

SCANNING TECHNOLOGY



Introduction

A scanner works somewhat like a copy machine, except that it translates an image or text into digital data and stores that data on the system disc. The user can then electronically display and edit the image or text, print it, or bring it into a desktop publishing or word-processing package. (For a technical description of the scanning process, please refer to Appendix A.)

First introduced in the early 1980's, desktop scanners were strictly image or text-entry devices. The ScanJet Plus has excellent image input flexibility to allow users to scan hardcopy information for a variety of uses. High-quality images can be imported into third-party packages such as Aldus PageMaker® and Ventura Publisher® and sent to a variety of output devices from desktop printers to typesetters. Other third-party packages enable users to scan text and convert it to ASCII for archival or editing purposes. ScanJet Plus can also be used for tasks such as PC FAX and convenience copying using third party software and hardware packages. In the future, scanners will become an increasingly important productivity tool.

Image Scanning

ScanJet Plus uses three image-processing modes: **Binary**, **Grayscale**, and **Dithering**. (In the ScanJet Plus - Macintosh software, **Line-Art** and **Halftone** are used in place of Binary and Dithering.)

Binary (Line-Art)

Binary scanning is for pure black and white drawings or line-art; ScanJet Plus recognizes either black or white data and then returns that information to the computer.

Grayscale

In publishing terms, grayscale is a measurement of the gray data in a portion of a photograph or picture. A black and white photograph contains continuous shades of gray, with some areas lighter or darker than others.

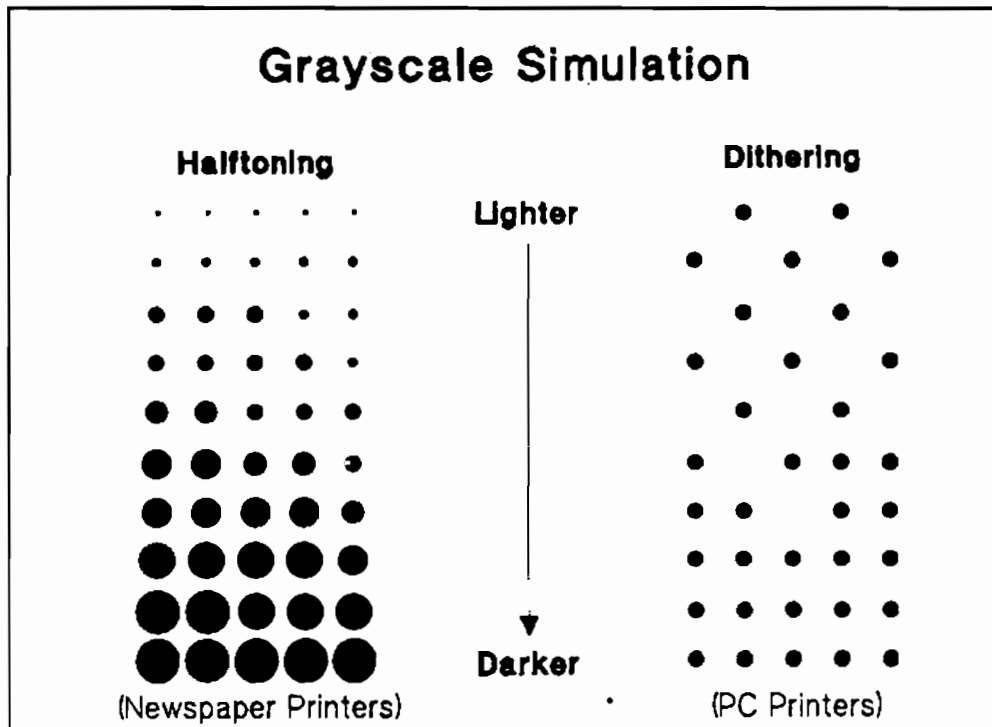
ScanJet Plus can scan in Grayscale mode and read up to 256 levels of gray. Today's desktop printers and most computer displays, however, support only black and white. So why scan in Grayscale mode? Scanning in Grayscale allows ScanJet Plus to output to more advanced printers and Linotype typesetting machines. Grayscale scanning will prove an advantage when desktop printers support grayscale. And some applications, like PageMaker, can import grayscale images for output to typesetters. Software applications that can utilize grayscale information also have the capability to perform image manipulation such as scaling, contrast, and intensity variation.

Dithering and Halftoning

If you look closely at a newspaper or laser-printed image, you'll notice that it's composed of a series of closely-spaced black dots (pixels) and does not have continuous gray tones like a photograph.

Halftoning, the process used by newspapers and magazines, simulates grayscale by varying the size of pixels on a fixed grid pattern.

Dithering, on the other hand, varies the number of pixels to simulate grayscale, since today's printers cannot vary the size of pixels. The following figure illustrates the difference between the two image-processing techniques:



ScanJet Plus's PC imaging software, *Scanning Gallery Plus*, offers a choice of four dithering patterns: Fattening, Coarse Fattening, Bayer, and Vertical Line Dither. Generally, the best pattern to use is Coarse Fattening, as it provides good tonal quality and photocopies well. The other dither patterns have different purposes and are documented in the *Scanning Gallery Plus User's Guide*. ScanJet Plus's dithering patterns and intensity levels are matched to the LaserJet series II.

DeskScan, the image-scanning desk accessory for the Macintosh, offers six dithering (called "half-tone" in DeskScan) patterns as well: Normal, Fine, Extra Fine, Horizontal, Vertical Line, and Diffusion. The *Desk Gallery Plus User's Guide* offers guidelines on using these patterns.

SCANNER MARKET



Scanner Market Trends

The monochrome (black and white) scanner market is still in its infancy, but phenomenal growth is expected through 1992. According to Dataquest projections, the estimated market size in 1992 is 445,300 units, or \$801.54 million. Growth rate is expected to be 450% (112.5% avg. annual growth), for unit shipments between 1986 and 1992. Revenue growth during that period is expected to be 304% (76% annual growth through 1992).

As costs for scanner hardware and software rapidly decline, technical capabilities have increased to include 256 levels of gray, 300 dpi, and typeset support for low-cost OCR. Office applications such as fax, personal copying, and forms-generation and processing are also forcing market growth.

HP has been the scanner market leader since the introduction of the ScanJet in 1987. According to a recent Dataquest survey of 300 DTP (Desktop Publishing) users, the overall market leaders were: HP (18%), Dest (14%), Abaton (11%), Datacopy (8%), and Microtek (8%). Of PC-based users, HP leads the market at 37%, followed by Dest (8%), Datacopy (6%), IBM (6%), and Microtek (5%). A recent Gallup poll commissioned by Computer Reseller News shows HP as the 1988 leader as well. Of the 300 Fortune 1000 MISs polled, 56% had purchased scanners; of those, 31% had purchased HP ScanJets. The closest competitors were Dest at 15%, and IBM at 11%; all others were less than 2%. And even better news: 44% planned on purchasing scanners in 1988! HP ScanJet Plus, In-foworld's 1988 Graphics Product of the Year, will be the contender for first place in 1989.

ScanJet Trends

The first scanner customers were innovative types — avid readers of personal computer magazines and risk-takers excited by the new, low-cost scanning technologies and applications. We now have to tap the rest of the market, providing timely and real solutions for the entire office market, from image and text-processing applications to fax, personal copying, and forms-processing. We also have to hold market share, offering the array of interfaces important for competitive parity and innovative, easy-to-use software.

Sales reps must be able to convince the less adventurous customers that ScanJet Plus offers them new and creative possibilities, which demands both a sensitive and thorough knowledge of a quickly changing and expanding market as well as practical expertise in demonstrating ScanJet Plus and its applications.

Many different kinds of industries bought ScanJet, which tells us that the potential for growth is great. For more details on who our current customers are, see Appendix C.

ScanJet Plus in Low-End Applications

This end of the market has great potential because of its size and because of inroads already made by LaserJets. ScanJet is the perfect companion to the LaserJet in this market and is well-suited to the office for both OCR and simple merged text and graphic applications. And ScanJet Plus' facsimile capabilities make it a multi-use tool in every office.

OCR

OCR is the tool for those customers who need to find a substitute for the time- and labor-intensive task of re-typing printed material into a computer for:

Editorial changes — to make changes in style, format, and text; in short, to edit with a word-processor.

Document archiving — to archive files electronically, to allow for word searches and eliminate storage space.

Electronic distribution — to send a document electronically, with or without editing.

Data conversion — to move data from one system to another, where compatibility or feasibility is a problem.

Simple Merged Text and Graphics

For those customers who want a low-end graphics solution without the sophistication (and associated training) of a DTP package, ScanJet Plus works with third-party software such as Polaris' ScanMerge®. A scanning menu drops down in the word-processing screen, allowing the user to import scanned images directly into her documents.

WordPerfect® and other popular word-processing software packages are defining a new market called "word-publishing," where the power and ease-of-use of word-processing and desktop publishing software are combined. WordPerfect 5.0, for example, can import scanned images directly. Look for real growth in this market in 1989.

All word-processing customers are potential ScanJet Plus users. More and more, messages must compete for audiences: enhancing those messages with images or making the user more productive with OCR becomes a real advantage.

Fax

ScanJet Plus can be used as a facsimile machine with third-party boards and software. Currently, ScanJet Plus supports four packages that range in cost and capabilities (see Software Guide).

HP Computer Museum
www.hpmuseum.net

For research and education purposes only.

Some Potential High-End ScanJet Plus Customers

Advertising Agencies — brochures, proposals, preliminary layouts (all publications)

Commercial Construction Firms, Architecture/Engineering Firms — layouts, proposals, reports

Commercial Typesetting Shops — all publications

Corporate Publishers — technical documentation, business forms, sales literature, financial reports, proposals, reports, presentations (all publications)

Graphic Design Studios — all publications

Institutions (Educational/Non-Profit/Governmental/Religious) — promotional and fund-raising literature, bulletins, newsletters

Medical/Scientific Professionals — journals, proposals, reports

Print Shops — all publications

Professional Publishers — magazines, books, newsletters, catalogs, directories, small/mid-sized newspapers

Real Estate Companies — listings, invitations, newsletters

Restaurants — menus

Service Bureaus — mailers, catalogs, directories

Small Retailers — newsletters, advertising

Success Stories

A college publishes a weekly calendar/newsletter using ScanJet and PageMaker.

A medical research firm incorporates scanned line-art into slides and proposals.

The Hewlett-Packard Greeley Hardcopy documentation group imports scanned line-art into review and final copies of user and service manuals.

A designer in an advertising agency uses ScanJet for both preliminary and final graphics in his award-winning brochures.

Some Potential Low-End ScanJet Plus Customers

Corporate Publishing (low-end) — newsletters, memos, proposals, reports

Government — records, contracts, reports

Insurance Companies — records, contracts

Law Offices — briefs, records, contracts

Medical Profession — journals, records

Personnel Departments — records, newsletters, contracts

Print Shops — all publications

Title Companies — records, contracts

Success Stories

A department of Criminal Justice OCRs documents from legal binders and police reports and transports them via HP 3000s to other users on the system for modification and access.

A copy shop uses OCR to create professional-quality dissertations and papers for local university students and faculty.

ScanJet Plus in High-End Applications

ScanJet Plus is also a professional tool for the customer who wants to incorporate graphics into her documents. Right now, ScanJet is selling quite well in the DTP market. ScanJet Plus can also succeed in the professional design world.

Any customer who uses or buys desktop publishing software such as PageMaker® or Ventura Publisher® (the two largest DTP sellers) is a candidate for a ScanJet Plus.

PC-CAD customers can use ScanJet Plus with ScanPro®, a raster-to-vector conversion utility. (See the Software Guide for more information.)

Designers are also finding out that scanners can increase their productivity. ScanJet Plus is not limited to 300-dpi printers; scanning grayscale images and sending them to typesetters allows the designer to get quality results without the expense and time of outside services. Drafting layouts with publishing packages and ScanJet Plus can also save time and money.

Actual Users of ScanJet Plus for Image and OCR

Image

Title:

Assistant Manager

Computer-Generated Documents: Catalogs, newsletters, brochures, price lists with images

Uses scanner for images from: Product pictures, drawings of designs, line art

Stated Value:

Cost savings, timeliness, flexibility

Text

Title:

Researcher

Computer-Generated Documents: Newsletters, reports, training manuals, presentations

Uses OCR for inputs from:

Previously published reports, journal articles, books,
and photocopies

Stated Value:

Replacement for a secretary, timeliness, convenience

SCANJET PLUS POSITIONING



The HP ScanJet Plus Desktop Scanner advances the standards of excellence by providing easy capture of high quality images and automated entry at a breakthrough price.

ScanJet Plus is supported on the IBM AT/XT (an compatibles), the Personal System 2 models 30, 50, 60, 70 and 80, and the Macintosh Se, Plus, and II.

ScanJet Plus' flatbed allows users to choose images from any source. Users can scan images from books, bound documents, and small photographs. An optional, 20-page automatic document feeder allows scanning of multi-page documents and is a perfect companion to ScanJet Plus' OCR solutions.

Three image scanning mes, Binary (Line-Art), Dithering, and Grayscale, allow users to capture any type of graphic, be it line-art or a photograph. User-selectable resolution from 12 to 1500 dpi makes it easy to match input to printer capability. Images can be reduced or enlarged from 2 to 5000% of their original size (depending on the selected resolution) with the built-in scaling feature. And ScanJet Plus scales images before the Final Scan, preventing the distortion that can occur when images are sized later in desktop publishing packages.

Scanning Gallery Plus, ScanJet Plus' PC imaging software, is a Windows-based, easy-to-learn and use package designed to provide users with full scanning functionality and basic editing tools such as cutting, pasting, and cropping. Desk Gallery Plus, ScanJet Plus' Macintosh imaging software, is a complete scanning and editing package combining HP's DeskScan and Zedcor's DeskPaint. DeskScan and DeskPaint can be used as desk accessories or applications. The innovative desk accessory design allows users to access scanning and editing functions within their applications. DeskPaint is a complete editing package with MacPaint-like editing and patining tools.

HP currently distributes one OCR solution for the PC. TrueScan from Calera Corporation is a high-end OCR solution for the PC, and is targeted to professionals and office personnel who regularly need to bring printed documents into their applications. TrueScan offers customers the ability to enter the widest range of common office documents into their PC. It recognizes most typewritten, typeset, laser printed, and dot matrix output, and does not require Windows or a mouse.

OmniPage, ScanJet Plus' OCR listed product for the Macintosh, also converts images of letters, numbers, and symbols into ASCII for word processor compatibility. In addition to recognizing virtually any font type in sizes of 8 to 72 points, OmniPage has page recognition features which allow the program to interpret the page layout. This reduces re-typing chores and allows for greater flexibility in the type of document to be read.

Third-party software support is another feature which has helped HP gain scanner market share. The most popular DTP and special application packages in both the IBM and Macintosh worlds support ScanJet Plus, either directly or through file exchange. ScanJet Plus is also supported on a range of third-party facsimile solutions.

Best of all, ScanJet Plus' total package price, including all accessories and software, is considerably less than most competitors'.

How to Sell More HP ScanJet Plus Scanners

The advanced features of the HP ScanJet Plus scanner provide expanded image quality and versatility for your customers. Understanding these features can help you sell more scanners:

Feature: 256 Levels of Gray

Customer Benefit: Provides the ability to maintain contourless images even after major contrast and intensity adjustments

Grayscale refers to a scale of gray tones from white to black. In a scanned image, too few levels of gray will produce contouring, bands or seams that appear between the gray levels. Some of our competitors say that an image only has to contain 50 levels of gray for the human eye to perceive it as continuous tone. Therefore, they say, 64 levels of grayscale are adequate in scanning.

