLF
        done
        i=`expr $i + 1`
done

exit 0
```

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8250: 50MB fixed & 20MB removable
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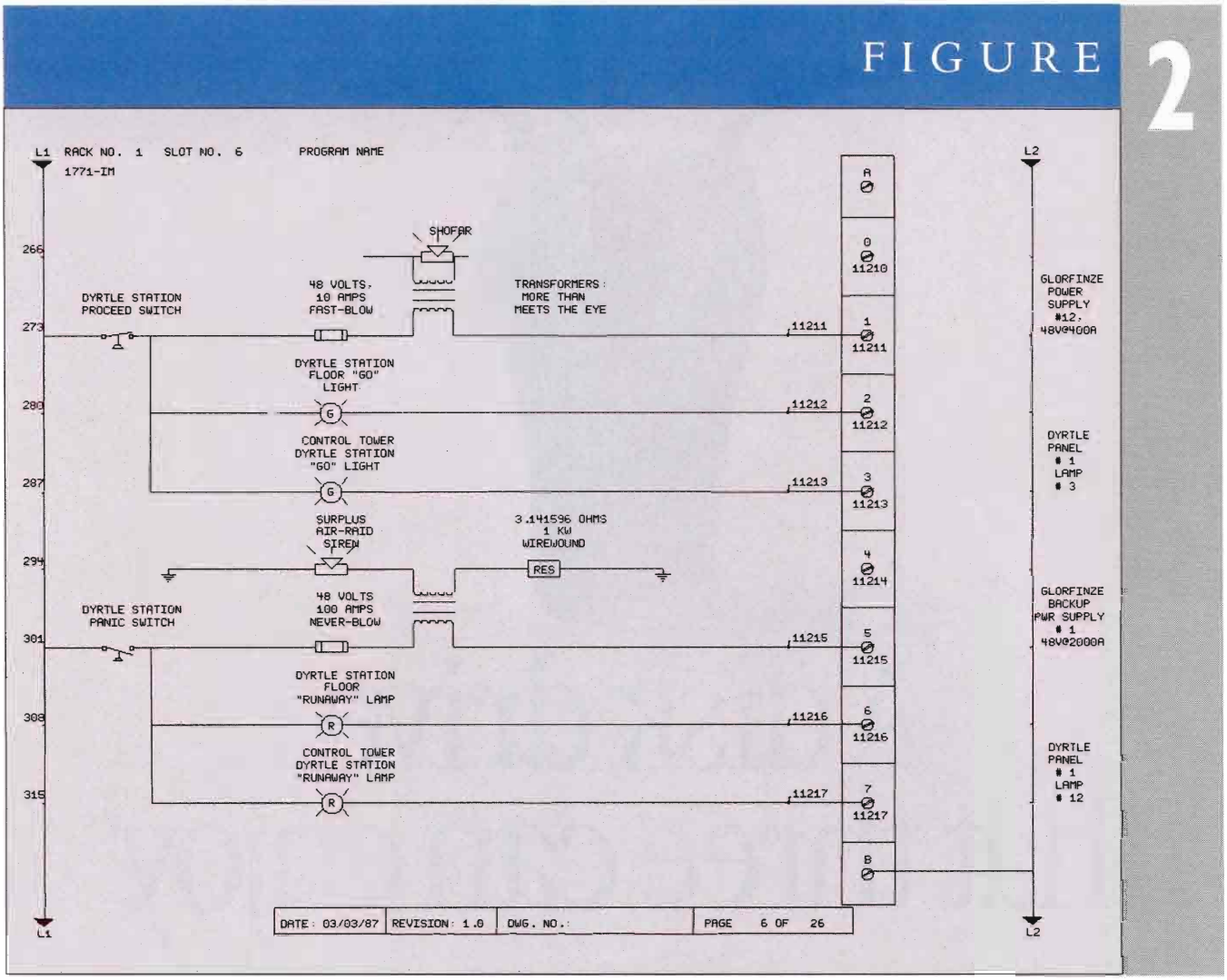
FIGURE 2



Sample of a low-resolution print from ProDraft on an HP 2564B printer.

advertised. While **-n** should set page length to infinity, it instead has the effect of setting page length to one line. This didn't produce the effect for which we were striving. Finally, we just set the **-l** flag (page length) to a value larger than the number of raster lines on a page, knowing we'd never exceed the true page length.

The **slp** documentation itself never mentions HP-IB; while the connection may be made somewhere in an HP manual, I learned about it by asking an HP analyst. Furthermore, our system hangs during the boot process at the **slp** command if the printer is offline. No message informing you of impending problems appears. The system just waits until you place the printer online. We couldn't find any documentation about this "feature" of **slp**.

The quality of the HP 9000 and HP-UX documentation is generally among the best I've seen on UNIX systems. The **slp** documentation problems don't seem to be the norm.

THE HP2564B ISN'T MENTIONED anywhere that I can find in the HP documentation; however, everything described here applies to all HP256x printers using the HP-IB. Furthermore, the same concepts apply to any other graphics device hooked to a 9000/3xx system. Serial hookups are slightly easier, but everything else remains pretty much the same.

I'd like to thank the folks at the HP Software Response Center for their hard work in helping us resolve this problem. I'd also like to thank Dave Outzs of the local office. Without his help, we would've completed the project much later. *—Miles O'Neal is software department manager at Process & Information Design Inc., Marietta, GA.*

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DEVELOPMENT

Lisa Burns Hartman

Quick Prototyping

If your experience is anything like ours, you've had mixed success with various methods of specifying systems. Specifying new systems is a difficult process and can result in lengthy documents that are never read. Even for enhancements to existing systems, it can be difficult to express on the printed page what the new feature will do. Using diagrams of new screens can help, but it's not the same as logging on and interacting with a system. Users who receive systems designed only with written documents may be surprised and unhappy when the system arrives.

OUR FIRST ANSWER to this problem was to build prototypes of new features. This was more successful than a written document for several reasons. Our users could see the screens online. This allowed them to try out the ergonomics of the screens: the video enhancements, the softkeys, the TABing, the placement and length of the fields, and the overall aesthetics of the screen itself. By interacting with a working prototype they could type in transactions, see data returned to them and clear up any confusion about how the new screen or feature was really going to work. This was infinitely more informative than reading a document.

However, building the prototypes wasn't cheap. We didn't want to use a fourth generation language because of the heavy interaction with our existing system for some of these prototypes. It was difficult to integrate prototypes written in a 4GL with existing programs in COBOL. So, since we used COBOL for the prototypes, it took six weeks or more to develop some of them. By that time, our investment in the design as we saw it was quite high.

However, our prototype sessions proved that our idea for a new feature didn't always work in a real office environment. If users wanted significant changes to the initial design, it would be quite expensive to develop another prototype. It was very tempting to go ahead and install the code we already had developed and to ignore the users' input. We weren't catching design problems or possible design improvements early enough in the process.

Because of these experiences, we decided to try another approach. By using the FORMSPEC subsystem within V/PLUS, we designed screens for our new features. By linking these screens together and adding plausible data to be displayed to the user, we built a simulated prototype of the new feature which could be run using the ENTRY subsystem of V/PLUS. This prototype included a narrative script where users are told to enter values in the various fields to set up a transaction.

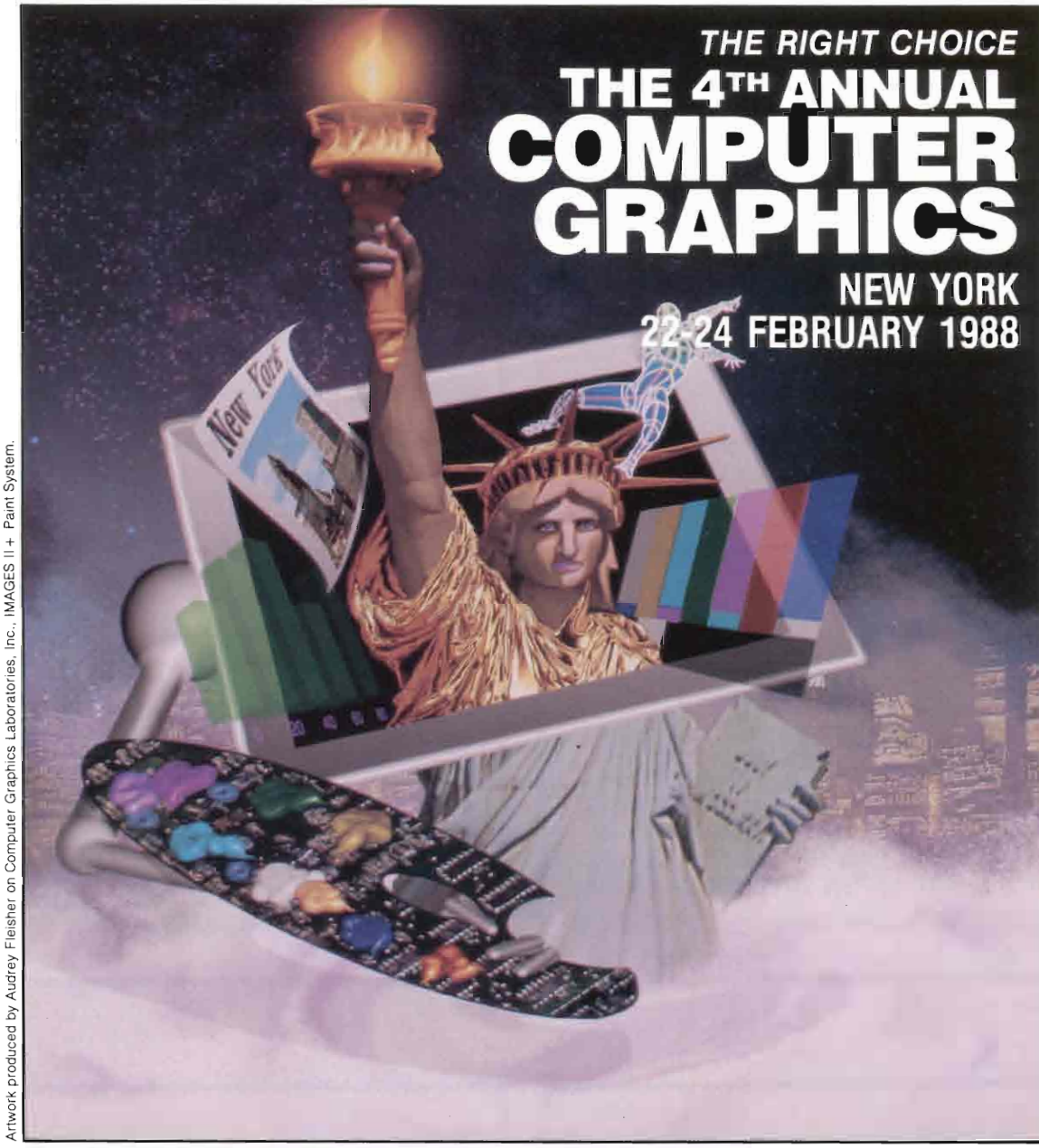
The entire setup for the prototype took our summer student, who was not familiar with FORMSPEC, less than two days. Not a single line of code needed to be written!