But that's not true in every situation. Increasing the contrast reduces the number of gray levels. Because many dark or color photographs require large contrast adjustments, the scanner's range may be reduced. Often a dark image may be contained within a third or less of the grayscale range. To lighten and brighten this type of image, both the contrast and intensity must be significantly increased. And that's when contouring can become a problem. For example, with a 64-level grayscale scanner (6-bit), only about 21 usable levels of grayscale remain—not enough to work with to produce a good quality image. With a 256-level grayscale scanner (8-bit), however, about 85 usable levels of grayscale remain—more than enough to satisfy the requirements of the human eye. (See Figures 1 through 3)

Feature: Contrast and Intensity

Customer Benefit: Provides image-enhancement capabilities

The HP ScanJet Plus scanner has the capability of providing 256 levels of control for both contrast and intensity. Because end users are more comfortable using percentages, we chose to show these controls in our software ranging from 0% to 100% with 1% steps and a default of 50%. Even though this reduces the total number of adjustment levels to 101, the ability to compensate for images that are too light or dark or have poor contrast is finer than we think our users will ever need. Look at how our software compares to other software:

<u>Feature:</u>	HP ScanJet Plus Scanner	Apple® Scanner	MicroTek 300G Scanner
Grayscale mode:			
Maximum Gray Levels	256 (8-bit)	16 (4-bit)	256 (8-bit)
Intensity Levels	101	16	14
Contrast Levels	101	8	14
Dither mode:			
Intensity Levels	101	16	14
Contrast Levels	101	8	14
Line Art mode			
Intensity Levels	101	16	14

Feature: Resolution and Scaling

Customer Benefit: Gives the user the ability to reduce/enlarge a picture to the exact print size desired while maintaining maximum image quality

Optical Resolution refers to the number of pixels (PICTure ELEmentS) or samples per inch that the image sensor in the scanner can read from an original. The HP ScanJet Plus scanner has an optical resolution of 300 ppi, meaning the scanner records data in a format of 300 pixels per inch (ppi). In the scanner industry, ppi has come to be referred to as dpi (dots per inch), a printer term, so the HP ScanJet Plus scanner is referred to as a 300 dpi scanner.

Output Resolution refers to the dpi that the user has requested from the scanner. The HP ScanJet Plus scanner has an output resolution range from 12 to 1500 dpi selectable in 1 dpi increments—an advantage to help match optical resolutions exactly to output resolutions. Compare this to the Apple scanner which only supports resolutions of 75, 100, 150, 200 and 300 dpi and the Microtek 300G which supports 75, 100, 150, 200, 240, and 300 dpi.

Scaling refers to the ability to reduce or enlarge a scanned image from the original size (100%). For example, at an output resolution of 300 dpi, the HP ScanJet Plus scanner offers a scaling range of 4% to 200% in 1% increments—an advantage that lets users make a picture exactly the size they want. Compare this to the Apple® scanner which, at an output resolution of 300 dpi, supports only 5 scaling values for grayscale images and 18 for line art and dithered images ranging from 25 to 100%. The Microtek 300G, at 300 dpi, can only scan from 1% to 100% in 1% increments for grayscale images and from 25% to 100% in 5% increments for binary and dithered images.

Scaling and resolution are interrelated. How? Think of it this way. You have several gears in your car—1st, 2nd, 3rd, etc. When the clutch is all the way out, 1st may only work from 5 to 15 MPH, 2nd from 10 to 30, 3rd from 20 to 60, and so on. Likewise, for every output resolution (gear) that the scanner supports, there is a fixed scaling range (speed). At 300 dpi, for example, an image can be reduced to 4% or enlarged up to 200% of the original size. At output resolutions above 600 dpi, the size of the output will always be smaller than the original, e.g. at 1270 dpi, the maximum scaling value allowed would be 47%. In effect, the scanner scales the image so the best image quality is achieved.

In summary, if your output resolution doesn't match your printer's resolution, you've got a problem. These features allow the user to tell the scanner what the printer resolution is so that the scanner can provide distortion-free images and give accurate size feedback to the user.

Color Studio Photograph

Grayscale Pixel Distribution

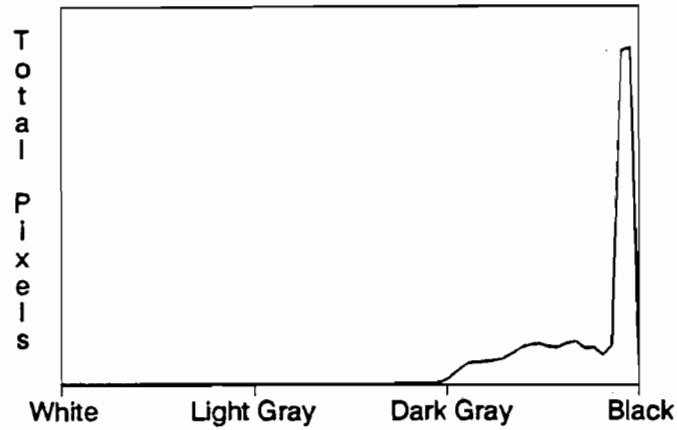


Figure 1. The distribution of grayscale pixels within the photograph scanned for figures 2 and 3. The lightest pixels are a dark shade of gray. There are about 85 gray levels between the lightest and the darkest pixels in the image.



Figure 2. A color photo scanned by the HP ScanJet Plus scanner with default contrast and brightness settings. The lightest pixels in the image are a dark shade of gray. Printed at 300 dpi on an HP LaserJet II printer.



Figure 3. A color photo scanned by the HP ScanJet Plus scanner with high contrast and brightness settings. The dark gray pixels in the image are represented as white, leaving approximately 85 gray levels between white and black. Printed at 300 dpi on an HP LaserJet II printer.

Why Should I Buy the ScanJet Plus?

- **Market leader**
- **Broadest software support in industry**
- **HP dedicated to scanner market**
- **Ease of use, intuitive**
- **Superior service/support**
- **Product reliability (<1% annualized failure rate – among industry leaders)**

Selling Against the Competition

Microtek 300Z

Software not intuitive,
difficult to learn

Bigger footprint than
ScanJet Plus

ScanJet Plus

Software easy to learn,
intuitive

Smaller footprint

- Broader software support
- Market leader
- Superior service/support
- Product reliability

Benefit

Productivity, Ease of
use, better for first-
time/frequent user

Flexibility, space
savings

Selling Against the Competition

Datacopy 730GS

ScanJet Plus

Benefit

Flatbed only

Flatbed/ADF

Productivity/Flexibility

6 bit (64 levels of gray)

8 bit (256 levels of gray)

Maximize output
quality

Slower scanning speed

10 sec.

Productivity, Time
savings

- Broader software support
- Market leader
- Superior service/support
- Product reliability



Selling Against the Competition

<u>Apple</u>	<u>ScanJet Plus</u>	<u>Benefit</u>
4 bit (16 levels of gray)	8 bit (256 levels of gray)	Maximize output quality
Application only	Application or DA	Ease of use, Time savings
5 levels of output resolution	12-1500 in 1 dpi increments	Matches any printer resolution
8 contrast, 16 Intensity settings	100 settings	Fine tune Images
Flatbed	Flatbed/ADF	Greater flexibility/Productivity (OCR)
Apple focused on CPU market	HP committed to scanner market	

HP ScanJet Plus

Key Features

Price/Performance Breakthrough

8-bit, flatbed scanner for under \$2200

High Quality Imaging

256 levels of grayscale information

Wide range of contrast and intensity controls

High-resolution output - to 1500 dpi

HP Design Quality

Ease of Use

Intuitive PC software shortens learning curve

Mac desk accessories - as little as 6 clicks to integrate an image

Third Party OCR Software Support

Gives customers wide range of choices

Best solution to meet needs and price range

Versatility

Flatbed with optional automatic document feeder

Image and OCR

Operates in multiple environments

Scanning Gallery Plus

Software for the HP ScanJet Plus

Key Features

For PCs and compatibles and PS/2

Windows-based (Version 2.1)

Interactive Scaling - see changes in size and shape before final scan

Contrast and Intensity controls - 256 levels each

Custom Resolution - 12-1500 dpi, selectable in one dot increments

Specify Applications - easy access to other applications

Launchable OCR - scan text from within Scanning Gallery Plus

On-Line Help

Industry-standard File formats:

TIFF

EPSF

MS Paint

GEM

PC Paintbrush

Desk Gallery Plus

Software for the HP ScanJet Plus

Key Features

For Mac Plus, SE and II

DeskScan and DeskPaint™ - may be used as desk accessories or applications

Custom Resolution - 12-1500 dpi, selectable in one dot increments

Brightness and Contrast controls - 256 levels each

Live Preview - gives instant feedback on changes in brightness or contrast

Zoom Feature - large view of Preview image

Scan to Printer

New tools added to DeskPaint

Extensive On-Line Help

File Formats Supported:

- TIFF
- EPSF
- MacPaint
- PICT
- Clipboard

PC Desktop Scanners *

Feature	HP ScanJet Plus	DEST 1000 Series	DEST 2000 Series	Datasec Model 830	Microtek 300Q	Microtek 300Q
Hardware Design	Flatbed	Flatbed	Edgefeed	Flatbed	Flatbed	Flatbed
Automatic Document Feeder	YES	YES	N/A	YES	NO	NO
Maximum Document Size	8.5" x 14"	8.5" x 14"	8.5" x 14"	8.5" x 14"	8.5" x 14"	8.5" x 14"
Host Support	MAC; Plus, SE, II IBM PC, XT, AT IBM PS/2	Mac; Plus, SE, II IBM PC, XT, AT IBM PS/2	MAC; Plus, SE, II IBM PC, XT, AT IBM PS/2	MAC; Plus, SE, II IBM PC, XT, AT	MAC; Plus, SE, II IBM PC, XT, AT IBM PS/2, SUN	MAC; Plus, SE, II IBM PC, XT, AT IBM PS/2, SUN
Scanning Speed	10 Seconds	20 seconds	9.4 seconds	14 seconds	11 seconds	11 seconds
Greyscale	256 levels	16 levels	256 levels	64 levels	64 levels	256 levels
Output Resolution	12 - 1500 dpi	38-300 dpi	38-300 dpi	75, 100, 120, 150, 180, 200 240, 300	75, 100, 150, 200 240, 300 dpi	75, 100, 150, 200, 240, 300 dpi
Scaling	4% - 200%	13% - 200%	13% - 200%	None	1% - 100% (mul- tiple); 25% - 100% (single bit)	1% - 100% (mul- tiple); 25% - 100% (single bit)
Contrast Settings	256	3	3	3	14	14
Intensity Settings	256	0	0	5	14	14
OCR Capability	ReadRight by OCR Systems; TrueScan by Calera	TextPac (proprietary)	TextPac (proprietary)	OCR Plus	ReadRight by OCR Systems	ReadRight by OCR Systems
Integrated Image/OCR	YES	YES	YES	NO	NO	NO
Price (2/1/89)	\$2190	\$1750	\$1500	\$3495	\$2495	\$3495

* Information Subject to Change

Mac Desktop Scanners *

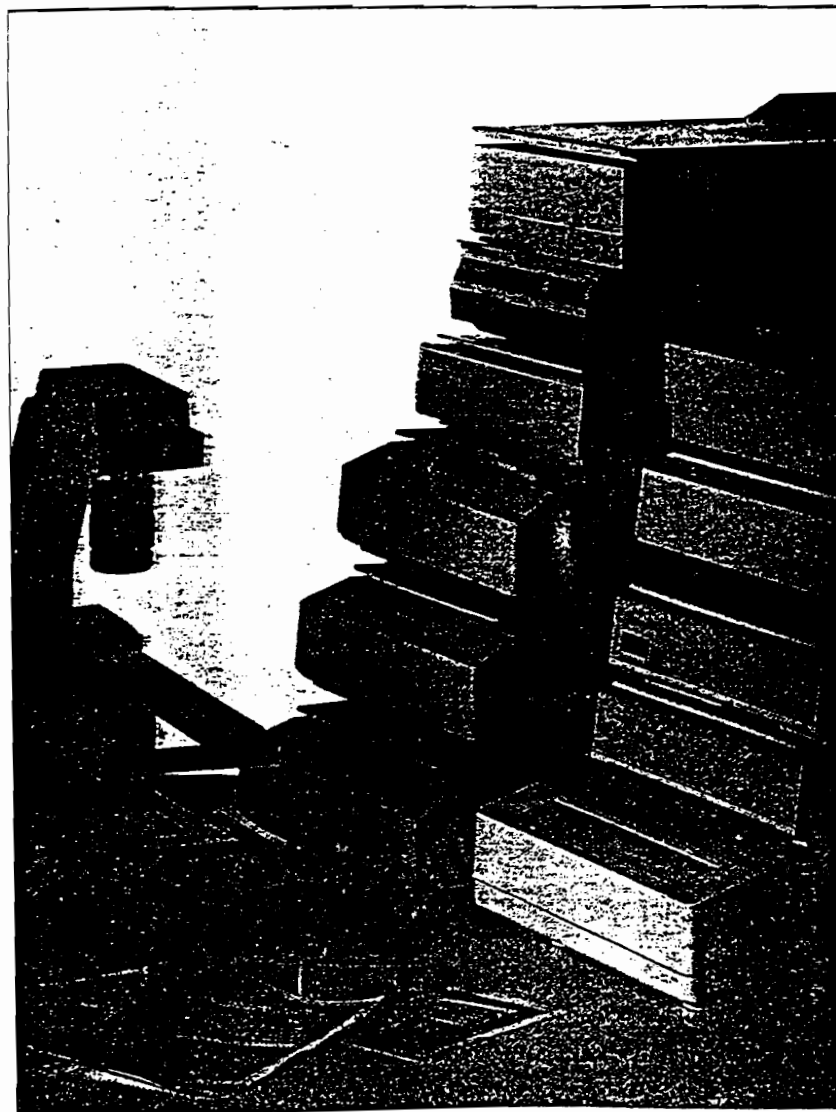
Feature	HP ScanJet Plus	DEST 1000 Series	DEST 2000 Series	Datascopy Model 990	Abaton 900/S	Apple Scanner
Hardware Design	Flatbed	Flatbed	Edgefeed	Flatbed	Flatbed	Flatbed
Automatic Document Feeder	YES	YES	N/A	YES	NO	NO
Maximum Document Size	8.5" x 14"	8.5" x 14"	8.5" x 14"	8.5" x 14"	8.5" x 14"	8.5" x 14"
Host Support	MAC: Plus, SE, II IBM PC, XT, AT IBM PS/2	MAC: Plus, SE, II IBM PC, XT, AT IBM PS/2	MAC: Plus, SE, II IBM PC, XT, AT IBM PS/2	MAC: Plus, SE, II IBM PC, XT, AT IBM PS/2	MAC: Plus, SE, II IBM PC, XT, AT IBM PS/2	MAC: Plus, SE, II
Scanning Speed	10 Seconds	20 seconds	9.4 seconds	14 seconds	25 seconds	20 seconds
Grayscale	256 levels	16 levels	256 levels	64 levels	16 levels	16 levels
Output Resolution	12 - 1500 dpi	38-300 dpi	38-300 dpi	75, 100, 120, 150, 180, 200 240, 300	72, 300 dpi	75, 100, 150, 200, 300dpi
Scaling	4% - 200%	13% - 200%	13% - 200%	None	25%, 33%, 50% 66%, 80%, 100%	25% to 400%
Contrast Settings	256	3	3	3	8	8
Intensity Settings	256	0	0	5	16	16
Scanning Software Design	Desk Accessory or Application	Application	Application	Application	Application or Control Panel	Application
Painting/Editing	YES	YES	YES	NO	YES	NO
Live Preview	YES	NO	NO	NO	NO	YES
OCR Capability	OmniPage from Caere Corp.	PublishPac (proprietary)	PublishPac (Proprietary)	MacOCR	InText	OmniPage by Caere Corp.
Price (2/1/89)	\$2190	\$1750	\$1500	\$3495	\$2295	\$1799

* Information Subject to Change



MacUser UK LABS

The launch last year of the Apple Scanner was widely seen as official endorsement for scanning on the Macintosh. Since then, the market has been inundated with new devices - presenting a daunting choice to anyone looking to buy. In this issue's MacUser UK Labs report, Tony Tyler bench tests and compares thirteen mono scanners for the Mac.



A digital scanner is the eyeball of the computer. Operationally facile but technically complicated, scanners enable you to import visual data. Anything they can 'see' - artwork, photography, text or even solid objects - can be transformed into a computer file. It can then be viewed, manipulated and even exported into graphic design, desktop publishing or presentation software.

Scanners are simple to use. In most cases you just connect the scanner, choose an image, scan it using proprietary software, and there it is on-screen. There are several different classes of device, right across a price range from a few hundred pounds to tens of thousands for professional equipment found in reprographic houses. Qualitatively, many scanning levels are available depending on your needs and your purse, from simple binary (black or white) to images in full colour with undisplayable resolutions of nearly 4000 lines and pixel depths up to an equally undisplayable 36 bits.

This enormous range of products, capabilities and prices is complemented by considerable variety in scanning systems. The most popular is the photocopier-style flatbed - a box with a glass lid - but there are still a few edge-feeders on the market at generally lower prices. At the upper end of the scale there are scanners that use direct video input and are mounted on moving tressles like miniature dockyard cranes, while the cheaper seats are beginning to fill up with budget hand-held scanners like oversized shavers,



Image conscious

which are still capable of useful results.

These days most scanners are SCSI devices – an improvement on the days when most of them were serially-connected but still inferior in speed terms to NuBus connection. The arrival of the Mac IIcx should have signalled that at least half of the Mac II and IIx's slots are probably redundant, and as scanners are highly SCSI-sensitive devices anyway, it is a pity that more developers do not make their devices NuBus-compatible, with consequently faster data processing speeds.

Resolution is another area of divergence. Devices such as the Truvel TZ-3 nominally scan at up to 900 dots per inch, while the maximum rate for a general purpose desktop scanner (like the Apple Scanner) is a 'mere' 300 dots per inch (dpi).

However, as has been explained in previous issues of MacUser, these pure line rates are not altogether what they seem. Imagesetting and printing processes often require final output screens, or line frequencies, much less even than 300 dpi – 133 lines per inch (lpi) being an accepted standard for industrial printing presses. There are exceptions to this of course – line art is one – but for halftone (photographic) material, unless the conditions are rather special, 150 lines per inch is a sensible scanning choice, and higher resolutions are usually superfluous. Incidentally, not many scanners allow you to adjust sample (dpi) rate with total freedom, and some offer very limited choices indeed, making the

tuning of a scan to a desired output line rate an inexact business.

This is not true for line art – visuals in which there are no intermediate shades, merely black or white. These, preferring binary scans no matter what the engine type, can use all the resolution they can get, and this is where grids above 300 dpi come in.

Grey Eminences

Yet another way in which scanners differ from each other is in pixel depth – the amount of data per scan dot that the engine can recognise and the software can cope with. Binary (photocell) scanners only offer a single bit of information at this level – a dot is either on or off, black or white. However more advanced devices – so-called grey level scanners or Charge Coupled Devices (CCDs) – are able to 'see' and subsequently store an analogue of the grey level of the dot. In this case the maximum bit depth usually found in the more advanced grey scanners is eight bits, or any one of 254 grey levels plus Blinding White and Utter Black (which in any case should never be used). Put simply, this allows the cell of the eight-bit CCD to look at a small portion of a photograph or charcoal drawing, measure its photoamplitude, and allocate any one of 256 values to that scanned pixel. This is much finer grey tuning than is possible with, say, the Apple Scanner which currently operates at four bits or 16 greys.

Bearing in mind that the human eye can barely distinguish more than

thirty differing shades of grey when these are presented out of context, 256 levels may seem like bizarre overkill, but the truth is that grey information is rarely presented to the human eye out of context. Finely-shaded contours – for example, the range of greys found on a moodily-photographed human face between the areas of greatest light (the upper cheekbone) to the darkest zones (the lower cheekbone) – require the largest amount of 'grey discrimination' if the delicate shading is to be reproduced exactly.

Two hundred and fifty-six greyscales is ample for the finest magazine work, provided resolution and paper quality are also on the top line. But 64 is also usually more than enough – often the only way to tell a 64-grey from a 256-grey scan of the same original is to compare the two side by side. By common consent lower grey levels than this value are not of publishing quality, though it is true that they are more than optimised for the lower resolutions typically found in laser printers. And there are tricks even binary scanners (or more properly their software) can use, such as dithering and patterning (substituting algorithmic dot patterns for true greys), which can at least partially simulate a halftone effect at the lower end of the resolution scale.

And then there is colour, an area of vast interest and even now coming on-stream – although colour scanners are currently demoralisingly expensive. Quality scanning in colour at the RGB equivalent of eight bits of grey means the same scan three

PICTURE THIS!

To avoid unfair and pointless comparisons of like with unlike – where some devices are scanning at higher grey rates than others – the following bench tests were devised to test the scanners' speed on a kilobyte-per-second basis. Both tests were devised to simulate realistic conditions – 150 dpi and maximum greyscales for a halftone photograph, 300 dpi line art for line art. Higher line rates than this were available from a number of the scanners but this would have interfered with the bench test.

Files were saved as TIFF where possible, though EPS would be an alternative for line artwork (however files tend to be larger). Saving times have not been included in the bench tests, which refer to scanning times only. These were measured from the click of the 'OK' button to the return of control to the user.

The system used in testing was a Macintosh II with 5M RAM, colour monitor, 65M internal hard disk and 45M removable hard disk used for archiving.

Bench Test 1: Halftone

SCANNER	TIME (s)	FILESIZE	K's PER SECOND
NEW IMAGE TECHNOLOGY MACSCAN PRO 256	7	1.1 M	157.0
HEWLETT PACKARD SCANJET PLUS	20	720 K	36.0
AGFA FOCUS 600GS	28	835 K	29.8
ABATON SCAN 300/FB	47	1.3 M	27.6
SIEMENS ST800	30	726 K	24.2
TRUVEL TZ-38WC	80	1.6 M	20.0
MICROTEK MS-300GS	50	848 K	16.9
FORMSCAN PC SCAN 1000	37	502 K	15.5
APPLE SCANNER	34	520 K	15.2
DATACOPY 730GS	60	798 K	13.3
MICROTEK MS-300G	65	726 K	11.1
LOGITECH SCANMAN	6	42 K	6.0
TAXAN TXF 300	100	114 K	1.14

Bench Test 2: Line art

SCANNER	TIME (s)	FILESIZE	K's PER SECOND
LOGITECH SCANMAN	6	258 K	43.0
HEWLETT PACKARD SCANJET PLUS	12	256 K	21.3
SIEMENS ST800	17	271 K	15.9
DATACOPY 730GS	20	246 K	12.3
AGFA FOCUS 600GS	95	1.1 M	11.5
APPLE SCANNER	30	279 K	9.3
MACSCAN 256	9	73 K	8.1
TRUVEL TZ-38WC	47	359 K	7.6
MICROTEK MSF-300GS	40	251 K	6.2
MICROTEK MSF-300G	40	251 K	6.2
TAXAN TXF-300	175	448 K (EPS FILE)	2.5
ABATON SCAN 300/FB	27	62 K	2.2
FORMSCAN PC SCAN 1000	30	35 K	0.85

times over, in red, green and blue – in other words a total of 24 bits of information per scanner pixel (not to mention 32-bit colour QuickDraw to run the result on Macintoshes under Apple protocols). Few devices as yet will scan at these terrific pixel depths, and though most of those already on the market are of the flatbed type (both video and CCD), the repro and professional publishing markets are likely to set a greater premium on transparency scanners (and there are one or two devices of this type already on the market). But in this report we are concerning ourselves solely with monochrome scanners. Colour is a story which will have to wait a little longer. (Look out for a future Labs report on colour scanners.)

Who Scans, Wins

Why would anyone want a digital scanner anyway? Image processing comes fairly low down the average Macintosh user's worklist – unless you happen to be in the image processing business in the first place – and most users will almost certainly splash out on a laser printer before even contemplating the purchase of a digital scanner. But for those whose business or pleasure lies in the use of images, a scanner of some kind is an absolute desideratum.

The cheaper and less capable (but still pretty useful for all that) scanners will be purchased, as the original and much-loved Thunderscan once was, for display graphics, and for use with laser printer output. True greyscaling requires imagesetting, but budget scanners with impressive line resolutions, and little or no grey recognition whatever can still make a good fist of importing images and dithering them to make them look halftone-like both on-screen (for embellishing HyperCard stacks, for example) and on laser printouts (newsletters, stationery, brochures, price lists and so on). In the display context, if the final destination of your image is to be a Macintosh screen, and if the Macintosh in question is one of the compact range which don't display greyscales, then grey level scanners will be partially wasted anyway. But their dot resolution is no less than on Mac II series screens, and as a result line art looks as good on one display as the other. Grey files can be printed via a compact Mac, whether they can be displayed or not.

Although good results can be obtained, they are 'amateur night' set against what's obtainable with a true grey level CCD machine when displayed on a Mac II series grey or colour tube – a fair analogue in its own right for quality printing. In this

(grey) context, the more you get scanwise the more you will see screenwise, right up to the eight bits or 256 greys displayable with the Expanded Apple Video Card. Therefore the perfect match to an 8-bit tube is an 8-bit scanner – what it gets is what you see – and scanners that scan at less than 256 greys are not fulfilling the tube's potential.

One exception to this is the new range of screens from Apple, which offers (at present) no more than four bits or 16 greys, a mystifying product until you consider the perfectly matched Apple Scanner, which also offers (at present) only 16 greys. A new, not-quite-professional standard in the making, or a crafty move to provide an easy entry level to grey image processing, which will then open the door to a series of expensive but tempting upgrades? That aside, 256 or 64 greys are considered the professional levels of scanning, and for this kind of performance you are expected to pay.

Here also you find line resolutions beginning to break the 300 barrier – 400, 600, 800 and even a notional 900 dpi being available from the machines on test. Remember the more greys you want in a picture, the fewer of these gigantic resolutions you can use, unless the final output device is of extremely high resolution (with very small machine pixels)

and the RAM and disk space inside your Macintosh are both highly capacious. It is quite easy to work out how big files will be: in theory a 300 dpi/256-grey level scan will set you back in the region of 90K per square inch. Cunning compression algorithms can reduce these figures, but large high-resolution scans at high grey levels, even when allowed by RAM, can generate files that are almost impossibly big. An A4 photo scanned at a resolution of, say, 800 dpi at maximum grey (256) will occupy almost 60M of disk space.

Soft Options

Scanners are driven by software, and seldom will one manufacturer's software drive another's scanner, even when they use the same CCD engine. Software varies in both quality and range of ambition – from excellent (Agfa, Apple, Datacopy, Hewlett-Packard) to pretty good (Dest, Abaton) to moderately bad (Truvel, Taxan). Some programs provide a vast range of options but do little to help you through, while others not only steer a safe and effective course through the choices, but also throw in valuable enhancements – Agfa's McView's de-screening option, Abaton's PanelScan COEV which allows scanning from any application, or HP's Desk suite which does the same thing.

All, virtually without exception, support a decent range of file formats. PageMaker 1.2s, also known as FOTO, is a 300 dpi high-resolution bit-map format and all but obsolete. MacPaint is supported by all (presumably with HyperCard in mind), and PICT is very popular, both binary (PICT1) and eight-bit (PICT2). The two formats that matter most are TIFF (any kind of TIFF) and Enhanced PostScript (EPS). These formats are the key to onward exportation of images to DTP packages (PICT being more useful for presentations), but once saved in EPS format, an image is 'fixed' and may no longer be edited.

Other formats on offer include occasional 'native' file types: Raster Image File Format (or RIFF, as used by both Quark XPress and Image Studio); SuperPaint, and PostScript itself, which of course can't be displayed, only printed.

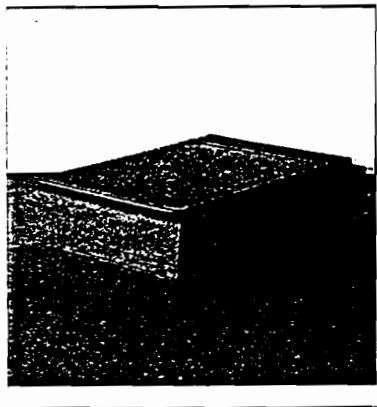
Virtually all scanning software will print in its own right, and some annotates the printout with device settings as well as applying a halftone screen. A few manufacturers pare their scan software to the bone on the assumption that users will invariably employ other software from that point on. Many provide kits of tools for image editing but in almost all cases these are inferior to the equivalents found within dedicated IP packages like Image Studio and Digital Darkroom (see



BEST BUY: 8-BIT

*Hewlett Packard
ScanJet Plus
CCD flatbed, 256 greys,
300 dpi*

The second fastest of all the quality scanners (in grey mode), offering a minimalist but clean and effective double desk accessory package of DeskScan and DeskPaint for scanning and editing (though the software can run on standalone). Quiet, well-made product, and in a single box which plugged and played first time with no SCSI nonsense.



'The Image Makers', Issue 32) and professionals will certainly opt for this route.

Doing It

The easiest machines to use are the photocopier-type flatbeds. Simply lift the cover, lay your image on the glass, and click 'OK'. Edge feeders, while useful for optical character recognition (a means of translating scanned text into computer-readable codes – see last issue's report, 'A Test of Character'), require flexible artwork or text to be posted in – you hope it comes out straight, indeed you hope it comes out at all.

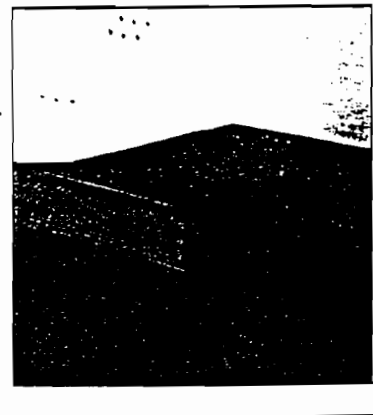
The majority of flatbed types, on the other hand (all except one – the Truvel – in this test), can accept input from, say, a book without first tearing out the relevant page. The Truvel goes even further than this on OCR



BEST BUY: 8-BIT

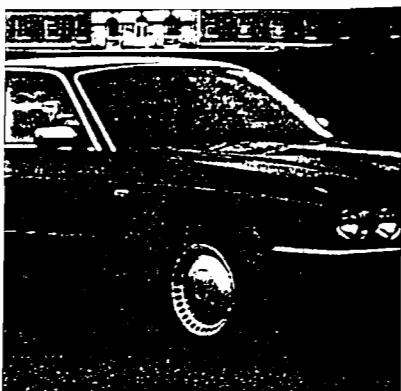
*New Image Technology
MacScan Professional 256
CCD flatbed, 256 greys,
300 dpi*

A phenomenally fast scanner (in grey mode) based on the Canon IX-12F with improved but still flawed software that does not include a proper pre-scan facility and offers insufficient line-rate choices for a device of this class. What stopped the MacScan Professional winning its group outright was its interfacing system – two distinct cables joining the scanner to a (separately powered) SCSI box, plus one 25-to-25 way SCSI which incidentally forces the device's position as the first link in any SCSI chain. The latter is handled sensibly (you simply can't plug it in anywhere else) but the overall effect is desktop-cluttering – an abiding fault with this developer, who otherwise offers fully professional performance at tremendous speed. Digital Darkroom bundled.



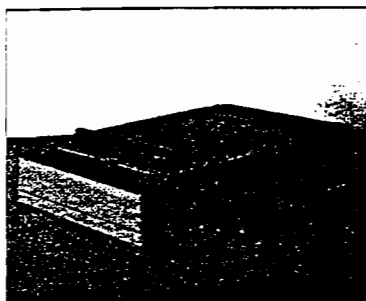
products since it is a video flatbed scanner and has a generous lens aperture, objects of up to 2" or 3" in depth can be scanned.

For anything short of professional publishing, there is a large range of adequate, even excellent, products – some under £1000 and occupying the slot once filled by the dear old ThunderScan. The small number of greyscale devices available at



BEST BUY: 6-BIT
Agfa Focus S600GS
 CCD flatbed, 64 greys,
 600 dpi,

This slightly over bulky but well made 64 greyscale scanner offers professional levels of quality and speed, total SCSI tolerance and the best scanning software of all - featuring de-screening, vectorisation and a built-in densitometer in a single desktop box. No discernible vices, but slower operation with line art than greys. Its larger brother offers 800 dpi for around £500 more - the S600 will do for most.



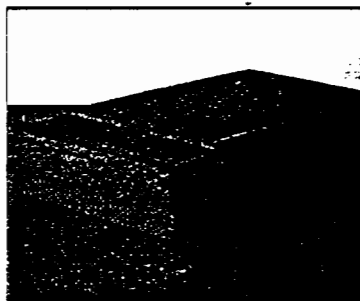
budget prices can be used for effects work, but will not properly display anything like a challenging contone even on a Mac II series screen. Their forte is line art and, for this task, they are nearly as good as much more expensive devices.