When we sat down with users to show them the new screens, they were very pleased. As with traditional prototyping, they could see the screens online. They could review the placement of fields, which fields they wanted to see, the video enhancements to be used and the overall appearance of the screen. They could enter transactions according to instructions in our narrative and work with TABing and length of fields. Again, this was much better than asking them to respond to a written document, and much more informative.

You already may have used ENTRY to allow users to try out screen designs. It's an excellent way to get feedback quickly. But blank screens have limitations. Without displaying data back to the users, we cannot meet the goal of simulating an interactive program. However, by linking several copies of the same screen together and placing data in the fields in the second screen, we can simulate a program interacting with the user. The users can respond to the demo as though there were a program returning the data, and give us feedback on the way the function was designed.

To illustrate how to set up such a simulation, let's take an example of an order inquiry screen. Suppose that we're going to design an inquiry screen to access an order database. The first step is to run FORMSPEC.PUB.SYS, and set up the new screen. *Screen 1* shows the design of our first screen when brought up in ENTRY. This will be the first screen the users see when they run the prototype.

Now that we have our basic screen design, let's think about how our prototype will work. With this screen, the user will be able to query our database using three different keys: Customer, P.O. number and Order number. How might a user expect this screen to operate? How will the searches work? Will partial keys be allowed? How will the orders be sorted when they do appear? Our prototype sessions with the users will answer these questions.



Artwork produced by Audrey Fleisher on Computer Graphics Laboratories, Inc., IMAGES II + Paint System.

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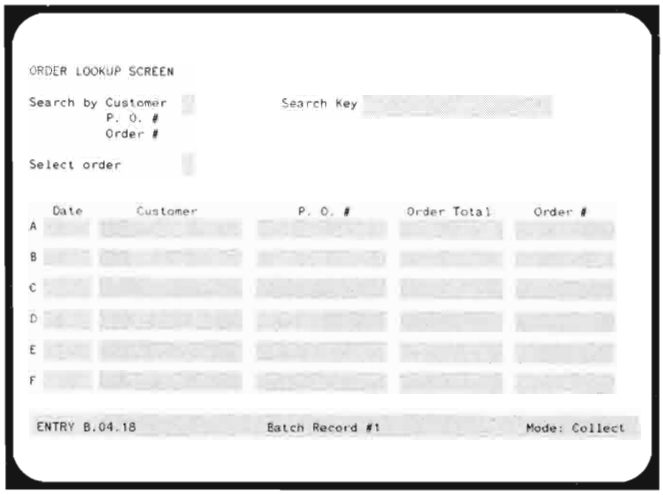
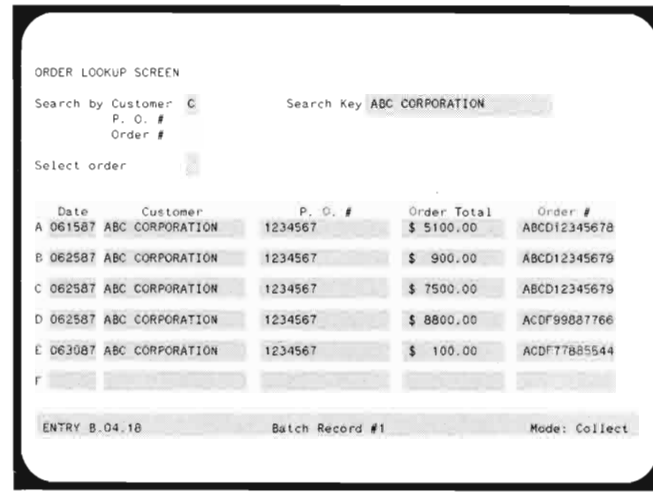
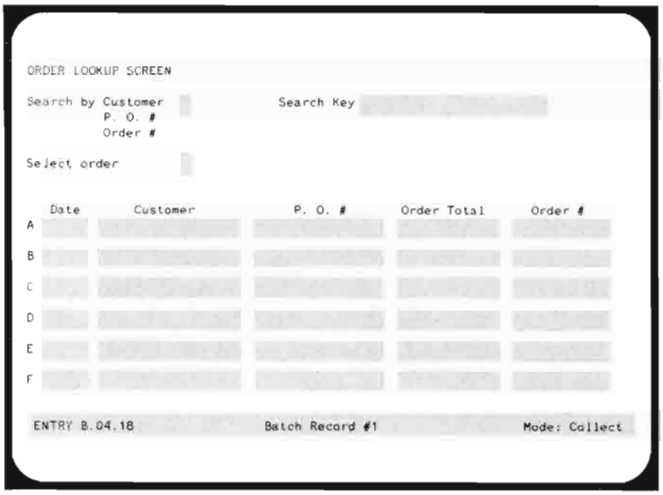


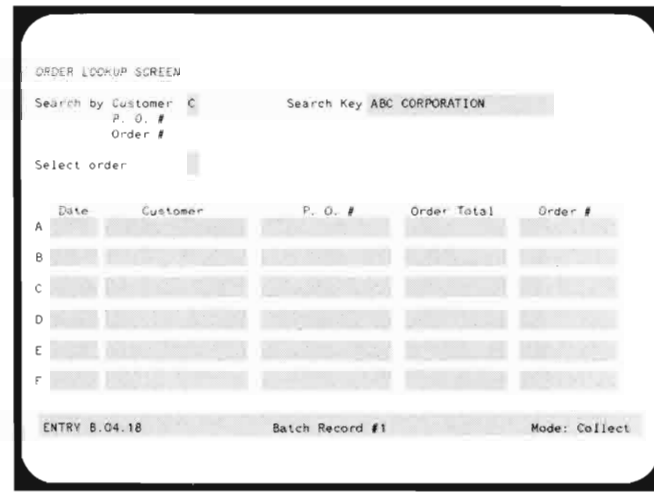
Screen 1.



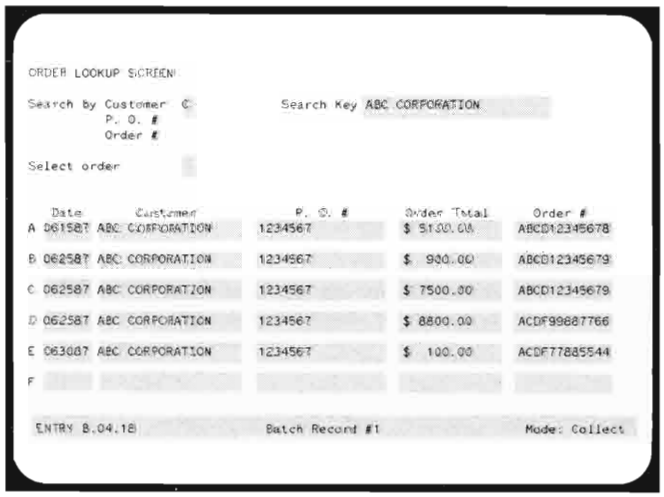
Screen 2.