For professional DTP work a true CCD or video scanner capable of at least 64 greys and 300 dpi is essential, with more resolution only necessary if a good deal of fine-detail line artwork is contemplated in addition to halftoning. These machines start in the region of £3000, and for the big Truvel (which, to be fair, will also scan 24-bit colour), you have to pay £8545 (-VAT), plus another thousand or so for the appropriate SCSI interface. (The mono scanner, offering the same resolution and grey levels, is a somewhat more reasonable £5395, plus £1000 for a SCSI box.) Results from devices of this class are quite



BEST BUY: 4-BIT
Apple Scanner
 CCD flatbed, 16 greys,
 300 dpi

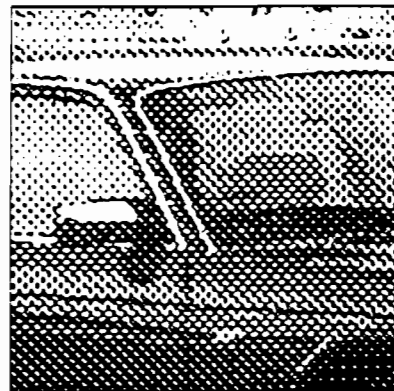
Probably the best-known of all Macintosh scanners. In operation the 16 greyscale Apple device offers only average performance in speed and file size terms, but comes to life with excellent software, including Bill Atkinson's HyperScan for capturing directly into HyperCard. This software offers the best dithering patterns available. Small, neat and easy to set up, the Apple Scanner also scores for its SCSI tolerance. An utterly reliable package - but this class of device does not really offer professional DTP quality.



excellent, far in excess of what was predicted two years ago. Drawbacks are slow operating speeds and large file sizes, with concomitant strains on RAM, disk space and patience.

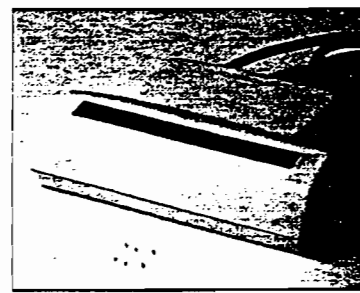
Let's Get Digital

This report is based around extensive bench testing of a number of digital scanners of all types and prices. As usual we tried to get as many products as we could, and our thanks go to the 12 manufacturers and distributors who participated. The review's terms of reference exclude colour-only scanners, transparency scanners, Thunderscan Mark 1, dedicated optical character recognition systems and scanners unsuitable for handling images in



BEST BUY: BINARY
Logitech ScanMan
 Hand-held photocell,
 400 dpi

Using the same SCSI arrangement as the MacScan (ie 25-each-way SCSI cabling to force pole position in the external SCSI chain), this extraordinary little device is actually capable, in line art terms at least, of equal performance to devices costing six times as much - provided the image is not too large. No greyscales are available, but a choice of four grain sizes allows a certain amount of dithering that is more than acceptable for laser output or screen display. It wins its class by virtue of being the only entrant, but receives the Best Buy accolade entirely on merits.



document form, such as the otherwise highly eligible video grabbers from Neotech and Data Translation. Most of these products form separate application categories and those applicable to Macintosh users will be addressed in their own right in due course. No edge feeders were submitted, an indicator of this breed's lapsing popularity.

In reviews of this type it is only fair to compare like with like, and for that reason the devices have been split up into classes based on their professional abilities (greyscaling and resolution). Scanners were judged on a subjective combination of performance, software, value for money, ease of installation and support. Note was also taken of the number and complexity of devices in

SCANNING THE RANGE

8-BIT	TYPE	ENGINE	GREYS	DPI (Max)	GREY DISPLAY	INTERFACE COMPONENTS	SOFTWARE	PRICE £	REMARKS	DISTRIBUTOR
TRUVEL TZ-3/BWC	Flatbed Tower	Video	256 16 4	75-900	Yes	SCSI 2	Truscan 3.3	5395 (BWC 8545)	Cumbersome setting-up procedures but excellent results attainable. Poor software.	Headway Computer Products, Headway Hse, Christy Estate, Ivy Road, Aldershot, Hants, Tel. 0252 333575
SIEMENS ST800	Flatbed	CCD	256	75-800	Yes	SCSI 1	Highscan 1.14	3995	Brilliant performer with excellent software spoiled only by single SCSI bus.	MacEurope, The Granary, Trowse Bridge, Braconate, Norwich, NR1 2EG, Tel. 0603 630636
NEW IMAGE TECHNOLOGY MACSCAN PROFESSIONAL 256	Flatbed	CCD	256	75-300	Yes	SCSI 2	MacScan 1.46	2495	Subfast high quality scanner with too many interfaces, but a star performer anyway.	Heyden & Son, Spectrum House, Hillview Gardens, London NW4 2JQ, Tel. 01 203 5171
MICROTEK MSF-300G	Flatbed	CCD	256	75-300		via Digital Darkroom SCSI 2	Digital Darkroom 'plug-in plus' DA module	1662	Professional two-piece scanner with good performance and reliability.	Katakana, Manhattan Hse, Bridge Road, Maidenhead, Berkshire, SL6 8DB, Tel. 0628 75641
HEWLETT PACKARD SCANJET PLUS	Flatbed	CCD	256 16	300	Yes	SCSI 2	Deskscan, Deskpaint	1300	Very fast and quiet flatbed scanner with 'win-module scanedit' DA software.	HP, King lane, Wokingham, Berkshire, RG11 5AR, Tel. 0734 784774

6-BIT	TYPE	ENGINE	GREYS	DPI (Max)	GREY DISPLAY	INTERFACE COMPONENTS	SOFTWARE	PRICE £	REMARKS	DISTRIBUTOR
AGFA FOCUS 560GS	Flatbed	CCD	64	75-600	Yes	SCSI 1	McView 1.0	3195	The best performer in its class and probably the best all-round, outstanding software (800GS also available)	Agfa Gevaert, 27 Great West Road, Brentford, Middlesex, TW8 9AX, Tel. 01 560 2131
MICROTEK MSF-300GS	Flatbed	CCD	64	75-300		via Digital Darkroom SCSI 1	Digital Darkroom 'plug-in plus' DA module	1418	Good quality one-piece scanner, timings not indicative since software scans to disk	Katakana, Manhattan House, Bridge Road, Maidenhead, Berkshire, SL6 8DB, Tel. 0628 75641
DATACOPY 730GS	Flatbed	CCD	64 16	75-300	Yes	SCSI 1	MacImage 2.10	1475 (includes cables & interfaces)	Vastly improved slimline scanner now offers professional results at acceptable speeds.	Applied Technology, 29 Caocam Centre, 16 High Force Road, Middlesborough, Cleveland, TS2 1RJ, Tel. 0642 230860

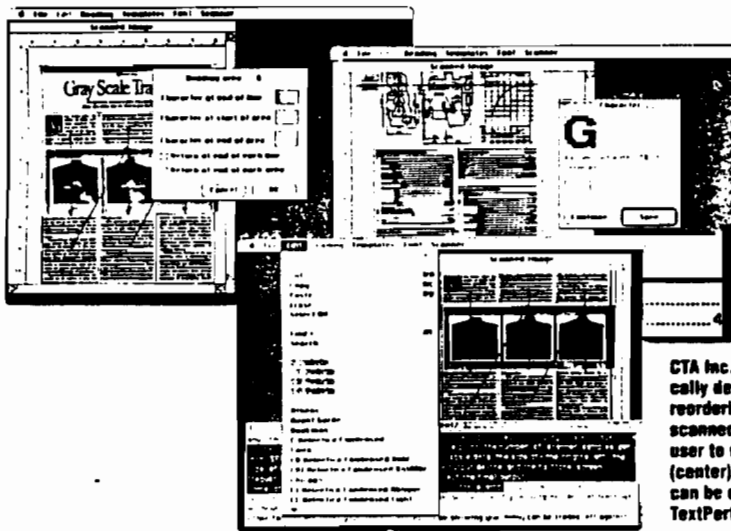
4-BIT	TYPE	ENGINE	GREYS	DPI (Max)	GREY DISPLAY	INTERFACE COMPONENTS	SOFTWARE	PRICE £	REMARKS	DISTRIBUTOR
BEST PC SCAN-100E	Flatbed	CCD	16	75-300	No	SCSI 2	Publish Pac 2.0	1575	Despite lack of grey display and over-large file sizes, a good performer. Sheetfeeder available.	Formscan, Apex House, West End, Frome, Somerset, BA11 3AS, Tel. 0373 61446
ABATON SCAN 300/FB	Flatbed	CCD	16	75-300	No	SCSI 2	C-Scan Plus	1250	Well-made scanner, software rather stark but excellent CDQV allows scanning from anywhere.	Everex, 72 Capitol Way, Edgware Road, London, NW6 0EW, Tel. 01 205 0607
APPLE SCANNER	Flatbed	CCD	16	75-300	Yes	SCSI 1	Appescan, HyperScan	1295	Superb value for money from this near-professional quality machine. Excellent software.	Apple Computer UK, 6 Roundwood Ave, Stockley Park, Uxbridge, Middlesex, UB11 1BB, Tel. 01 569 1199
TAXAN TXF-300	Flatbed	CCD	16	75-300	No	Serial 1	Versacan+ 1.6	1479	Slow serial scanner with average software and large filesizes. True greys (16) only obtainable by 75% dbr reduction.	Taxan, Taxan House, Cookham Road, Bracknell, Berkshire, RG12 1RB, Tel. 0344 484646

BINARY	TYPE	ENGINE	GREYS	DPI (Max)	GREY DISPLAY	INTERFACE COMPONENTS	SOFTWARE	PRICE £	REMARKS	DISTRIBUTOR
LOGITECH SCANMAN	Handheld	Photocell	None	100-400	No	SCSI 2	ScanMan 1.0	345	Excellent value for money basic line art scanner with high resolution though no true greys. DA version of software.	Logitech plc, Logitech House, Bradley Lane, Stanish, Great Manchester, WN6 0XQ, Tel. 0257 426644

a single package, interfacing, SCSI peculiarities and related matters. The number and type of connections and power requirements were also taken into account, as were operating manuals, installation procedures,

prices and, of course, performances. Software is tremendously important, and scanners were judged critically on this. The bench tests were devised to test the scanners' abilities for both line art and halftones.

Tony Tyler is an author, computer journalist and DTP consultant. He was launch editor of *DTP Desktop Publishing* and has been a regular contributor to *MacUser* since the magazine was launched.



Keeping scanners in character

CTA Inc.'s TextPert provides the ability to automatically define columns and gives users the option of reordering or redefining the manner in which the scanned text is read (for left). This allows the user to download material into database programs (center). After the reading phase, blocks of text can be edited and font size and type altered within TextPert (bottom screen).

scanner, the more accurate information presented to the OCR system, the better it can distinguish among characters. The higher the resolution, the smaller the type size that can be read with any given level of error.

The 300-dpi standard used for most Macintosh scanners is usually adequate for larger type sizes starting with 10 or 12 point and workable in some circumstances at 8 point and below. The 400-dpi scanners can read some varieties of type as small as 6 point.

OCR can also be done using the high-resolution Tag Image File Format (TIFF) images from Group 3 fax modems. It's possible that some larger-size text could be read from scans used in Group 2, but OCR software publishers generally don't recommend it.

All of the available scanning software for the Mac expects a binary (black-and-white but no gray) image, which would represent the lower end of the scanner market in the context of graphics. "My opinion is that gray scale doesn't make a difference," said Boyssel. "If the scanner does 300 dpi, you can go with something low-priced."

But John Kozlowski, director of marketing for Microtek, said that because there are no useful accuracy and performance specs available for the scanner part of OCR systems, about the only way you can select for quality is to look at what the scanner can do for graphics. In that context, gray scale is often an indicator of overall quality. "A 64-gray-scale scanner probably is better than one that offers only 16 levels."

For the second type of hardware suitability, the
See SCANNERS, Page 42

By Steve Rosenthal

Breakthroughs in scanner technology are making OCR an attractive alternative to keying in original copy.

Getting printed copy out of a Mac has always been easy: getting printed copy in hasn't. However, with the current generation of scanners and optical character-recognition programs, a Mac can now read text more rapidly than most of us can type, and often with comparable or better accuracy.

Now information on loose pieces of paper or in books and magazines can be entered into a computer, then searched, saved or edited. For example, the San Francisco-based executive search company The Corporate Staff is beginning to create electronic images of résumés, according to President Richard Crandall.

Without scanning in images, concurred Larry Miller, vice president of OCR software publisher Caere Corp., if there isn't an immediate match, there is no practical way to save a candidate's information for a future opening. "Apple gets more than a thousand résumés a week," he said.

OCR for the Mac actually comes in two classes, the main one being OCR programs that run on the Mac and work with scanners that also capture graphics. There are also OCR systems that do the translation outside the Mac and send the Mac the resulting data.

With a scanner and separate OCR software, character recognition is a two-step process: The scanner captures the image, then the OCR software translates the patterns into characters.

From the user's point of view, however, the two processes may be combined because you can set up many of the OCR programs to control the operation of a scanner and automatically read the resulting files. In fact, John Woodhall, systems coordinator at Pacific Coast Printing Inc. of Tacoma, Wash., said his company has replaced its previous scanner with Apple's because the software it was interested in, such as Caere's OmniPage and Read-It! from Olduvai Software, directly control that device.

Most makers of Mac-compatible scanners, however, now bundle in their own or customized OCR software or make drivers available, and several of the stand-alone programs have menu choices for the more popular scanners.

Note that with any of the Macintosh setups, the complete scanned-page image has to be read in before it's processed. Most OCR systems are therefore only practical with 1-Mbyte or more of memory, and only on Macs with hard disks. A few of the newer programs are particularly resource-hungry. Caere's OmniPage, for example, needs at least a 4-Mbyte Mac, and if that computer isn't a Mac II, it needs an accelerator board.

The scanners used with OCR programs come in several varieties. For Mac users, the principal choices are flat-bed or sheet-fed configurations.

Because most Macintosh scanners are meant to reproduce artwork as well as read text, many users prefer flat-bed scanners. With this type of device, you lay copy to be read face down as if you were making a photocopy. "We also want to be able to scan a picture and put it into standard letters on the

theory that one picture equals a thousand words," said Crandall.

The flat-bed design is the format used by Apple, Hewlett-Packard, some of the models from Microtek, and DFST Corp. A flat-bed scanner is required if you're going to be reading in bound volumes, or if you want to scan in odd sizes and shapes of paper.

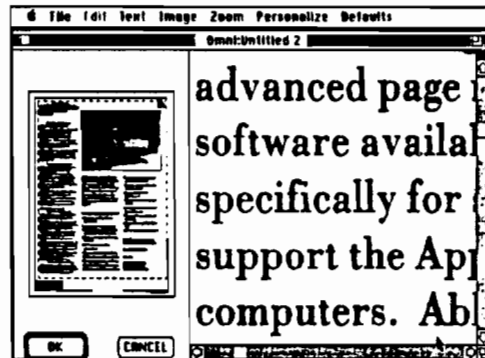
However, if you're going to be scanning multipage documents on a regular basis, said Lee Boyssel, one of the founders of Four-Phase Computers of Cupertino, Calif., and now a private investor, "One thing that people want is a scanner with a sheet feeder on it." Scanning and text recognition can take up to several minutes per page, so you want a model that will operate unattended while you do your other work.

Some companies, such as HP, also offer sheet feeders for their flat-bed models, in effect making them into convertibles. Sheet-feeder input trays vary in size from slightly more than a dozen pages to almost 100.

One further variant, the overhead scanner, also is available from a few manufacturers. In this configuration, the document sits face up on a copyboard underneath a lens and optical-sensor chip. Overhead models, however, tend to be either very expensive and oriented toward color press work for publishing or very low in cost and oriented toward capturing simple graphics that include some 3-D elements.

Not surprisingly, most Mac scanners use the same 300-dpi resolution established as the standard by the Apple LaserWriter. A few low-cost models, notably ThunderScan from Thunderware (which clips onto the printing carriage of an ImageWriter printer) are limited to lower values, and models from Microtek and Siemens go as high as 400 dpi.

For OCR, the makers of the software have said, the higher the resolution the better. Because the OCR process only can work with the image furnished by the



Caere's OmniPage (above and left) directly controls the scanner device. It understands multiple columns and a wide variety of fonts. The software can even recognize mixed fonts on the page without any training by the user. Unlike Olduvai's Read-It!, however, OmniPage's results cannot be improved by user "font training."