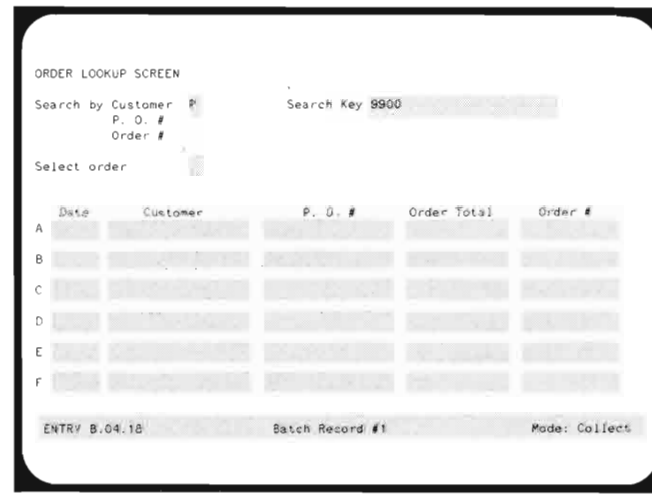
Screen 3a.



Screen 3b.



Screen 3c.



Screen 4a.

WE NEED TO SET UP demonstrations to answer each of our questions. Let's set up an example for customer searching. First, we make a copy of the screen to a second screen name in FORMSPEC. Then we link these two screens together using the NEXT FORM field. Then, working on the second screen, we use the Initial Values field in FORMSPEC to set up prototype data.

I found that printing the sample screen and writing in plausible values for each field made the data entry of initial values in FORMSPEC much easier. The results of this data entry are shown in *Screen 2*.

In only a few minutes we've just written a small prototype! By running ENTRY.PUB.SYS and specifying the FORMSFILE name, we can run the prototype. The user first sees the blank basic screen *(Screen 3a)*. Our narrative calls for a demonstration of the customer search feature. In our script, the user is asked to type a "C" for customer search in the first field of the screen, and then to type the customer name "ABC CORPORATION" *(Screen 3b)*. The user then hits <ENTER>, and the second screen we created is painted, with our sample data from the Initial Values fields in FORMSPEC *(Screen 3c)*.

This example illustrates the basic concept we followed in creating our prototype: Show the basic screen, tell users what to enter in each field, then show the next screen filled with data corresponding to the matching entered data.

The same technique can be used to illustrate alternatives for implementing a particular program function. *Screens 4a-d* illustrate a data inquiry function that could display data in one of three different sort orders. Users viewing this prototype could choose the sort order that most closely fits their needs.

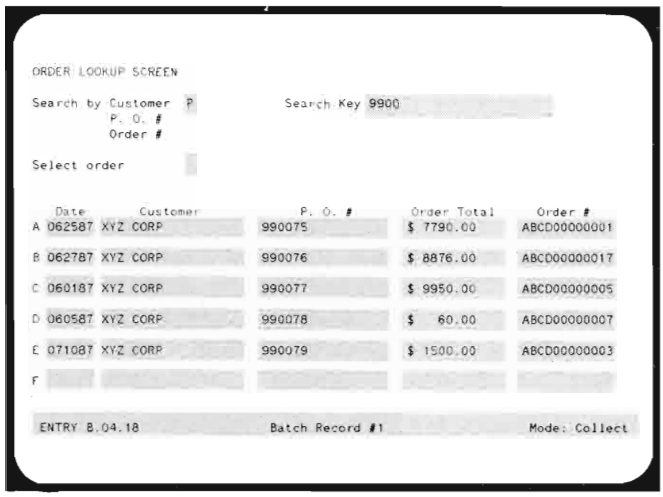
What else can an ENTRY prototype show our users? By making copies of the basic screen and then varying the copies, we can demonstrate the effect of different video enhancements. *Screen 5* shows a variation of our basic screen with underline enhancements for some of the fields rather than half-inverse. ENTRY also can allow users to experiment with field placement.

Screen 6 and *Screen 7* show the same data elements arranged differently on each screen. By having users enter data from actual transactions into these screens, they can determine the best placement of the fields for ease of data entry. The placement of fields and the video enhancements used may seem trivial to a programmer, but to someone who stares at screens eight hours a day, these are very important issues.

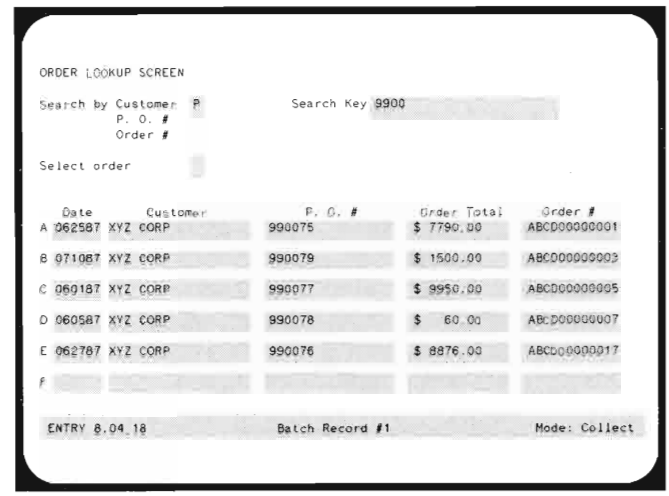
By linking various scenarios together, we can set up a prototype session illustrating several alternatives for a new screen design. This session will yield very effective user feedback and help us resolve design issues before we write a single line of code.

Writing the prototype is only half the battle for getting user input. By asking the right questions, we can elicit very important information from your users. The following are some tips we have found helpful when setting up an ENTRY prototype session.

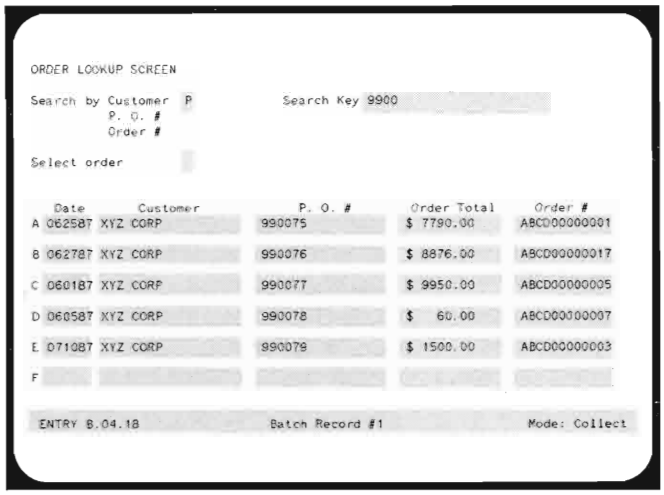
- *Schedule the prototype meeting at a time when users will have an hour or so to devote to this activity.* We've found that our users are very excited to participate in the sessions, so getting them to take time to see the prototype isn't usually a problem.
- *Set up the prototype in a room where the users and the designers won't be distracted.* This allows everyone to concentrate on the session.
- *Set up several terminals, one for every two or three people.* This allows each person to get hands-on experience with the screens.
- *Give each user a copy of your narrative so they understand the test data to be entered.* Include instructions for running ENTRY.PUB.SYS and putting up the first screen. This will minimize confusion during the session and allow easy data entry according to the narrative.



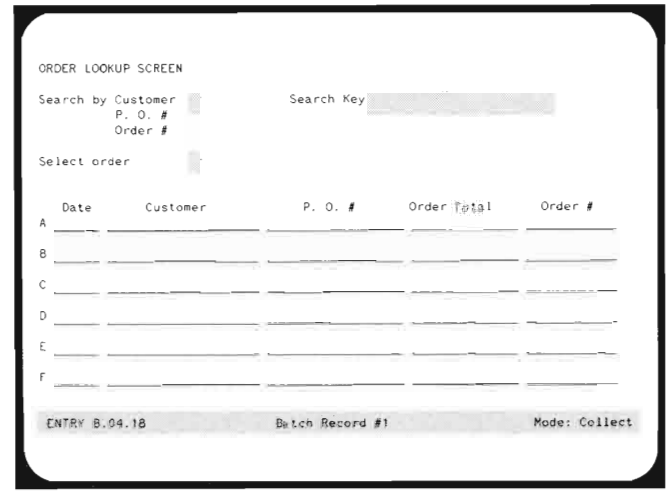
Screen 4b.



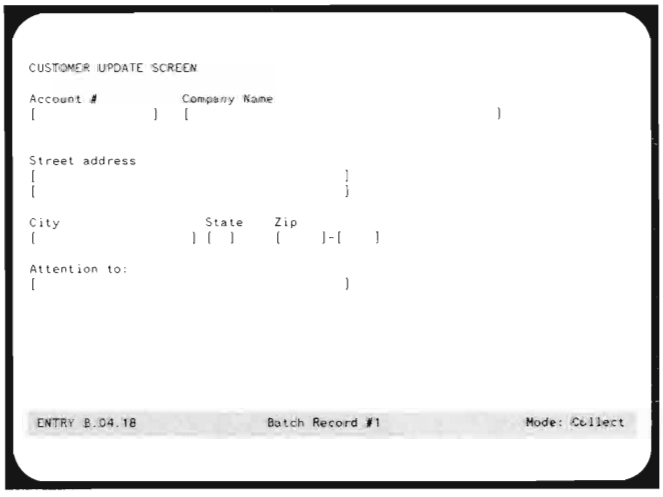
Screen 4c.



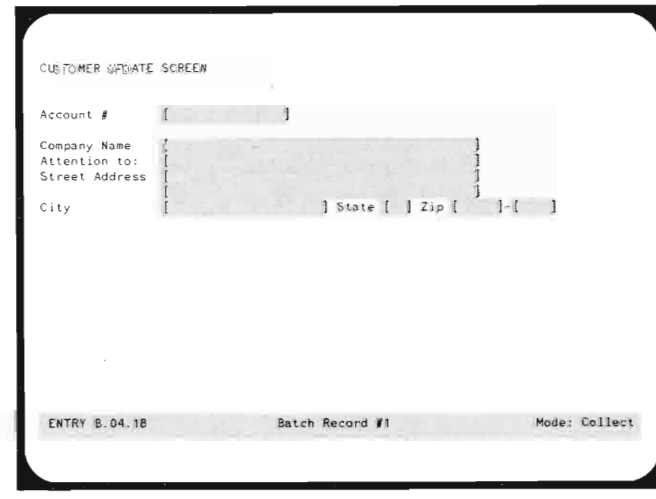
Screen 4d.



Screen 5.



Screen 6.



Screen 7.

Now it's time to begin the session. As each screen comes up, ask the users questions: Do you like the order of the fields? Do you like the video enhancements? Is the screen too busy? Are the field labels clear? And so on.

Have them tab around the screen and enter sample transactions. Ask them if the fields are in an intuitive order, if seldom-entered fields are at the end, and if tabbing works the way they'd like.

As you display each alternative design, ask which features they like the most: Does this sort order work best for you? Do you need a search on less than a full key? Is enough data displayed? Are error messages self-explanatory? Does the system respond in a way that makes sense to you? Does it operate in a manner that fits the way you do business? You may need to ask leading questions in order to stimulate discussion.

You may wish to designate one of the designers as a scribe so that answers to these questions can be recorded. When the session is over, the scribe should summarize the results of the session, noting users' preferences and any changes to the screens which were suggested.

As a final check, you may wish to run a second session with the combined results in a new screen or screens. This will help ensure that you heard your users correctly.

Once your prototype sessions are completed, you should publish a document with printed screen layouts explaining your final external specification. Hopefully, this document will be far shorter than one generated without user input, since design alternatives have been eliminated and issues have been resolved. You then can proceed to construct the new screens or system, confident that you're creating something that your users will like and which will fit their needs.

THERE ARE A FEW MINOR limitations of ENTRY prototyping. One that users may notice right away is that, in order to display the data, the entire screen will be repainted. In a real application, only the data would be reshown. Users must be reassured that the final system will not function this way. Also, since there's no application program running behind the screens, response time won't be accurate.

Another minor limitation is that softkey functionality cannot be demonstrated for menu-driven applications. Finally, the cursor always will return to the first field on the screen. For applications doing cursor placement in a field somewhere else on the screen, this may confuse users.

The advantages of ENTRY prototyping outweigh the limitations for many applications. The technique allows users to interact with the system and provides most of the benefits that a prototype program provides. It isn't necessary for designers to learn a new language. If their application is V/PLUS-based, they're already familiar with FORMSPEC. But by far the biggest advantage of ENTRY prototyping is the speed of development. I developed all of the screens for this article in under two hours. Modifications to screens also can be made very quickly.

Using FORMSPEC and ENTRY to set up prototypes can be very valuable for application teams. A day or two invested up front can save weeks and months of redesign later in the development cycle. ENTRY prototyping lets the user interact with the proposed system hands-on, online.

By showing users exactly what the system will do and letting them see and touch a prototype, developers can be confident that the product they'll deliver is what the user wants. Our experience with ENTRY prototyping has been extremely positive. We plan to expand its use for new enhancements to our systems. *—Lisa Burns Hartman manages an internal business software programming team at Hewlett-Packard corporate headquarters, Palo Alto, CA.*

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Continued from page 25.

plications to run simultaneously. The workstations offer rapid access to information and file sharing — activities that are becoming essential to complex CAE/CAD requirements.
Contact EEsof, Inc., 31194 La Baya Drive, Westlake Village, CA 91362; (818) 991-7530.

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InCase Introduces New Security Software

InCase Corp.'s new EnGarde/InCase operating system security analysis software for the HP 3000 instantly provides system access/security status to authorized personnel such as MIS or financial management.

EnGarde checks for security problems in accounting structure, file access rights and historical patterns. It provides the following information through three distinct reports to the system manager:

- *System summary and historical tracking*
- *System detail*
- *Account-by-account detail*

The reports are presented in a readable format with problem ID messages that are understandable to both technical and nontechnical managers. A user reference guide is provided to explain further the messages reported and to provide suggestions for correcting problems uncovered. EnGarde doesn't use privileged-mode code and is user configurable.
Contact InCase Corporation, 2055 Woodside Rd., Suite 171, Redwood City, CA 94061; (415) 369-1941.

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IOtech Introduces IEEE 488 Bus Expander

IOtech's new Expander488 will enable test engineers to double the number of devices they can use on the IEEE bus.

The Expander488 will link as many as 30 instruments, printers, plotters and other devices in a system. It functions transparent to the system's controller and has no effect on bus transfer rates. Maximum data transfer rate is 1 MB per second.

Since the IEEE bus has built-in support for 30 valid primary bus addresses, no special software or bank-switching is necessary to access the additional 15 devices allowed by the Expander488.

Two IEEE ports are provided on the Expander488 box, one that attaches directly to the host computer IEEE bus and another that can drive the additional 15 IEEE devices.

The Expander488 is priced at $795.
Contact IOtech Inc., 23400 Aurora Rd., Cleveland, OH 44146; (216) 439-4091.

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Centronics Interface Card For HP 9000 Series 200, 300

IEM, Inc., has introduced a Centronics Interface card for HP 9000 Series 200 and 300 computers. The card plugs directly into any available backplane slot and emulates either an HP 98626A or HP 98644A serial card. The card has both input and output capabilities and features a 32-KB output buffer.

The interface card looks like a serial card to the operating system and user programs. The existing serial drivers are used, so programs don't need modification in order to take advantage of this card. The interrupt level and emulation are selectable with switches on the card.

The card can be used with any HP Series 200 and 300 computer under BASIC, PASCAL or HP-UX Operating System. The serial driver is required with BASIC and the RS-232 driver is required for use with the PASCAL Operating System. HP-UX requires either the HP 98626, 98628 or 98642 driver.
Contact IEM, Inc., P.O. Box 8915, Fort Collins, CO 80525; (303) 223-6071 or (800) 321-4671; TWX 910 930 9445; FAX (303) 223-4246.

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OCS, RIGHT! Form Interface Link

Operations Control Systems (OCS) and RIGHT! have signed an agreement to jointly market an interface between OCS/LIBRARIAN and COMPRESS/3000.

OCS/LIBRARIAN is a file management and version control system that controls and tracks file movement and access automatically, while managing software versions, releases and generations. COMPRESS/3000 is a data compression utility that compresses files and databases up to 90 percent.

The interface allows users to compress and decompress files automatically during any movement between production and development. Compress/3000 runs transparently and doesn't require the user to learn any special commands or syntax. OCS/LIBRARIAN users have the convenience of retaining previous versions on disk without overloading storage capacity.
Contact Operations Control Systems, San Antonio Rd., Palo Alto, CA 94306; (415) 493-4122.

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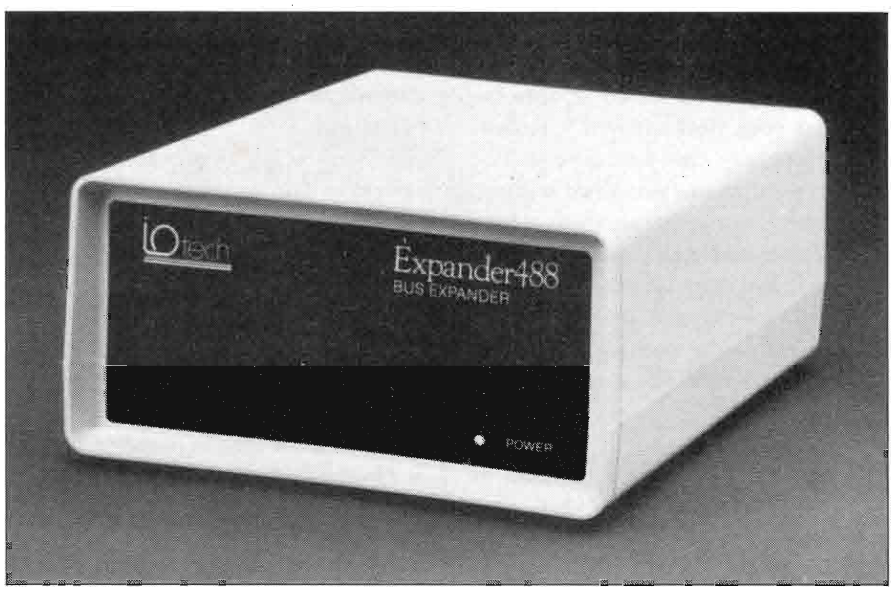
Bessel Math Compatible With HP Series 200, 300

The Bessel math package has been released by Image Acoustics for the HP Series 200 and 300 computers operating under HP BASIC 5.0. The program file contains over 35 compiled mathematical functions and subprograms, including cylindrical and



Expander488 allows you to double the number of devices you can use on the IEEE bus.