WINDOW ON/SCANNERS

Continued from Page 40

best choice is a scanner with a matched OCR system built in. Larry Orr, marketing manager at DEST Corp., said that his company's Work-Less Station II is probably a good arrangement when there's a particularly heavy scanning load.

The unit, priced at almost \$10,000, costs as much as a scanner and a Mac together and does the entire scanning and recognition job. The resulting text is sent to the Mac over a SCSI or serial link as the complete text of the page in your choice of ASCII, MacWrite or Microsoft Word formats.

Most Mac users don't have such heavy scanning loads and may not need such targeted hardware. "From a consultant's point of view, from a user's point of view, I look for something that's economical and fast," said Richard Gillespie, system development manager at Microcomputer Technology Inc. of Costa Mesa, Calif.

Right now OCR software is experiencing

dynamic growth; there are many possibilities.

Generally programs fall into three classes. The simplest can read only mono-spaced (fixed-width) characters, and are mostly used for entering typed documents or certain computer printouts.

This type of program, such as MacInText from Microtek Lab, is thrown off if there are overhanging characters, such as the "T" over the "o" in "To," or if any two characters have connecting lines (ligatures). This category is also unsuitable for most printed material, which generally uses proportional-width type.

More sophisticated programs, such as Olduvai's Read-It!, can handle the proportional width fonts that are used in printed text, but the majority of programs can handle only a few different fonts at a time. These programs often have to be "trained" to recognize new fonts, which can be a problem if the documents to be read include a wide and changing set of typefaces.

The newest advance is with the type of program that can read most standard fonts, including mixtures of many fonts on the same page.

The Mac program getting the most attention lately is the just-released OmniPage, which lists for \$795. The package not only reads multiple fonts per page but also recognizes such page structures as columns and mixed text and graphics. "I consider it a major breakthrough," said Boysel.

OmniPage uses a built-in intelligent-recognition strategy, which means that it can read a wide variety of fonts and even mixed fonts on the page without any training by the user. On the other hand, because no training is accepted, the program's results cannot be improved by the user. Most Mac scanner vendors, including Apple, HP and Microtek, have or are implementing a version of OmniPage that works directly with their hardware. The program also reads TIFF files.

Another widely used program, Read-It!, must be trained to recognize new fonts (it comes with files for 40 popular fonts). It is also available on a wide variety of scanners. Olduvai even has a version of the program that works with images created by the low-cost ThunderScan system.

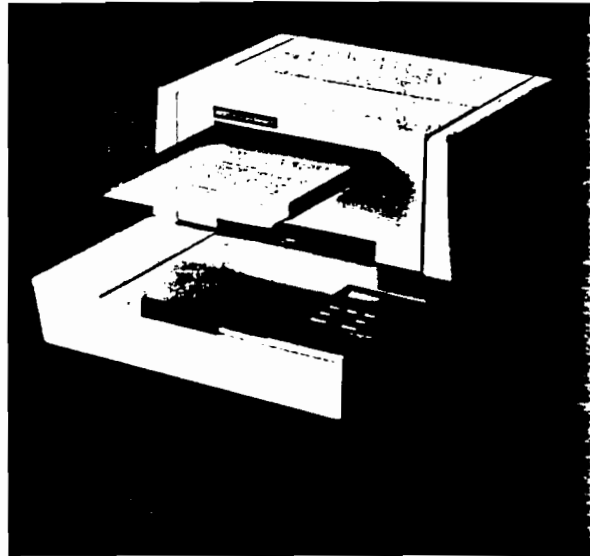
Read-It! understands both TIFF and PICT files, so it can be used with images that were created with non-supported scanners, fax boards or other graphics applications. A new version of the product that adds more intelligent recognition techniques to the basic matrix matching (see story at left) is due out this fall.

The third program that receives most mentions from scanner makers is ReadStar II Plus from Inovatic. Although previously distinguished in part by its \$4,500 price tag, a new \$995 list price has made it more accessible. It uses an intelligent character-recognition scheme and is available with drivers for many of the popular scanners.

TextPert, a new program recently imported from Spain, also claims to use an intelligent-recognition method "integrating all three of the OCR technologies." The \$995 program is now marketed and supported by a U.S. affiliate, CTA Inc. Because of the attention to accuracy and flexibility of setup, said Juan Vich, marketing manager for the product, it provides an overall throughput that is faster even though it does not read text as fast as some of the other programs.

There are at least half a dozen more programs on the Mac, such as TextScan from New Image Technology, in various stages of development. Several scanner manufacturers, such as DEST with its MacInText, offer their own entry-level program but rely on the leading packages to satisfy the needs of the more demanding OCR customers.

All of the programs specify accuracy



DEST's Work-Less Station II costs as much as a scanner and a Mac together and does the entire scanning and recognition job.

How characters get recognized

Scanning programs and systems generally use one or more of three main techniques to recognize characters: matrix matching, feature extraction and intelligent recognition.

Matrix matching is the simplest of the techniques and requires the least software complexity. Each character is isolated, translated to a dot pattern in a standard matrix, then matched against the dot patterns of known characters.

Matrix matching can produce fast, accurate results when used with mono-spaced (typewriter-style) fonts that have good character differentiation. Some companies also have been able to produce systems that do well with many of the proportional fonts used for printed text. However, matrix matching has a hard time with multiple fonts, with letters that are kerned (spaced close) and with broken or dirty type.

Feature extraction analyzes characters in terms of their open shapes. Typically, a system might look for closed areas, convex and concave arcs, intersecting lines and so on.

Properly analyzing features takes a lot of computing cycles, so this technique tends to be slower than matrix matching. However, it is more tolerant of slight variations in character shape, size or position.

The third technique goes by a variety of names such as flexible matching, holistic recognition and intelligent recognition. Essentially, it is the application of artificial intelligence-derived methods for shape recognition to characters.

This last method tends to require a lot of computation, but it is the most tolerant of changes in the letterforms and multiple type fonts. In fact, at least one product for the Mac, Caere Corp.'s OmniPage, bills itself as "omnifont" recognition.

Especially with the first two methods, where the details of individual characters are important, the system may need to be "trained" for each font. In this procedure, the user furnishes a sample of the font to be scanned and identifies for the system any characters that are not yet recognized. This training process can take from a few minutes to nearly a quarter of an hour. Most systems that use training also come with pre-built training files for the more popular typefaces. — By Steve Rosenthal

rates of better than 99 percent on text within their reading parameters. But users have said that the result is often more modest.

"We hit 97 percent on a normal multiple-column document with no breaks, such as a White Pages [document]," said Pacific Coast Publishing's Woodhall, "but we hit 44 percent on complex, multiple-column documents like the Yellow Pages. In our particular case, 99 percent is most desirable, 97 percent gets to

be troublesome — 2 or 3 percent error is a breaking point for us."

However, when the alternative is complete rekeying or significant correcting, there is no doubt in most users' minds which they would rather do. Mac OCR may not yet be perfect, but in many instances it's clearly a lot better than the input alternatives. □

Steve Rosenthal is a MacWEEK contributing editor.

PRODUCT INFO

Apple
Apple Scanner: \$1,799
20525 Mariani Ave.
Cupertino, Calif. 95014
(408) 996-1010; (800) 538-9696

Caere Corp.
OmniPage: \$795
100 Cooper Court
Los Gatos, Calif. 95030
(408) 395-7000;
(800) 535-7226

CTA Inc.
TextPert: \$995
866 Second Ave.
New York, N.Y. 10017
(212) 759-6201

Datascopy Corp.
Mac(OCR): \$695; JetReader Scanner:
\$1,300; Model 730 Scanner: \$1,800
1215 Terra Bella Ave.
Mountain View, Calif. 94043
(415) 965-7900; (800) 821-2898

DEST Corp.
Text Pac: \$595; PC Scan 1000 and
2000 series: \$1,495 and up; WorkLess Station
II: \$9,795 and up; Publish Pac: \$595
1201 Cadillac Court
Milpitas, Calif. 95035
(408) 946-7100;
(800) 538-7583

Hewlett-Packard
HP ScanJet: \$2,090
19310 Pruneridge Ave.
Cupertino, Calif. 95014
(619) 592-8363;
(800) 752-0900

Inovatic
ReadStar II Plus: \$995
1911 N. FL Myer Drive, Suite 708
Arlington, Va. 22209
(703) 522-3053

Intelligent Optics Corp.
700A: \$5,495
4 Heritage Park Road
Clinton, Conn. 06413
(203) 669-3650

Microtek Lab Inc.
MSF-300C: \$1,595; MSF-300QS: \$2,295
until Dec. 1, then \$2,495; MSF-300G:
\$3,495; MSF-400G: \$3,995;
MacInText: \$199
16901 S. Western Ave.
Gardena, Calif. 90247
(213) 321-2121; (800) 654-4160

Mirror Technologies Inc.
N-205 Overhead Scanner
(VisionScan): \$595
2644 Patton Road
Roseville, Minn. 55113
(612) 633-3255

New Image Technology
MacScan: \$1,995; TextScan: \$395
9701 Philadelphia Court
Lanham, Md. 20706
(301) 731-2000

Olduvai Software
Read-It!: \$395; Read-It! TF (for use with
ThunderScan): \$149
7520 Red Road, Suite A
South Miami, Fla. 33143
(305) 665-4665; (800) 822-0772

Siemens Peripheral Systems Division
HighScan: \$4,900 to \$6,800, volume
discounts available
240 E. Palms Road
Anaheim, Calif. 92805
(714) 991-9700

Thunderware Inc.
ThunderScan: \$249
21 Orinda Way
Orinda, Calif. 94563
(415) 254-6581

AppleScan scans it several times with different parameters, and prints all the test pages on a single sheet (this only works with bi-level images, presumably on the assumption that you can correct gray-scale scans after they're captured).

If you are capturing images destined for publication, your scanning software should at least let you adjust the size of the printed image, and with gray-scale images, the screen frequency and angle. Printing options aren't so important if you're just capturing images for FPO screen display, or drawing templates.

WHAT TO BUY

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Now that you know more than you ever wanted to know about scanning hardware and software, you probably want to know which scanner you should buy. As usual, it depends—on your needs and your budget. Your budget is your business, but here's a roundup of the features you will want for the four scanning scenarios I listed at the beginning.

- **Drawing Templates** You don't need a top-notch scanner if you just want to capture images that you will then draw over in something like Illustrator or Free-Hand. An inexpensive sheetfed, overhead, or hand-held scanner (for small images) will do. You don't generally need or want gray scales for drawing templates; while proper scan alignment can save you some time, it is not as critical for templates as it is with scans for line-art publication.

- **Publishing Line Art** You don't need the best scanner in the world for line-art publishing, either. What you do need is an overhead or flatbed that lets you align art precisely (though if you're on a limited budget and don't need to scan large images very often, a hand-held will suffice). In any case, resolution is important—go for 300 dpi. Explicit threshold control in the scanning software is useful,

- high brightness and contrast control for scanning can achieve much the same effect. You'll definitely want a good bit-map-editing program like DeskPaint,

MacPaint, or SuperPaint 2.0

- **Screen Display** Your needs here depend on the software and hardware you'll be using for display. If your setup can display gray levels (VideoWorks on a Mac II, for instance), it's to your advantage to use a gray-scale scanner. Gray-scale scanning is also useful with HyperScan, even though the latter displays only bi-level bitmaps, since you can adjust images for brightness, contrast, and dither pattern at scan time.

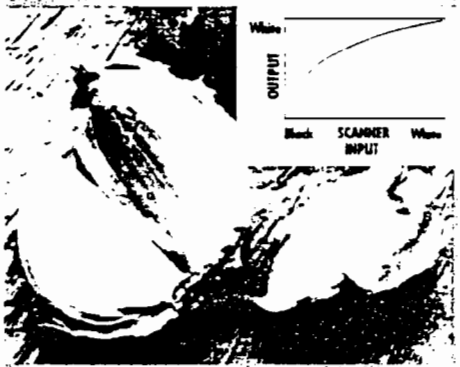
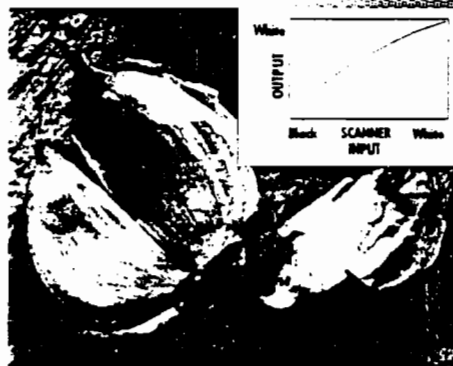
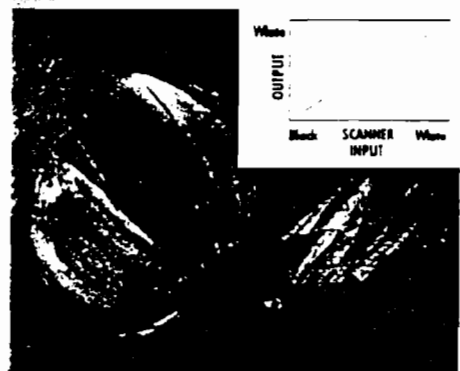
If you can't afford the flexibility of the AppleScan/HyperScan combo or another gray-scale scanner, just about any scanner will work for capturing screen images, since resolution doesn't have to be high. The main thing to look for in a bi-level scanner is a variety of dither patterns, or at least one dither pattern that you like. Alignment is not crucial.

- **FPO Placement** Get something cheap and fast. A sheetfed will do just fine; resolution is not important, and no gray scales are required. As long as the image is accurate enough that you can wrap type around it, and clear enough so your printer knows what goes where, you're in business. You'll want control over scan area and some simple editing tools to erase unwanted areas before you place the image.

- **Halftone Publication** This is the most demanding scanner application, and you'll need the best hardware and software you can buy. While the 4-bit flatbed scanners on the market can provide reasonable quality if you're not too demanding or are just using laser output, for really good images off the Linotronic you'll need an 8-bit scanner. You'll want control over brightness and contrast at scan time, the ability to alter the overall gamma curve (if you can get it), and tools for manipulating and editing the gray-scale image after it's been captured. ■

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Steve Roth is an editor of *Real World PostScript* (Addison-Wesley, 1988) and the former editor of *Personal Publishing Magazine*.



Gamma Correction in Action
The graphs inset in each of these gray-scale halftones come from Datacube's *MacImage* and show the gamma-curve settings used to make each scan. The curve shows the relationship between input values and output. When the curve at the dark end of this flat, dark image is stretched, small differences in input brightness are made to yield increasingly larger changes in output brightness. The result: a more even distribution of tones and a better print.

OmniPage makes OCR a snap

But keying in data is still easier, cheaper



OmniPage

Caere Corp.
100 Cooper Court
Los Gatos, Calif. 95030
(408) 395-7000; (800) 535-7226

List Price \$795

+ Automatically separates multiple columns and text from graphics; automatic font recognition; easy to use.

- Expensive hardware requirements; does not handle large amounts of material efficiently; can't read Draft mode from the ImageWriter.

BY SCOTT BEAMER

OmniPage from Caere Corp. has brought optical character recognition (OCR) technology to the attention of a large portion of the Macintosh public for the first time. It is a breakthrough product offering technology never before seen in such a low price range on microcomputers. OmniPage is so easy to use that even computer neophytes will get useful results on their first try. What the ads say is true; it quickly reads most printed material such as books, newspapers, magazines and, of course, typewritten text.

Big hardware. Many who are considering giving OmniPage a try will be surprised by its price and then shocked by its hardware requirements. OmniPage was built to run on a Mac II with 4 Mbytes of RAM. In a pinch, you can make do with an SE, although Caere recommends it be equipped with a 68020 accelerator board with the requisite 4 Mbytes of RAM.

The heavy hardware requirements are because OmniPage works only with documents scanned or saved as uncompressed TIFF files. An 8-by-10-inch page saved in this format takes up about 1.2 Mbytes of disk space. As OmniPage keeps the original image of the page and a temporary copy in RAM, it is not surprising that it requires 3.1 Mbytes of dedicated RAM. And if you expect to scan pages first and interpret them later, also plan to have a high-capacity hard disk on which to store them.