spherical Bessel functions with complex arguments and Legendre polynomials.

The package consists of SUB and FN routine sets. The SUB type produces an array of orders in one subprogram call for each function. The FN type produces functions for the first two orders or the first order and its derivative. Three sample driver programs and a graphics program for real subprogram functions are included.

The manual and disk with compiled routines are available for $495.
Contact Image Acoustics, Inc., P.O. Box 6, North Marshfield, MA 02059; (617) 834-6376.

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SPEEDEDIT, SPEEDDOC Enhanced

The SPEEDEDIT full screen editor and SPEEDDOC word processing system packages from Bradford Business Systems have been updated.

The SPEEDEDIT system has added a feature for revision marking that adds a revision stamp to each line of text that has been modified. The revision stamp indicates the type of modification and the date on which the modification was made.

SPEEDEDIT has the ability to list, either on the system printer or a slave printer, the changes that had been made since a given date. This facility augments the existing revision-tracking capabilities of SPEEDEDIT.

The SPEEDDOC system has been enhanced to support HP's LaserJet Plus printer with font downloading and switching capabilities in addition to simple graphics such as lines, boxes and shading.
Contact Bradford Business Systems, 25301 Cabot Rd., Suite 201, Laguna Hills, CA 92653; (714) 859-4428.

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MONTEST-AD8 Tests All PC Monitors

MONTEST-AD8 from Network Technologies Inc. is the first video generator that tests the full range of PC monitors from monochrome to Multisync. It is intended as a universal generator for graphics, CAD/CAM and desktop publishing software engineers.

Using an 8 MHz dot clock, the MONTEST-AD8 generates four test patterns with eight horizontal scan frequencies from 15.7 KHz to 31.5 KHz. Each pattern — full raster, color bars, cross-hatch and windows — is generated on three different output connectors — BNC, 9-pin D analog or 9-pin D digital. This allows the use of any digital monitor or analog (PGA) and combination-type monitors such as multisync. This is the first generator of its kind that directly tests the operation of a multisync monitor, using the 9-pin analog output connector for calibration.

Because of the flexibility offered by the MONTEST-AD8, many HP, IBM and AT&T products and their equivalents can be used. The MONTEST-AD8 is battery-

powered for field use and can be line-powered using an accompanying AC adapter. It is priced at $875. A one-year warranty is standard.

Contact Network Technologies Inc., 19145 Elizabeth St., Aurora, OH 44202; (800) RGB-TECH or (216) 543-1646.

Enter 915 on reader card

Analog Introduces Design Tool Kit

Analog Design Tools has announced a special set of design tools for the Analog Workbench that focuses on the simulation and analysis needs of designers working on power supplies and other power circuits.

The Power Design Tool kit, used in conjunction with the Analog Workbench is the first major CAE package to offer the combination of an accurate, nonlinear model of transformer core magnetics with libraries of magnetic core materials and semiconductor power devices.

The Power Design Module, Basic Device Library, Smoke Alarm, Statistics and Parametric Plotting Module are included in the Power Design Tool Kit.

The price of the Power Design Tool Kit, offered as an option to the Analog Workbench, is $18,000 for the PC Workbench version and $33,000 for the Analog Workbench version.

Contact Analog Design Tools, 1080 East Arques Ave., Sunnyvale, CA 94086; (800) ANALOG-4 or (408) 737-7300.

Enter 920 on reader card

A New Generation Of FERRUPS Power Systems

A new generation of FERRUPS Uninterruptible Power Systems (UPS) has been introduced by Best Power Technology Inc., featuring Pulse Width Modulation (PWM), internal bypass switches and the UL Listing Mark.

Standard equipment on all FERRUPS in the 7.5 to 15KVA range is a proprietary-design inverter using hybrid Pulse Width Modulated (PWM) Ferroresonant technology circuitry.

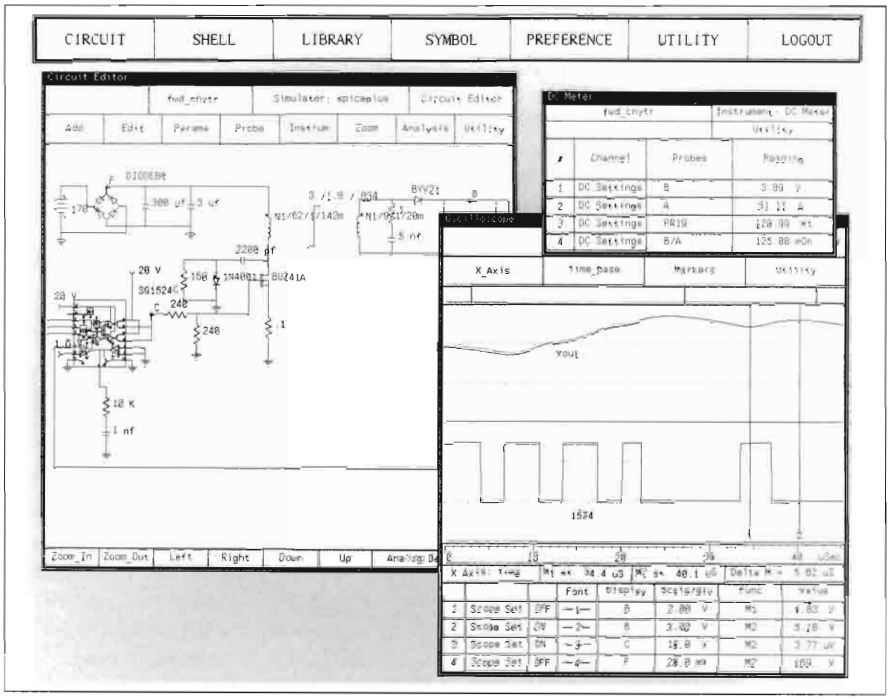
The second major enhancement is the standard internal bypass switch, which eliminates the need for a separate and costly breaker box in a facility's electrical system to cut FERRUPS out of the system for testing or service.

In addition, UL has granted use of its Listing Mark on the top-of-the-line FERRUPS in the 7.5 to 15KVA range.

All Best FERRUPS from the 250 VA Micro-FERRUPS to the 15KVA models have UL approval.

Contact Best Power Technology, Inc., P.O. Box 280, Necedah, WI 54646; (800) 356-5794 or (608) 565-7200 (in Wisconsin).

Enter 912 on reader card



Analog Design Tools' Power Design Tool Kit enables designers to accurately simulate entire power supplies.

MicroPlot 80 HP-IB: Intelligent HP-IB Buffer

Intelligent Interfaces, Inc. announced its recent shipment of the MicroPlot 80 Intelligent HP-IB (IEEE-488) buffer.

The MicroPlot 80 is designed for the user whose primary applications are large printouts, such as multiple forms or source code listings, or small- to intermediate-size plots, such as graphs or small CAD/CAE plots.

The MicroPlot 80 installs between a Hewlett-Packard or other IEEE-488-equipped computer and printer or plotter. It accepts data from the computer at 20,000 bps, stores the data and sends it to a printer or plotter at a speed determined by the printing/plotting speed of the peripheral. The result is a 500 to 2,000 percent, or greater, time savings during output operations.

Features of the MicroPlot 80 include Pause, Multiple Copy, Purge, Printer/Plotter Mode, Plot Queuing (using Intelligent Interfaces' standard end-of-plot sequence), Self-Test and Front Panel Status Indicators.

Contact Intelligent Interfaces Inc., P.O. Box 1486, Stone Mountain, GA 30086-1486; (404) 381-9891.

Enter 914 on reader card

Infocentre Adds To Speedware Product Line

SpeedNet, a real-time PC integration facility is Infocentre's newest addition to the Speedware Environment of products.

The SpeedNet software resides on the HP mini/mainframe computer and controls the real-time data access or transfer between the two computers via one or a number of ports. The layers of SpeedNet include a database server, networking, user control and line/port control.

SpeedNet uses the full processing power of the PC to reduce the workload on the HP mini/mainframe. The microcomputer handles all of the processing of the application such as data editing, screen compilations, reporting and computations. The HP 3000 is used only to access databases that remain stored on its disk drives due to their size, the necessity for centralized access and security or other concerns. All other data resides locally on the PC.

SpeedNet also allows access to databases in a network of mini/mainframe systems using DS or similar products. For example, a user could access financial data from one HP

3000 and then use engineering data residing on another main computer that's linked to the first.

SpeedNet contributes significantly to ensure 100 percent uptime by allowing specific remote information to be downloaded automatically to the local PC on a predetermined schedule. If the HP 3000 becomes inaccessible during the hour or shift, the application can run completely standalone on the PC.

Contact Infocentre, 7420 Airport Rd., Mississauga, Ontario, Canada; (416) 678-1841.

Enter 916 on reader card

EMC Expands Falcon Capacity Range

EMC Corporation recently announced Falcon 5000 and Falcon 8000 Series disk drive subsystems for HP 3000 computer systems. These subsystems are the newest additions to the Falcon Series disk subsystem product line, featuring higher performance Winchester disk drives of varying capacities to meet a variety of mass storage needs.