When looking at the requirements for OmniPage or any similar product, remember that OCR is an alternate technology. You can always type the data into the computer yourself or pay a service bureau or team of

typists to do it for you. Therefore, most businesses should perform a careful cost analysis to determine OmniPage's suitability for their situation.

In rough terms, having a service bureau enter your data for you will cost between \$1 and \$2 a page. Thus the break-even point for using OmniPage will be several thousand pages if you include hardware costs. And don't forget the cost of processing labor. Even experienced OmniPage users can process only about 30 pages an hour at a sustained rate. This does not include data checking or cleanup. With any OCR product, careful proofing is necessary to remove recognition errors (a spelling checker helps with this) and replace lost formatting. If you already have a 4-Mbyte Mac II and a scanner, you will still need to process more than 1,000 pages before the software begins paying for itself.

Stick shift or automatic. OmniPage is not the only sophisticated OCR product for the Mac. Three other programs can recognize typeset material: ReadIt! from Olduvai of South Miami, Fla.; TextPert from CTA of New York; and ReadStar Plus from Innovativ of Arlington, Va. These programs require you to first teach them to recognize the font in question. Although elaborate software controls help with this process, it is time-consuming, tedious and requires some expertise to produce acceptable results. If the font table you create is not good enough, the error rate will be too high, and the amount of time needed to clean up the data will make rekeying a more viable approach to your data-transfer needs.

The most striking difference between OmniPage and the competition is its high degree of automation. All OCR products automatically divide a section of scanned text into lines and characters. But only OmniPage scans the page and automatically identifies multiple columns and graphics. It is also the only Mac OCR product that automatically recognizes fonts in typeset material.

There are trade-offs between OmniPage's highly automated approach and the slower font table methods. OmniPage does not understand diacritical marks and therefore cannot read foreign languages that use them. It does not recognize some common fonts such as Draft mode from an ImageWriter printer. Sometimes it will consistently misidentify a character. And because you can't teach OmniPage anything, there is no way to adjust this. Such problems must be handled in the cleanup process.

When OmniPage works on a page, the screen animation shows it separating the page into units of text and graphics. If you have selected Manual Galley, it will pause at this point and allow you to designate the order in which blocks of text should appear in the text file. Each unit of text has been numbered and surrounded by a box. You can change the order or delete any boxes that you do not want included, such as headers, headlines or captions.

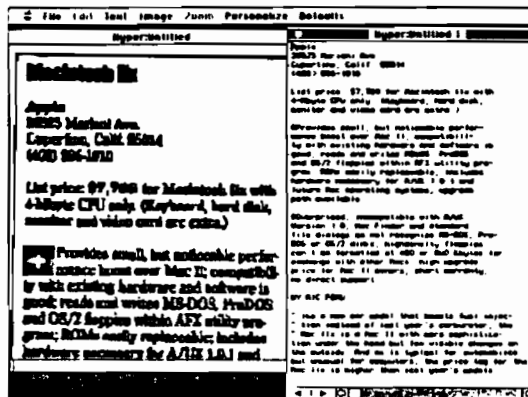
The acid test. In actual use, OmniPage works surprisingly well, but some shortcomings quickly become apparent. Principal among these is its deficiency as a heavy-duty OCR product. First of all, many users assume that the Apple Scanner is the best scanner to use with OmniPage since it is most often demonstrated on the Apple Scanner. But because it has no automatic document feeder, the Apple Scanner is not a good choice for continuous OCR work. To use the Apple Scanner with OmniPage, you must stand in front of the scanner, change pages and click the mouse every two minutes. This manual operation is the only way to combine multiple pages into a single text file.

With scanners that have document feeders, you can scan pages unattended and save them as uncompressed TIFF files. But then you have to process those TIFF files with

Continued on next page



Choosing Manual Galley causes OmniPage to pause after separating the page into blocks, allowing you to set the order in which they will be recognized. Blocks such as headlines, captions or footers can be deleted at this time. Note also that the page was somewhat skewed.



Zooming in is not intended to help the user read scanned text, but only to help identify text block boundaries. Notice that the character recognition is almost perfect in this section of a MacWEEK page.

THE WEEK IN REVIEWS

FontSizer ends on-screen jaggies

BY BECKY WARING

FontSizer from U.S. MicroLabs Inc. is a new utility that builds screen fonts in large sizes for PostScript printer users. Serious desktop publishers have long had problems with on-screen accuracy and spacing, not to mention readability, when using non-standard point sizes. Although laser printers can generate perfectly smooth outlines for non-standard sizes on paper, until now users have had to squint at and struggle with the jaggies on screen.

FontSizer builds the large sizes (from 12 to 127 points) using the imaging capabilities of any PostScript printer. It essentially captures the image of a font that would appear on a page and transfers it back to the Mac for use on screen. This procedure yields beautifully smooth screen fonts that can be kerned precisely and are easy on the eyes.

While the results will be worthwhile for heavy users of custom fonts, the building process has many unavoidable limitations. First, you must decide in advance what sizes and styles of each font to build. The actual imaging process itself takes about five minutes per font size. Since you'll most likely need multiple sizes and styles for each font, the total time required can be hours. While FontSizer can run in the background under MultiFinder, it will still tie up your laser printer. The manual recommends building fonts overnight.

Assuming that you are able to decide in advance exactly what sizes and styles of various fonts you will need and that the imaging process goes without a hitch, you'll find that you are devoting massive amounts of disk space to screen fonts. We filled up 5 Mbytes with just a few sizes and styles each of four different fonts. You also need to be careful when using FontSizer with Master Juggler and Suitcase. While the FontSizer manual is generally quite good, it does not cover this natural combination of font utilities, and there are several crucial steps that must be followed for them to work together properly. A phone call to U.S. MicroLabs' tech support solved the problems we had, however, and the company promised an addendum to the manual soon.

Despite its operational drawbacks, FontSizer is a great idea, much needed by ad agencies, type houses and other heavy font users. It will also be of use to companies that have standardized on certain fonts and sizes for desktop publishing. Now they can provide employees with readable screen fonts in selected styles. FontSizer is published by U.S. MicroLabs Inc., 1611 Headway Circle, Building 3, Austin, Texas 78754; (512) 339-0001.

Capture the screen. Get Mac II screen dumps with menus pulled down or dialog boxes open using Capture from Mainstay of Agoura Hills, Calif. Screen dumps are saved in color PICT2 format and can be edited by color paint and draw programs. Call (818) 991-6540 for more information.

Only 32 more computing days ... The Computer Museum of Boston has the best gifts for silicon addicts, including circuit design silk ties, blinking LED pins and earrings, computer trivia games and chocolate floppy disks. Call (617) 426-2800, ext. 307 for a catalog. □

Continued from previous page

Each page singly, saving the recognized text into a single file with a text editor or word processor. Text files recognized from multiple TIFF images should be able to be merged as they are processed. OmniPage's method is an unacceptably inefficient way of dealing with this situation.

Recognized text can be saved in plain text, MacWrite or Excel formats. Saving in Excel format actually creates a tab-delimited text file that can be imported into nearly any database or spreadsheet. No OCR product saves much formatting, and in OmniPage the font faces, styles, sizes and columns are usually lost. Text saved as MacWrite, however, retains bold and underline formatting.

Although 30 pages an hour is about as fast as you are likely to go with OmniPage, it does not slow down much when scanning complex pages — those with multiple columns, tables, graphics and sidebars. Problems arise more often during the recognition phase. Typewritten or poorly printed characters slow things noticeably. Poor-quality originals can be very slow. The biggest snag we encountered was caused by skewing. Although Caere claims the software can read lines skewed up to 0.25 inch, such lines can cause problems.

When OmniPage draws a block around a body of text with the last line skewed, it tends to shave the bottom off some of the letters. This cut-off line slows things down

so badly that one might assume the machine has hung.

Error rate. The quality of the material being scanned presents so many variables that it's impossible to set an exact error rate for any OCR software. Poor-quality printing, dirt on the page, a poor photocopy, handwritten corrections and non-standard characters (such as

products, it would seem appropriate to include warnings and advice about copyright law, but Caere does not.

You can call technical support through a toll-free number, but the wait to speak to a live person is so long that leaving a message is easier. We were called back the same day when we left messages, and the technical staff was friendly and knowledgeable.

Assuming six characters per word, some actual results were:

- A Wall Street Journal article: 823 words, 12 errors (99.9 percent accuracy).
- A page from a laser-printed software manual: 533 words, no errors (100 percent accuracy).
- A photocopy of a typed legal contract: 220 words, one error (99.9 percent accuracy).
- A typeset press release: 261 words, eight errors (99.5 percent accuracy).

Documentation and support. The manual is both informative and handsome. It offers a surprising amount of useful experiential advice, but it is short on technical specifications and tips on how to get heavy-duty performance out of the product.

Also, one of the examples in the manual appears to be an infringement of copyright law. In this example, an employee uses OmniPage to transcribe articles from the trade press to his Mac, and he assembles a company newsletter from these articles. Because of the ease of abuse of copyright with OCR

Conclusions. OmniPage is the most exciting and effective OCR product available on microcomputers. We think, however, that for dedicated text entry, the majority of businesses will continue with their traditional data processing methods because of OmniPage's high cost, hardware requirements and lack of high-volume data processing facilities.

Still, OmniPage can eliminate large amounts of drudgery from data processing chores in many Macintosh-equipped offices. Once installed, it is amazing how well OmniPage works. Anyone in the office who knows how to use a Mac can put a few pages on the scanner and have a text version of the document available a few minutes later.

Casual use of OmniPage is a dream come true. And for some, the convenience of painlessly transferring words from virtually any source to the computer in minutes will be cheap at any price. □

Scott Beamer is a free-lance writer in Berkeley, Calif.

Anyone who knows how to use a Mac can use OmniPage.

foreign accents, copyright and trademark symbols) all affect the recognition rate.

OmniPage's automation proves most valuable in situations where one is converting a wide range of printed material to electronic files. The large number of font tables needed would make the project infeasible for any trainable Macintosh OCR product. Thanks to OmniPage's automation, its error rate is at least as good as any other Macintosh OCR product, perhaps lower, and it does exceptionally well with very complex material.

In actual use we found accuracy rates ranging from 99.5 percent to 100 percent. Note that accuracy rates cited by OCR manufactur-

VideoWorks II

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Clip Animations	59.95
Clip Charts	59.95
Clip Sounds	59.95
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VideoWorks CD-ROM	695.00

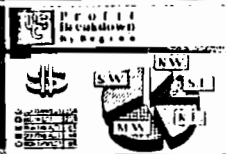
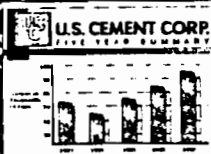
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1028 West Wolfgram,
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VideoWorks II was a 1987 winner of the MacUser Golden Eddy Award and Best Creativity and Best Vertical Market Product, 1987, from the Software Publishers Association.



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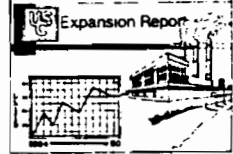
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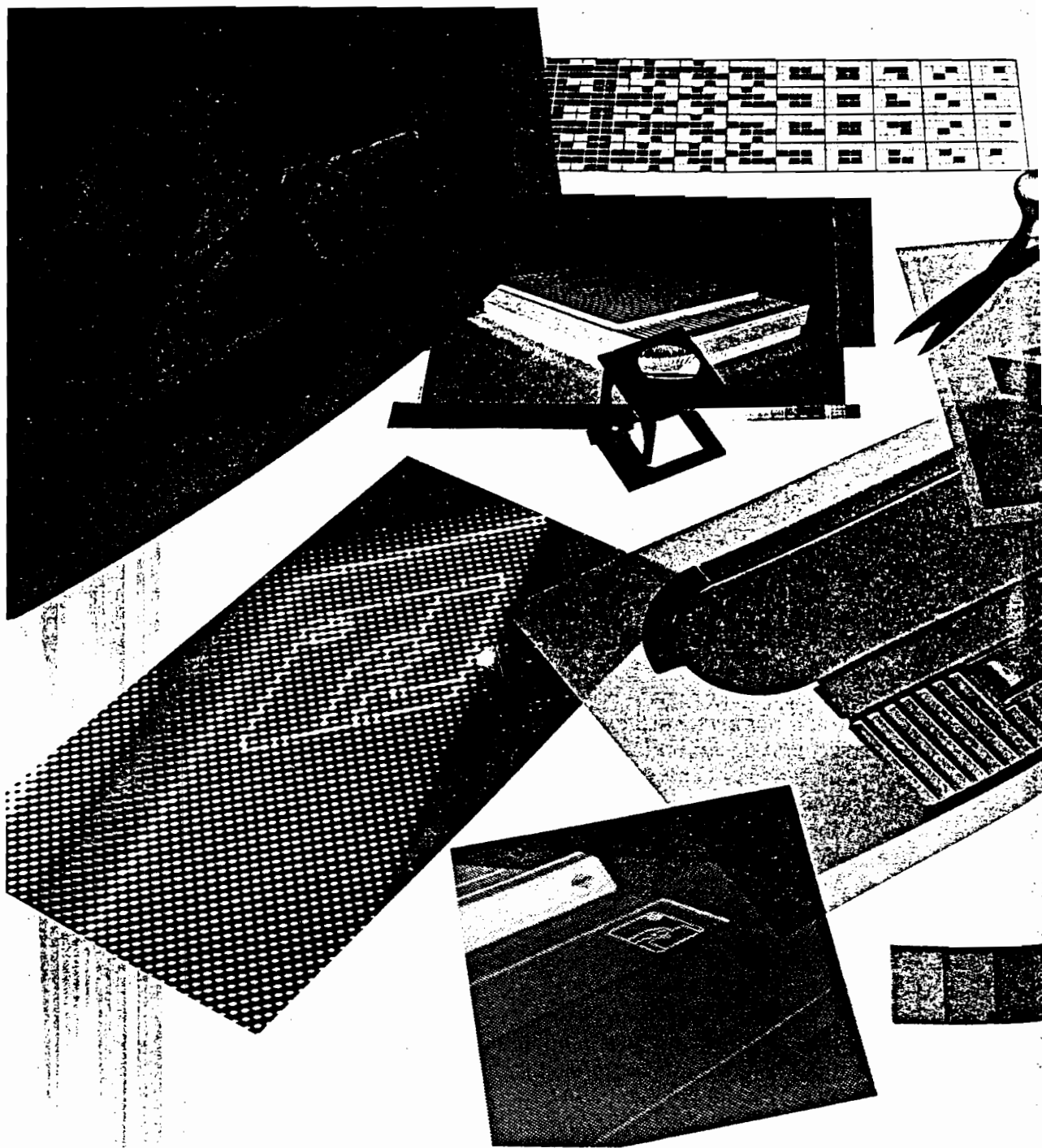
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Gray Expectations



A new generation of desktop scanners sports lower prices, higher resolutions, and amazing grays.

When the Macintosh burst onto the computer scene in 1984, it was hailed as the electronic equivalent of a graphics studio. As long as you created everything from scratch, using the fonts and drawing and painting tools on the computer, it was a brilliant conceit. But if your artistic talents were limited to scratching out stick figures, or if you wanted to use nonelectronic artwork, your options were few. True, desktop scanners also made their debut in 1984, but poor image quality and high prices limited their appeal. For the average user, there was no satisfactory way to bring high-quality drawings, photos, or text from the outside world to the digital desktop.

Fast-forward to 1989. MacUser Labs receives nearly a dozen of the trendiest peripherals in Macdom: gray-scale scanners. Recent advancements in scanning technology have spawned a new generation of desktop scanners with higher resolutions, expanded gray-scale capabilities, and lower prices. Today, a scanner that captures 256 levels of gray costs around \$2,000 — that's cheaper than a black-and-white model just two years ago.

To evaluate the current state of the gray-scale-scanner market, we put eight popular flatbed models — the Abaton Scan 300/S, AGFA Focus S800GS, Apple Scanner, Dest PC Scan 1000, Hewlett-Packard ScanJet Plus, Microtek MSF-300QS, New Image MacScanPro, and Xerox Imaging System's Datacopy

730GS — through their paces. All the scanners, except the AGFA, have resolutions of 300 dots per inch (dpi). We threw in AGFA's 400-dpi scanner to see how the higher resolution affected scanner performance.