The Falcon 5000 ($19,500) provides 625 MB of mass storage capacity, and the Falcon 8000 ($33,500) 1.25 GB of storage. Now Falcon Series subsystems allow users to configure up to 3.75 GB in a single cabinet, and include EMC's intelligent disk cache processing card with 4 MB of on-board cache as a standard feature.

The Falcon Series product line now includes four models: 406 MB, 625 MB, 812 MB and 1.25 GB. Like Falcon I and Falcon II subsystems, each Falcon 5000 and 8000 subsystem features EMC's intelligent disk cache processing card with 4 MB of high-speed cache. This controller card executes EMC's caching algorithm.

The Falcon has an average seek time of 15ms and a data transfer rate of 2.46 MB/sec. This is the highest transfer rate currently available for HP 3000 systems. This high transfer rate also allows Falcon subsystems to take advantage of future improvements HP might make in its bus.

All Falcon subsystems are 100 percent compatible with the MPE operating system and HP diagnostic procedures. Each subsystem undergoes stringent test and burn-in procedures prior to certification for shipment by EMC. EMC offers a variety of responsive maintenance programs to insure immediate response in the unlikely event of a disk problem.

Contact EMC Corporation, Hopkinton, MA 01748-9103; (800) 222-EMC2; in MA, (617) 435-2541. In Canada, contact EMC Corp., 100 Lombard Street, Toronto, Ontario, M5C 1M3; (416) 368-4726.

Enter 926 on reader card

SmartNet 5250/T Plus Makes Async Connection

PCI, Inc., announces SmartNet 5250/T Plus, a second generation protocol converter connecting up to seven asynchronous terminals, PCs, printers and graphic devices to the twinax port of IBM Systems 34, 36 and 38 minicomputers. It offers extended capability that's compatible with PC Support/36 and 38 for virtual disk and PC file transfer.

Transparent to the host and user, SmartNet 5250/T Plus supports more than 45 common asynchronous terminal types. In addition to more than 45 menu-selectable display types supported, other ASCII displays can be attached using the 5250/T Plus feature, "User Defined Display." Up to seven different tables supporting other ASCII display device types can be configured in the 5250/T. The UDD feature is also used to store redefinitions of the keyboard mappings for the menu-selectable displays.

The 5250/T supports more than 20 printer profiles, allowing users to connect any ASCII printer to a S/3X host.

SmartNet 5250/T is priced at $2,595 in the U.S.

Contact PCI, Inc., 26630 Agoura Rd., Calabasas, CA 91302-1988; (818) 880-5704.

Enter 906 on reader card

SmartNet 5250/T Plus protocol converter from PCI, Inc.

Dispatch Systems From SystemsExpress

SystemsExpress announced the release of Dispatching Systems for police and fire departments of small- and medium-sized cities. The IMAGE/3000-based systems give subsecond response time to queries on chains of callers, locations, vehicle availabilities and crew status.

The systems can run on HP Micro 3000 computers or older systems costing a minimum of $15,000. Turnkey systems with the necessary software can be enhanced to systems serving up to 200 or more stations at prices starting at $17,400.

Also available from SystemsExpress are a tape library system, public library book tracking system and an order-entry/accounts receivable/inventory management system.

The dispatching and library systems are menu-driven and provide chain, serial, hashed and generic search. They are priced at $1,200 each. The Order Entry system is priced at $2,400.

All the systems can be customized through use of :DBEXPRESS and optional COBOL source for each module are available at extra cost.

Contact SystemsExpress, 15015 Ventura Blvd., Sherman Oaks, CA 91403; (818) 784-6966.

Enter 919 on reader card

Project 4.0 Offers Major Upgrade

Microsoft Corporation announces a major update to its Project Version 4.0 project management package. Enhanced with plotter support, custom reports, resource leveling, new activity relationships, data filtering and more, the Microsoft Project Version 4.0 offers a complete set of project management features that are easy to use.

Microsoft Project 4.0 now supports the full line of Hewlett-Packard plotters, Houston Instruments plotters and all paper sizes from A to E.

Plotter support adds the ability to generate presentation-quality output needed for important reports.

For first-time users, a Computer-Based Training (CBT) with over 30 lessons is included. This CBT disk teaches both the concepts of project management and specific features of Microsoft Project.

Microsoft Project Version 4.0 is available now and is compatible with IBM PCs, IBM Personal System/2 Series or any of over 100 computers running MS-DOS. Minimum system requirements include DOS 2.0 or higher, 256K memory and two floppy disk drives, or one floppy disk and hard drive. Suggested retail price is $495.

Contact Microsoft Corporation, 16011 NE 36th Way, Box 97017, Redmond, WA 98073-9717; (206) 882-8080; Telex 328945; Fax (206) 883-8101.

Enter 921 on reader card

GUS/3000 Report Writer Available For HP 3000

Comprehensive Systems, Inc. (CSI) announces GUS, a friendly end-user report writer that's available for HP 3000s utilizing IMAGE, KSAM and MPE file structures. GUS/3000 is capable of selecting fields from a displayed list, subtotals, sorts, complex record selections, formulas and string manipulations. With GUS, the end user simply enters a selection number, presses a function key or occasionally enters constants to complete his requests.

The end user can execute GUS reports interactively, stream the report or store a GUS report in a report master. All reports first can be previewed at the terminal, with scrolling left/right, up/down capabilities, before printing or saving to an ASCII, binary or Lotus 1-2-3 disk file. For summary reports, the end user has the option to view either or both the summary and detail reports, then decide to print either one or

both of them.
Contact Comprehensive Systems, Inc., 720 King Georges Rd., Fords, NJ 08863; (201) 225-9670.

Enter 917 on reader card

STARLAN To STARLAN: Bridging The Gap

CrossComm Corporation recently announced the first STARLAN to STARLAN bridge. The new device, the 487-SS, interconnects two or more STARLAN networks expanding the capability of this network standard. This product complements other bridge products previously released by CrossComm.

The high performance bridge products are produced through the use of a proprietary ASIC containing a new bridging algorithm. Coupled with an 80186 processor, the 487-SS is designed around the IBM PC bus. The bridge is self-contained and requires only that network connections and power be applied for operation. All configuration, diagnostics and operating functions are provided automatically at power up.

Because of the proprietary bridging technique, the 487-SS has a throughput of 1,500 data packets per second, the highest packet generation rate of STARLAN networks. The 487-SS provides automatic packet filtering and contains battery backup address tables to provide reliability during power outages.
Contact CrossComm Corporation, P.O. Box 403, West Boylston, MA 01583; (617) 835-4226.

Enter 922 On Reader Card

New 3000 Show In London

Forum 3000, the new London-based show, will bring together vendors in the HP 3000 marketplace and users of the HP 3000 system November 4-5 from 10 a.m. to 8 p.m. The Novatel Exhibition Centre Hammersmith London will host the exhibition dedicated to face-to-face contact between the buyers and vendors.

Companies exhibiting will include The Perwill Group, Prolog Systems, System Software, Training Plus, Interex, EMC, Wick Hill Associates, Datasphere Systems, IMX Systems Corporation, Proactive Systems, Grampian Computer Facilities, Sydes UK, Affirm, Computer Engineering Services, Nike Computers, Intech, Info Support, Computer Disaster Recovery, IMX, Enline, Fletcher Lawson and Datasoft International. A wide range of software and peripheral products and services will be on display.
Contact the organizers, Sovereign Exhibition Management, Park House, 55 Park Lane, Carshalton, Surrey, SM5 3EE. Telephone 01-773-3751.

Enter 923 on reader card

MCBA Premiers Manufacturing Packages

MCBA, Inc.'s first two manufacturing packages in its Manufacturing System for the HP 3000 series debuted at the Interex conference, September 22-24, in Las Vegas.

The new manufacturing modules, Job Costing (J/C) and Labor Performance (L/P),

integrate fully with MCBA's existing accounting and distribution modules for the HP 3000, and when combined with other packages under development, will make up a powerful closed-loop Manufacturing Resource Planning (MRP II) system, suitable for both jobs shops and repetitive manufacturers.

J/C provides accurate cost reporting and comprehensive variance analysis for labor, material and subcontracting. The package allows cost analysis by job, department or work center. L/P tracks employee production, thereby allowing management to identify productivity problems and improve utilization of labor resources. The package allows for entry of clock card data, either manually or from a time and attendance data capture terminal.

Prices for Job Costing and Labor Performance range from $5,000 to $7,500 per package, depending on which HP 3000 computer is selected.

Contact MCBA, 425 W. Broadway, Glendale, CA 91204-1269; (818) 242-9600; Telex: 194188.

Enter 925 on reader card

LA Users Group Hosts HP 3000 Seminar

The Los Angeles Users Group is conducting a seminar entitled, "Effective HP 3000 System Management Techniques" to be held November 10, 1987, from 8:30 a.m. to 5:30 p.m. at the St. Petersburg restaurant in Los Angeles.

The seminar is open to system managers and supervisors, database administrators and programmer/analysts. The guest speaker is Gilles Schipper, a 10-year expert in the HP 3000 field. Schipper's background includes four years as a Systems Engineer and Performance Specialist with Hewlett-Packard in Toronto, Canada. He also has spent the last four years as an independent consultant, offering system management support services and software products to the HP 3000 community.

The registration fee for the seminar is $250 in the U.S. Make check payable to VESOFT indicating the names, addresses and phone numbers of all attendees. Purchase orders should indicate "TERMS: 10 days." Attendees will receive a binder package, gourmet lunch and coffee breaks throughout the day.

Contact VESOFT, Inc., 1135 South Beverly Dr., Los Angeles, CA 90036; (213) 282-0420.

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CORRECTION

In "Starring HP LANs," Vol. 1, No. 3, the author refers to "Advanced Mail" and "Disk Manager" on page 33. The correct product names are *AdvanceMail* and *DeskManager*.

Remember how computers remembered? Mercury delay lines? Punched cards with 90 columns and round holes? Hand-wired magnetic cores? In case your memory needs refreshing, The Computer Museum would like to share its memories with you.

The Computer Museum Memory Poster
We have created a limited edition, 20"x32" poster of the picture shown below. Printed in full-color, it includes an identification key to help you recall the memories you've forgotten. To get your poster, along with an information kit on museum membership, exhibits and activities, send a tax-deductible contribution of $25 or more to:
Memory Poster, The Computer Museum,
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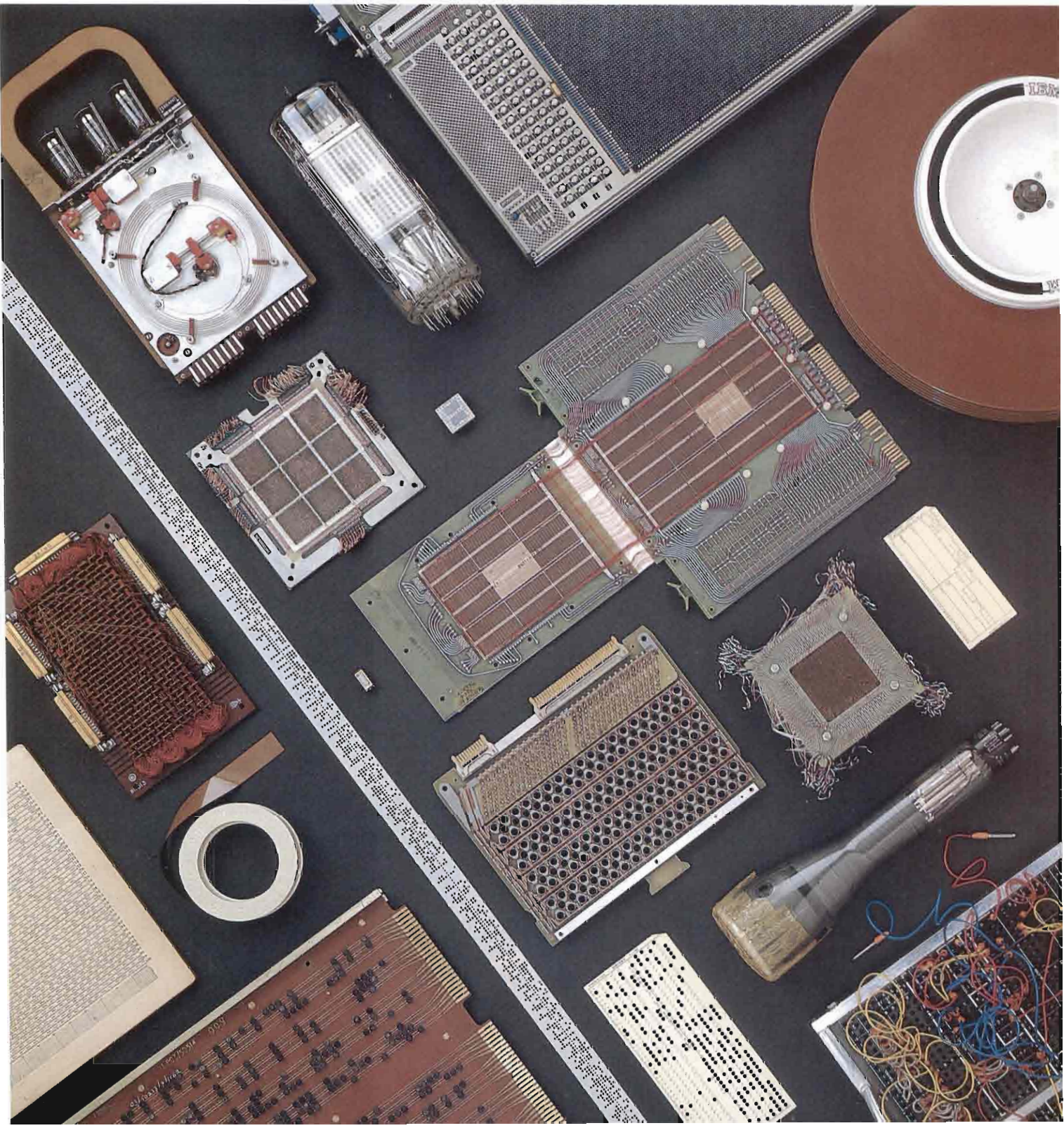

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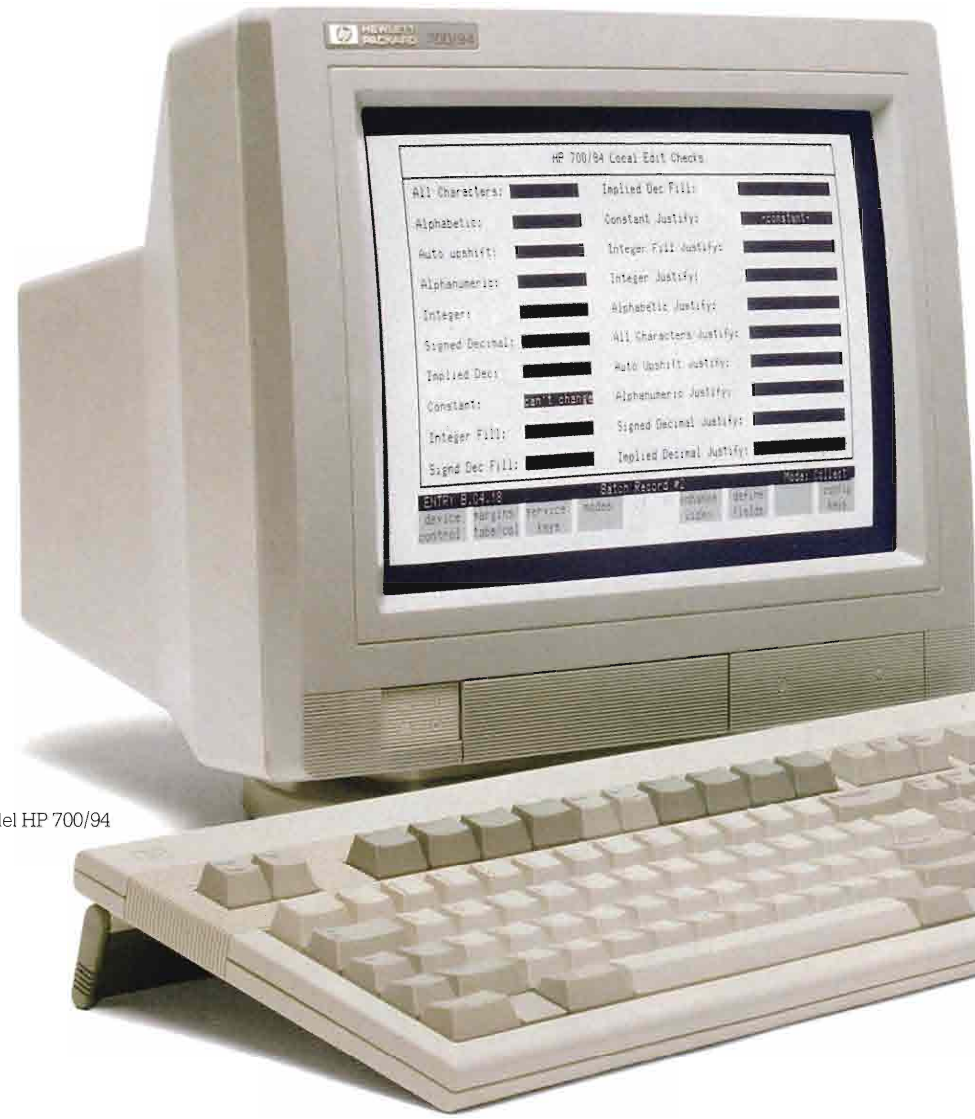

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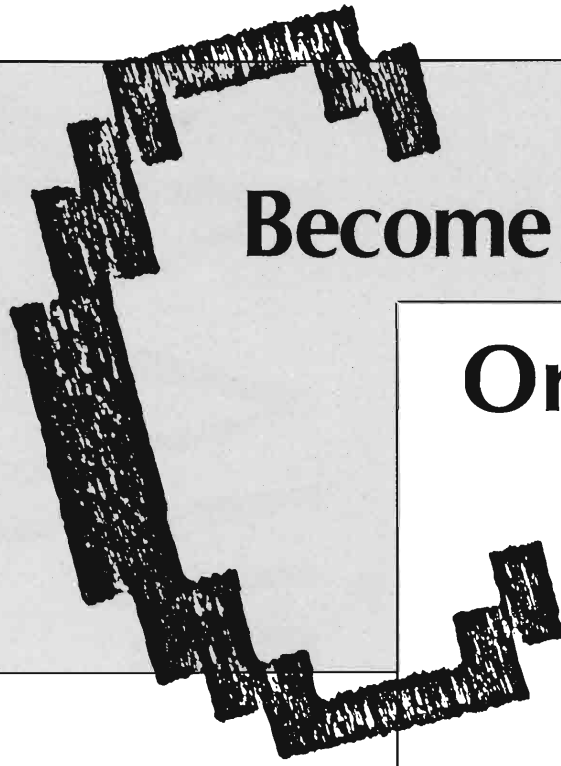

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Conference Notes

The week of September 21 was a busy one for the world of Hewlett-Packard. There were two simultaneous events: the Interex Conference in Las Vegas and the Technical System Sector's offering of a mountain rendezvous in Steamboat Springs, Colorado, a gathering for the technical OEM, VAR and VAB community to share their experiences and marketing plans.