We judged each scanner on its image sharpness, gray range, halftone quality, text-extraction capabilities, and ease of use. The results revealed each scanner's strengths and weaknesses as well as the sophistication and versatility of the software. Overall, the scanners ranged from very basic models to professional publishing machines; you should choose a scanner based on your applications and desired level of performance.

Popularity Explosion

The recent explosion in scanner popularity was triggered by the Mac II, with its increased processing power, and the introduction of gray-scale monitors and image-editing software such as Digital Darkroom and ImageStudio, which let you see and manipulate multiple levels of gray.

The gray-scale scanner has become the darling of the desktop-publishing world. You can scan a photograph into your Mac, enhance it with image-editing software, scale it for placement in a page-layout program, and print it along with text on a camera-ready page. Although the image quality still doesn't match that of traditional halftone photographs, it's good enough for most rudimentary and midlevel publishing needs.

**By Aileen Abernathy, Peter Weiss,
and the MacUser Labs Staff**

Desktop publishers aren't the only ones benefitting from the scanner revolution. Artists, engineers, and mapmakers, among others, can minimize manual tracing and redrawing by using a scanner to input drawings, logos, blueprints, circuit diagrams, and detailed maps.

Anyone who processes words (or numbers) for a living will enjoy the labor-saving benefits of a scanner coupled to an optical-character-recognition (OCR) program. OCR turns printed words into

electronic text files, eliminating the need for retyping. Letters, articles, books, forms, spreadsheets — all can be input rapidly to your Mac with a scanner and OCR software.



tantalizing, but how much green will you have to pay for the grays? Scanner prices

Green for Grays

The current crop of gray-scale scanners is certainly tantalizing, but how much green will you have to pay for the grays? Scanner prices

are dropping fast (both Microtek and New Image lowered their prices during the course of this report), but, in general, price and number of bits rise together.

Four-bit scanners with 16 grays retail for less than \$1,800; 6-bit models (64 grays) are about \$2,000, and New Image's 8-bit MacScanPro (256 grays) goes for \$2,495. The real bargain is Hewlett-Packard's ScanJet Plus, which has 8 bits (256 grays) but a price of only \$2,190. On the other hand, the AGFA Focus S800GS has only 6 bits, but its 400-dpi resolution demands a hefty \$5,495.

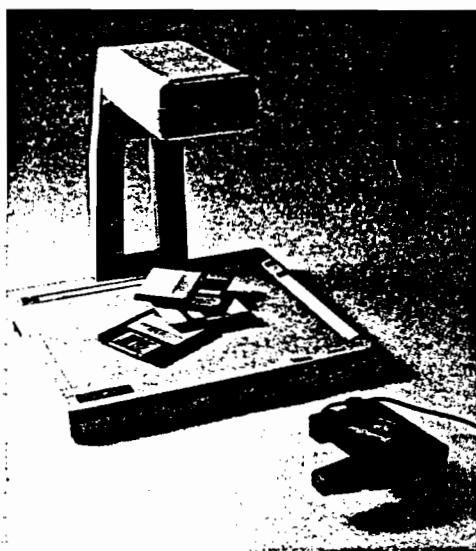
But before you plunk down \$2,000+ for the latest model, consider your total investment. A gray-scale scanner may seem expensive, but it's only the beginning. You can't see the grays without a gray-scale monitor and video card (\$1,500 to \$3,500). Gray-scale files can be several megabytes in size, so you may need to buy elusive and premium-priced RAM. And you shouldn't even consider working with gray-scale images without a sizable hard disk. If your scanner's software has limited image-editing abilities, you may need additional software, such as Silicon Beach's Digital Darkroom (\$295) or Letraset's ImageStudio (\$495).

Does the total bill make you feel faint? If so, and if your scanning demands are low-key, then you might consider some of the low-cost alternatives (see "Scanning on the Cheap" and "A Scan in the Hand" sidebars).

Scanning on the Cheap

If your wallet says "no" to a flatbed or sheetfed scanner, consider these low-priced alternatives:

ThunderScan, from ThunderWare (Orinda, Calif.), transforms an ImageWriter I or II (but not an LD) into a scanner by swapping a scanning head for the printer's ribbon cartridge. The head sweeps back and forth across the paper as it feeds through the printer's rollers, capturing information instead of printing it. This innovative product has shown amazing vigor against today's sophisticated competition, given that it's as much as 100 times slower than the average flatbed scanner, is difficult to focus, and can scan only what fits between the rollers. We credit its longevity to elegant simplicity, low price,



VisionScan and ThunderScan (front) give reasonable image quality at bargain-basement prices.

and some surprisingly sophisticated features: 32 levels (5 bits) of gray, a maximum resolution of 288 dpi, and respectable scan-control and image-editing software. ThunderScan lists for \$249 but drops to \$199 at many discount outlets.

The VisionScan 300, from Mirror Technologies (Roseville, Minn.), resembles an overhead projector or enlarger. Its image sensor is mounted in a motionless head overhanging a scanning bed. Only a mirror within the head moves, reflecting an image from the bed onto the optical sensor. The 1-bit scanner takes about ten minutes to scan a letter-size page at its full 300-dpi resolution (that's four-times faster than ThunderScan). It can also scan objects up to 1 inch in height. Mirror bundles VisionScan's driver software with Zedcor's DeskPaint. The VisionScan 300 retails for

\$795; an older 200-dpi model, the VisionScan 200, is \$595.

VisionScan and ThunderScan both transfer image data via the serial port — a boon if your Mac lacks a SCSI port but otherwise a culprit in the tedious pace of their scans.

If you have a stand-alone fax machine, you may be interested in FaxScan, from MDideas (Foster City, Calif.), which turns your fax machine into a scanner (line art only!). This external box connects your Mac to the fax machine. Flip a switch, and when you feed a document into your fax machine, instead of going out over the phone line, the data feeds into your Mac. You can cut and paste the resulting image via the Clipboard. At \$299.95, FaxScan gives you a fast and inexpensive scanner for your Mac, but it's compatible with Group II fax machines only.

— Peter Weiss

Flatbed or Sheetfed?

Scanners look and act a lot like photocopiers, except that the resulting image is an electronic bit map rather than ink on a piece of paper. In *flatbed* scanners, the light source moves across the original document; *sheetfed* machines hold the light steady and feed the original through a pair of rollers.

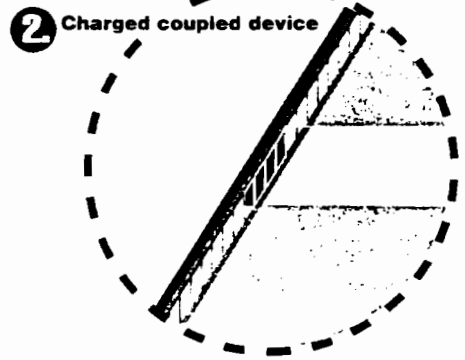
Sheetfed scanners are cheaper, but they accept pages of only certain sizes and thicknesses. Sheetfed models can also cause image distortions because they have problems with page alignment. A sheetfed scanner is a good choice for OCR, however, since it is easily fitted with an automatic document feeder for rapidly scanning many pages.

Flatbed scanners, the kind we're re-

How It Works

1 Illuminating the Original

In a flatbed scanner, the light bulb moves across a stationary original. The light shines on deflectors to illuminate the original without hot spots. The distance the light travels from the original to the CCD must remain constant for the image to remain in focus. The transport mechanism of motors, pulleys, and gears is built with great precision in order to maintain a constant light-path length and avoid image distortions.



2 Charged Coupled Device

The CCD is a tightly packed line of 2,000 to 4,000 photoelectric cells that produce a voltage proportional to the amount of light striking them. Each cell corresponds to a single pixel on the scanned image, which is read one line at a time. In this case, the stem of the apple reflects less light than its background. Thus, less light reaches the CCD, and a lower voltage is produced. This low voltage translates to a darker gray. A new charge accumulates in the exposed cells while previous charges are collected and measured by the analog-to-digital (A-to-D) converter.

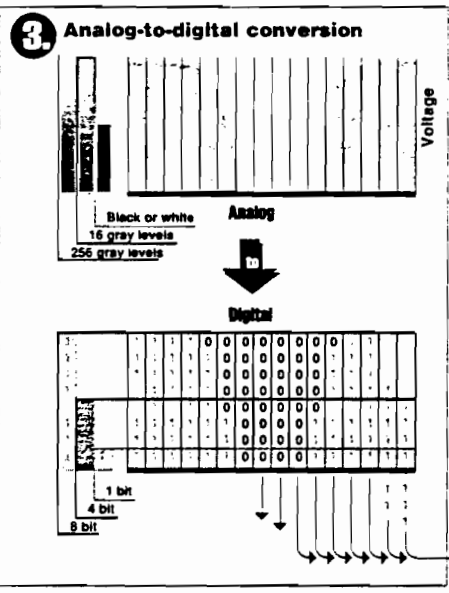
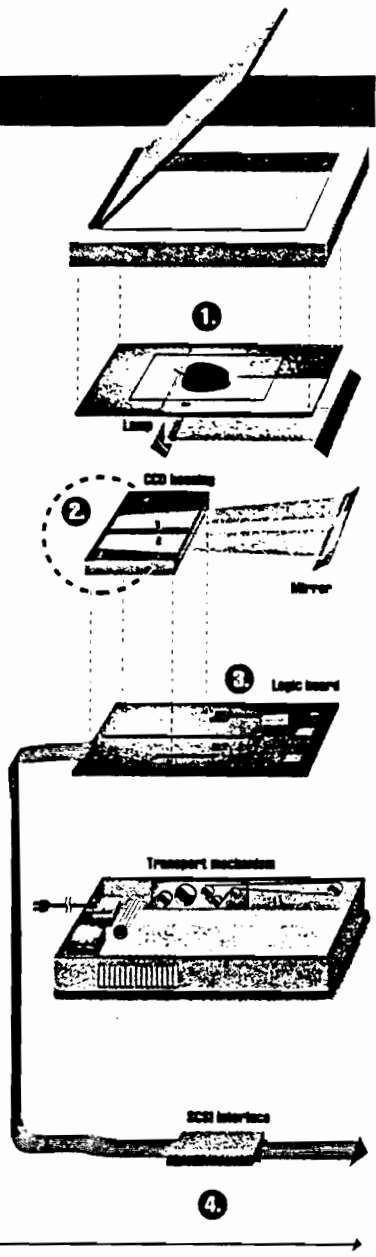


ILLUSTRATION MARK W. SWITNEY



3 Processing the Gray Scale

The A-to-D converter measures the incoming voltage and rounds it off to the nearest digital gray-scale value. The number of bits the scanner works with determines the gradations in the gray scale (16 for 4 bits, 256 for 8 bits). For line art and halftones, the electronics convert gray-scale data to black-and-white values.

4 Transmitting the Data

The external SCSI box handles data transmission between the logic board and the Mac. Some scanners have a built-in SCSI interface.

viewing here, provide higher-quality images because the original doesn't move. In general, they're a better investment, in that you can precisely position artwork and scan documents of any size and thickness—photographs, books, or oversized technical drawings. Some flatbed scan-

ners, such as the Dest and Hewlett-Packard models, can also be equipped with automatic sheet feeders. Unlike photocopiers, scanners rarely have hardware controls; everything happens through software. One exception is the Apple Scanner, which offers one-

touch scanning through its Remote Scan button. After setting the scanning parameters at your Mac, just press the button at the scanner, and the software controls the scans and saves them with sequential filenames. Remote scanning is handy if you're scanning a stack of photographs,

for example, or a set of papers to be read by an OCR program.

Under the Hood

Scanning technology isn't sleight of hand, but it does use lights and mirrors to give itself a good image. Light bounces off the original image and is conveyed, via a series of mirrors, to the scanner's "eyes" — the *charged coupled device* (CCD), a single row of up to 4,000 tightly packed light sensors.

The CCD produces an electrical signal proportional to the amount of light striking it. A dark spot on the original reflects less light, so less light falls onto the CCD, producing a lower voltage. Likewise, a light-colored object produces a stronger voltage. The scanner's electronics convert these voltage levels into digital gray-scale values and transmit them to the computer. The accuracy of the gray-scale data can be affected by several factors, including colors, glare, dust, grease spots, and electrical noise.

The transport mechanism of motors, pulleys, and gears is precisely engineered to ensure that the mirrors and lenses remain in focus by keeping the length of the light path constant. A vibrating transport causes image distortions, just as a shaky hand blurs a photograph. The pre-

cision required of the engine is one factor that makes scanners so expensive.

Of the scanner makers whose products we tested, only AGFA and Microtek make their own engines. Three scanners have Canon engines (Hewlett-Packard develops its engines with Canon), and Abaton and Apple use a TEC engine. We couldn't find any problems or discernible differences in the engines.

All the scanners have flat, uniform lighting provided by either incandescent or fluorescent bulbs. The ScanJet Plus automatically compensates for changes in light intensity; the MacScanPro leaves it up to the user. Light intensity is an especially important consideration for 8-bit scanners, since any deviation can distort the gray-scale values.

The Resolution Factor

The quality of a gray-scale image depends largely on two factors: resolution and the number of gray levels. *Resolution* is simply the number of pixels a scanner can cram into an inch. A *pixel*, or picture element, is the smallest area the scanner "sees." In scanning terminology, pixels are sometimes called *samples*, because the scanner obtains data by "sampling" the original image. To confuse matters further, manufacturers list a scanner's

resolution in dots per inch (dpi), the ubiquitous unit of measurement also used for monitors and printers.



In general, the higher the resolution, the more detail an image has — finer lines, smaller type, or more subtle gray transitions. Resolution is especially important for engineering and architectural drawings, maps, and other highly detailed images in which minute features are critical.

Of the scanners we tested, seven have a maximum resolution of 300 dots (or pixels) per inch; the AGFA can record up to 400 dpi. A 300-dpi resolution matches that of most laser printers; thus, the scanned and printed images will be the same size and show the same amount of detail. The added resolution of AGFA's scanner is barely noticeable on a 300-dpi printer, but it provides superior image quality for magnifying an image or sending output to a high-resolution printer.

Keep in mind that if the scanned and printed resolutions don't match, the image sizes won't be the same. For example, an image scanned at 300 dpi and printed at 600 dpi will be only one-fourth its original size. Why? Because a 600-dpi printer has twice as many dots per

Glossary

<p>charged coupled device (CCD) — A single row of up to 4,000 tightly packed photoelectric cells that serves as the scanner's "eyes." The CCD produces an electrical voltage proportional to the amount of light striking it. This voltage is converted to digital gray-scale values and transmitted to the computer.</p> <p>continuous-tone image — An image, such as a photograph or charcoal drawing, that has an unbroken, nearly infinite range of gray levels between black and white.</p> <p>contrast — An image's balance of gray tones. A scanner with good contrast provides an even distribution of highlights, dark shadows, and midrange tones. High-contrast images have white highlights, black shadows, and few midlevel grays. Low-contrast images look washed out because they have too many intermediate grays. When you change the contrast, every gray</p>	<p>in the image is affected, not just selected shades as in gamma correction.</p> <p>dithering — A digital technique for simulating grays by turning various combinations of pixels on (black) and off (white). The more pixels (or dots) turned on in a specific area, the darker the simulated gray. This method is what 1-bit scanners, monochrome monitors, and laser printers use to represent grays.</p> <p>dots per inch (dpi) — A generic term that describes the resolution of printers, monitors, and scanners. The ubiquitous use of <i>dot</i> can be confusing, since the smallest element depicted by a scanner or monitor is called a pixel, yet their resolution is expressed in dots per inch.</p> <p>flatbed — A scanner in which the original is placed on a glass surface and the light source moves across it.</p> <p>gamma correction — A technique for globally changing the displayed (or printed) brightness of one or more selected shades of gray.</p>
	<p>For example, you can arbitrarily transform all 40-percent grays in an image to 72-percent grays. Gamma correction is useful for bringing out shadow details or toning down highlighted areas and usually involves the use of a <i>gray-map</i>, a graph that correlates stored grays with displayed grays.</p> <p>gray scale — Just another way of saying "gray." Gray-scale images contain true grays, rather than dithered black-and-white patterns, because each pixel is a shade of gray. The number of grays a scanner (or monitor) can represent depends on the number of bits of digital data that describe each pixel. A 4-bit scanner can capture 16 grays; an 8-bit scanner can record 256 grays.</p> <p>halftoning — A method for reproducing a continuous-tone image, using a grid of evenly spaced dots. Different gray levels are simulated by variation in the size of these dots. Halftones are necessary because a printer has</p>

inch in both dimensions. You can't add more dots (pixels) to the scanned image, so two of its 300-dpi inches will fit into each of the printer's 600-dpi inches, both horizontally and vertically.