Perhaps the most weighty item discussed in either forum was the fact that commercial UNIX soon will be offered by the commercial side of the house. This will not be an attempt to replace MPE, but rather to recognize the growing usefulness of UNIX as a multitasking platform for commercial software.

There are a number of fine "user interfaces" available now for UNIX that take the user above the gibberish level of the native command interface. Also, with the emerging UNIX standards, wonderful tools are becoming available for true mainstream development. These tools include X Windows and all the networking and file sharing facilities that make "clusters" of diskless workstations a reality.

THE MOST IMPRESSIVE thing about the Interex show was the show itself. The level of activity and the strength and number of attendees were an order of magnitude greater than anything we have seen in the HP world to date.

The presence of a 950 running XL helped firm things up quite a bit. The 950 had just begun shipment (ahead of its expected date). A market like this gains a critical mass and then accelerates on its own.

Both shows featured a fully "fleshed-out" Vectra line. Most impressive were the new 16 and 20 MHz 386-based engines. The pricing and performance of these high-end workstations force some difficult choices when you compare them to the low-end 9000 series workstations.

MEANWHILE, BACK in the mountains, Dick Watts went to great lengths to inform all hands that HP is not about to dump the Motorola 68000 series for a micro Spectrum. In fact, he said that HP is actively planning an offering with the new 68030 chip set that is in the wings. As long as Motorola is advancing the state of the art with the 68000 set, HP will provide workstations based on that architecture. My take on that is that a cost-effective micro Spectrum chip set is still more than a year out, at least in workstation configurations.

The real message is that HP is now a "one NETWORK" company. There is evidence of a huge effort to fill in the remaining blanks in the networking offering. Once you can "cluster" workstations with file servers and truly distribute the computing power while providing "seamless" file transfer, mail and remote access, you are well on your way.

Networking and commercial UNIX will go a long way toward tearing down the artificial boundary that exists in HP today between the commercial and technical. In reality, 850s are 950s. Workstations have a large place in the commercial environment and should not be excluded from the focus of the commercial user. Everyone needs to network. Seamless is a term that we hear being applied to networking more and more. We really need to hear it applied to the Hewlett-Packard company as a whole.

We expect more interesting news and interested attendees at the technical Interex Conference in san Jose, October 18-22. Please be sure to stop by our booth (#146) and give us your input about *HP PROFESSIONAL* and the market.

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[CALENDAR]

[OCTOBER]

18-22: Interex Technical Conference, Red Lion Inn, San Jose, CA. Contact Interex; (408) 738-4848.

22: GHRUG (Greater Houston Regional Users Group), Hobby Hilton, Houston, TX. Contact Phil Curry; (713) 331-6111, ext. 255.

22-23: MARUG (North/South Carolina, Virginia). Fall Quarterly Meeting, Ocean Dunes Hotel, Myrtle Beach, NC. Conference theme centers on financial management systems. Contact Stephen Day; (804) 569-4857.

27-29: UNIX EXPO — The UNIX Operating System Exposition and Conference, Jacob K. Javits Convention Center, New York, NY. Contact National Expositions Co. Inc.; (212) 391-0111.

28-30: The World Conference On Electronic Printing & Publishing, Lisner Auditorium, George Washington University, 21st & H Streets NW, Washington, DC. Contact Henry B. Freeman; (703) 739-5510.

[NOVEMBER]

2-4: SuperGroup Users Conference-East, Washington Hilton, Washington, DC. Contact The Producers, Riverwalk, 360 Merrimack St., Lawrence, MA 01843; (617) 683-5622.

4-5: Forum 3000, Novatel Exhibition Centre, Hammersmith, London, 10:00 a.m. to 8:00 p.m. Contact Soverign Exhibition Management, Park House, 55 Park Lane, Carshalton, Surrey, SM5 3EE; telephone 01-773-3751.

9-12: NCGA's Mapping & Geographic Information Systems '87, The San Diego Princess Hotel, San Diego, CA. Event covers entire spectrum of the field from automated mapping/facilities management (AM/FM), to geographic information systems (GIS) to energy mapping. Contact Bob Cramblitt; (703) 698-9600.

10: Los Angeles Users Group seminar, "Effective HP 3000 System Management Techniques," 8:30 a.m. to 5:30 p.m., St. Petersburg Restaurant, Los Angeles. Registration fee $250. Contact VESOFT, Inc., 1135 S. Beverly Dr., Los Angeles, CA 90036; (213) 282-0420.

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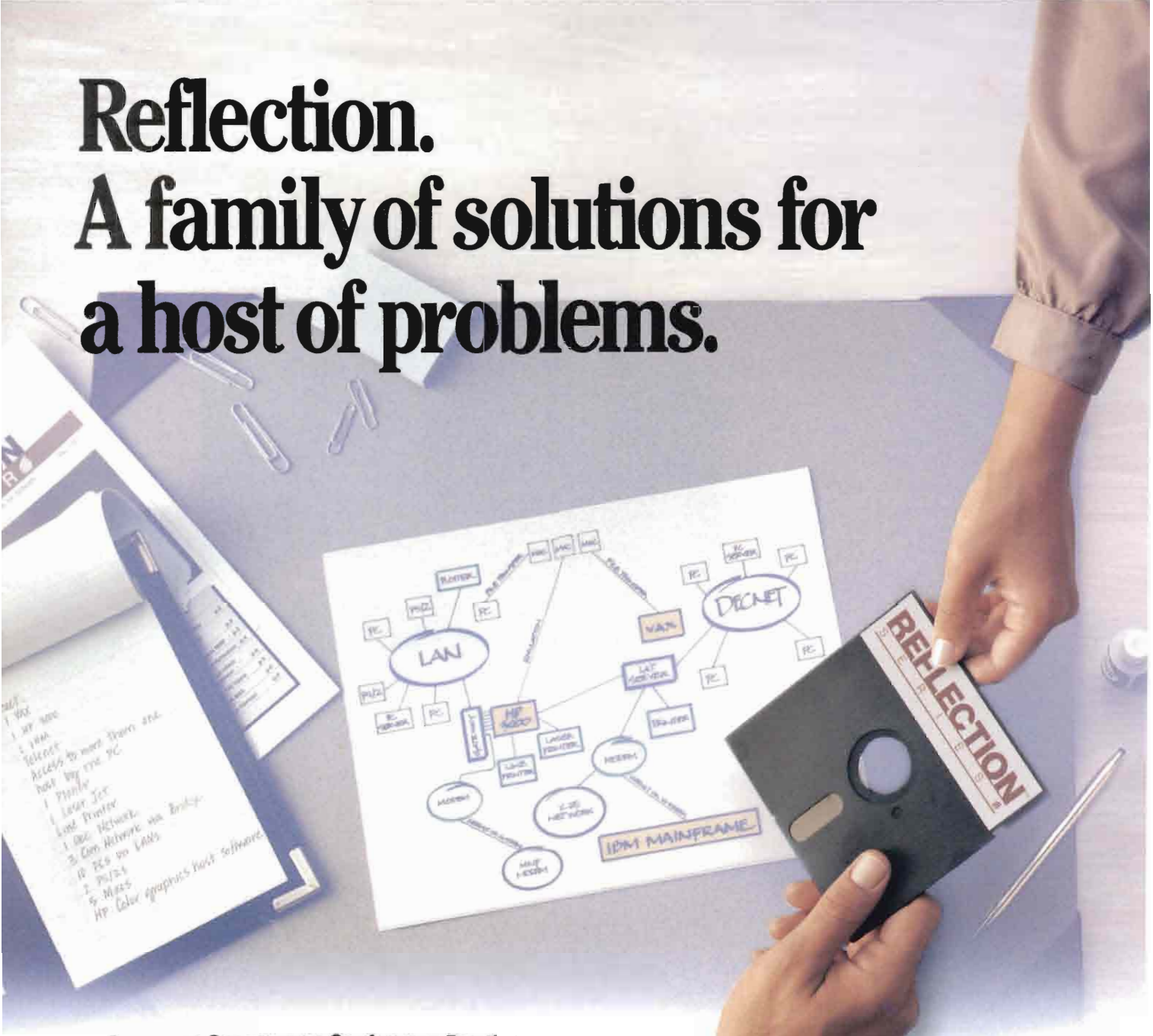

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