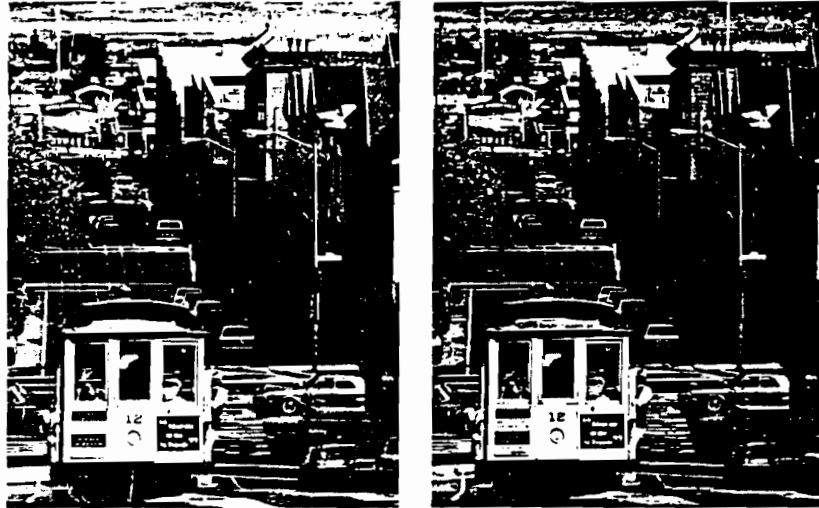
You get the opposite effect when displaying a scanned image on a standard 72-dpi monitor. Since the monitor can fit only one-fourth as many dots into an inch, the image will be four times its original (scanned) size. Although you won't be able to see all the image's details at 72 dpi, it will print with its full 300-dpi resolution.

Super-Sampling

If you don't need all those extra pixels or you're short on RAM and disk space, most scanners can do *subsampling*; that is, they can scan at resolutions below their maximum setting. Only the Abaton Scan 300/S locks you into 300-dpi scans (although you can scale images, which is almost the same thing).

A few scanners also claim to do *super-sampling*. AGFA's scanner has a nominal resolution of 400 dpi, but it provides an "addressable" resolution of up to 800 dpi through *interpolation*. Its circuitry averages an image's gray-scale values and places new pixels between the existing ones. The ScanJet Plus uses a similar

Resolution: 300 versus 400 dpi



On a low-resolution laser printer, images will look about the same whether they're scanned at 300 or 400 dpi. The superior image quality of a 400-dpi scanner (right) is readily apparent, however, when images are output on high-resolution printers such as the Linotronic 300. Note the crispness of fine details in the AGFA's output compared with the 300-dpi scan (left).

scheme to create resolutions of up to 1,500 dpi — selectable in 1-pixel increments — although its true resolution is only 300 dpi.

But don't be fooled by the hype. These scanners are *not* true high-resolution machines. Interpolated images have more

data, but they don't print with higher resolutions.

On high-resolution printers, the added data merely performs a smoothing function, providing better transitions between grays and reducing the jaggies on fine diagonal lines.

only black ink and thus can't reproduce a continuous-tone image. Because scanners and laser printers have a fixed dot size, digital halftones are created through dithering.

interpolation — A technique for increasing the amount of data in a scan by averaging an image's gray-scale values and placing new pixels between existing ones. It does not increase the printed resolution. Also called *super-sampling*.

line art — Drawings, text, and other images that are black-and-white only, with no gray tones.

OCR — Optical character recognition, the conversion of printed words to electronic text.

pixel — Picture element, the smallest area a scanner can record or a monitor can display. If just one bit of digital data describes a pixel, it can be only black or white. If a scanner records several bits of information per pixel, the pixel appear as a shade of gray.

preview — A rapid, low-resolution scan that shows the entire image on-screen; useful for selecting the area for the main scan and optimizing scan settings.

resolution — The maximum number of pixels that a scanner can fit into an inch. The higher the resolution, the more fine details you can see in an image. Resolution is usually expressed as dots per inch (dpi).

sample — The smallest area a scanner can record, also called a pixel. The name comes from a scanner's method of obtaining data by "sampling" the original image; that is, it records the grayness of each sampling site.

scan — To digitize, or convert, a real-world image, such as a photograph or text, into bits of data on a computer. The resulting digital image is also called a scan.

sheetfed — A scanner with a fixed light source that feeds the original through a pair of rollers.

TIFF — Tag image file format, a versatile method for storing bit-mapped images in various resolutions and numbers of grays. TIFF was created specifically for the storage of gray-scale data and is considered to be the standard format for saving scanned images.

thresholding — A process for eliminating gray-scale information from a scan, used mainly for line art and text. All pixels darker than a certain gray level turn black, and lighter pixels become white. The threshold value is usually adjusted automatically and continuously by the scanner, depending on the range of gray values in the scanning area.

vectorization — A means of converting line art or halftones into a group of vectors, or objects, for editing in programs such as Illustrator.

— Aileen Abernathy

MACUSER LABS

Shades of Gray

The number of grays a scanner can produce, its *gray scale*, depends on the amount of data it can record about each pixel. The first desktop scanners saw everything in black and white because they used only one bit of digital data to describe each pixel. They created the illusion of grays by *dithering* — turning various combinations of pixels on (black) and off (white). The greater the number

of pixels that were turned on in a particular area, the darker the simulated "gray." In the scanner world, dithered images are also called *halftones*, so named for their resemblance to traditional photographic halftones (see glossary).

Today's scanners can capture true grays because they store more information per pixel. The Apple Scanner, for example, stores 4 bits of data per pixel; thus, the pixel can be one of 16 shades of gray.

Likewise, Microtek's 6-bit scanner can display 64 grays, and New Image's 8-bit model can render images with 256 gray levels.



Gray-scale scanners still offer you the option of dithering, which can save scanning time and disk space for images that are mainly black-and-white or that will be printed at low resolutions. Unfortunately, dithering an image during the scanning process locks in its resolution and dither pattern. A 300-dpi halftone prints at the same resolution on a Linotronic as it does on a laser printer. Editing dithered images is virtually impossible: you can't even adjust the contrast and brightness. Furthermore, if you resize the image — for placing in a page-layout program, for example — you may wind up with ugly moiré patterns. (Actually, you *can* halve or double the size, but that's about it.)

In comparison, working with a gray-scale image is nirvana. You can resize and edit at will, adjust the contrast and brightness, lighten or darken (*dodge* or *burn*) selected areas, soften or sharpen, blend, smudge, or execute special effects using posterization (limiting the number of grays) and gamma correction (changing the brightness of selected grays). Additionally, you can output the image at whatever resolution your printer can handle.

Even so, a gray-scale image usually looks better on-screen than it does on paper, because a printer can't print grays. It has only black ink, so the image still has to be halftoned — that is, converted to a black-and-white dither pattern that simulates the original grays. But dithering on the output end means you can manipulate the gray-scale image to your heart's content *before* you print.

If, for some reason, you scan an image in the halftone mode and later want to convert it to gray scale, all is not lost. Both ImageStudio and Digital Darkroom can convert 1-bit, 300-dpi images into 4-bit, 75-dpi images. You lose three-fourths of the resolution, but you gain 16 grays that can be edited for maximum effect. Other gray levels are also available, with correspondingly lower resolutions.

A Scan in the Hand

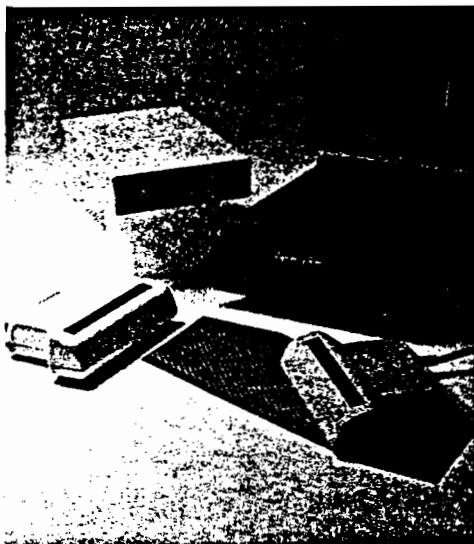
Scanners don't have to be big, serious, high-end office equipment. The small, mobile scanning wands recently introduced for the Macintosh have the Mac community abuzz over their signature-scooping, clip-art-collecting, and logo-lifting talents. These "personal scanners" can scan anything reasonably flat, albeit in narrow swaths. But you have to have a steady hand, or you'll wind up seeing double.

LightningScan, the first Mac hand scanner, was introduced last December by ThunderWare (Orinda, Calif.). It scans images of up to 4.1 inches wide at 100 to 400 dpi and has three dither patterns, a line-art mode, and adjustable brightness. The software has some image-editing tools and can save in several file formats.

LightningScan doesn't save grays, but on a Mac II the software can recover 16 gray levels from the dithered image. The scanning wand, which connects to the SCSI port, costs \$549.

ScanMan is a similar product from Logitech (Fremont, Calif.) that scans images up to 4.1-x-14 inches at resolutions of 100 to 400 dpi. Its DA software includes various editing functions but doesn't recover grays from halftones. Logitech's combination of scanner head, SCSI interface box, and software is \$499.

Yet another contender, NCL America (Sunnyvale, Calif.), should be shipping its hand scanners by the time you read this. Omniscan-105 (\$499) differs little from the others, except that it offers only one resolution, 200 dpi. NCL's second "hand-held" scanner, the gray-scale Omniscan-A4, stretches that definition just a bit. You can



PHOTOGRAPH BY PETER ALAN GOULD

New hand-held scanners such as ScanMan (left) and LightningScan can scoop up 4 inches of anything.

roll the 8.5-inch-wide platform over a letter-size page or let the original do the walking by snapping the scanning wand into a motorized transport for sheetfeeding. With 64 gray levels, true 400-dpi resolution (plus 200- and 300-dpi settings), and a \$1,350 price tag, the Omniscan-A4 competes with stationary scanners, lacking only the precision alignment of flatbeds.

Another elephantine handful, the JX-100 from Sharp Electronics (Mahway, N.J.), is a marvel of compact color scanning. You just place the 3.5-pound unit over the original (4-x-6 inches maximum), and it moves an internal scanning head across a viewing window. Color scans take three minutes or so; gray-scale images (64 levels) take 40 seconds at 200 dpi. The hardware costs \$995, including a cable to connect to the modem port (not the SCSI!). The software is another \$150; it saves to PICT and TIFF formats but has no editing features.

— Peter Weiss

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How Much Gray?

How much gray do you really need? That depends on the image and how you plan to use it. For drawings, text, and other black-and-white images, a 4-bit scanner (16 grays) will probably suffice. High resolution and precise alignment are more important than gray levels for line art. Gray-scale images, on the other hand, need at least 64 grays (6 bits) to trick the eye into thinking they are continuous-tone photographs. Four-bit images have a banded, paint-by-numbers look in areas that are short on detail and long on subtle gray transitions, such as clouds. For low-end desktop publishing such as newsletter production, most people do fine with 1-bit dithered images. Even if you use traditional photographic halftones for your publications, digital halftones can serve as placeholders to indicate scaling and cropping.

If you prefer the editing power of grays but are printing on a 300-dpi laser printer, stick with a 6-bit scanner. The 64 grays it provides are more than adequate for that resolution. Why? Because halftoning requires a trade-off between resolution and gray levels. The more gray levels you want to simulate, the lower the printing resolution, and vice versa. At its default resolution of 53 dpi, the LaserWriter can show only 32 grays. (For a complete explanation of resolution, gray scale, and digital halftones, see "A Touch of Gray," February '89). Using a high-resolution typesetter such as the 2,540-dpi Linotronic 300 eliminates this consideration. If you have an 8-bit scanner, you can print halftones with 256 grays at magazine-quality resolutions (133 to 150 dpi). Even if you don't print all 256 grays (that number is usually more than you need), such a scanner gives you more control during the image-editing process.

Fade to Black (and White)

Although gray-scale scanning can produce spectacular results, for many jobs it's neither necessary nor desirable. OCR, for example, is faster and more accurate in the line-art mode. *Line art* refers to images — such as drawings and text — that are black-and-white only, with no gray tones (although they can have dithered patterns).

Realistic Pictures Require Many Grays



1-bit image



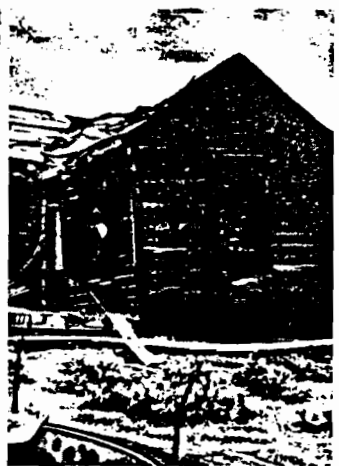
4-bit image



6-bit image



8-bit image



Scanned images vary in their ability to reproduce a continuous-tone photograph (top). The 1-bit image is black-and-white only; it creates the illusion of grays by dithering. The 4-bit scan has 16 grays, which aren't enough to prevent banding in transitional areas such as the clouds. The 6- and 8-bit scans display enough grays (64 and 256, respectively) to imitate continuous tone.

OCR Setting scanning parameters is simpler for line-art images, but they demand more from the scanner's electronics than do gray-scale images. For a gray-scale image, the scanner simply rounds off a voltage to the nearest

gray level. But for line art, it must decide whether each pixel should be black or white, depending on the range of grays in the scan area. This process is called *thresholding*, and most scanners have a default value that adjusts automatically during scanning. All pixels darker than the de-

fault are turned black, while lighter ones become white.

The Apple Scanner has a threshold control that lets you change the default value. The inclusion of this control is fortuitous, since this particular scanner has the worst default thresholding of the

Table 1: Features of Gray-Scale Scanners

	Abaton Scan 300/S	AGFA Focus S800GS	Apple Apple Scanner	Dest PC Scan 1000	Hewlett-Packard ScanJet Plus	Microtek MSF-300QS
Retail price	\$1,795	\$5,495	\$1,799	\$1,750	\$2,190	\$1,995
Cables included	yes	no, \$100	no, \$50	yes	no, \$60	yes
Software included	PanelScan Digital Darkroom	MC View Plus, \$495 extra	AppleScan HyperScan	Publish Pac	DeskScan DeskPaint	Digital Darkroom SuperPaint 2.0
OCR software (optional)	none	none	none	Text Processor, \$995*	none	MacinText, \$199
Sheet feeder (optional)	no	no	no	yes, \$595	yes, \$595	no
Warranty	90 days	90 days	90 days	90 days	1 year	180 days
Hardware features						
Resolution (dpi)	300	400	300	300	300	300
Bits per pixel	4	6	4	4	8	6
Gray levels	16	64	16	16	256	64
Scan area (inches)	8.5 x 14	8.5 x 13	8.5 x 14	8.5 x 13	8.5 x 13	8.5 x 14
RAM requirement	100K	1 Mb	660K	1 Mb	1 Mb	1 Mb
Engine manufacturer	TEC	AGFA	TEC	Canon	Canon	Microtek
Light source	green fluorescent	green fluorescent	green fluorescent	white incandescent	white fluorescent	white fluorescent
Interface	SCSI	SCSI	SCSI	SCSI (interface box)	SCSI (interface box)	SCSI
Power consumption	240 watts	85 watts	65 watts	240 watts	40 watts	192 watts
Dimensions (L x W x H, inches)	21.5 x 13.9 x 4.8	24 x 16.2 x 6.5	21.8 x 13.6 x 4.4	22.4 x 14.5 x 3.3	18.9 x 13.5 x 4.2	24 x 15.9 x 6
Weight	21.5 lb	40 lb	20 lb	25 lb	16.5 lb	26 lb
Controls on scanner	none	none	remote scan	none	none	none
IBM compatibility	yes	yes	no	yes	yes	yes
Software features						
Preview	yes	yes	yes	yes	yes	yes
Multiple modes in one scan	no	no	yes	no	no	yes
Resolution range (dpi)	300 only	100 to 800 [†]	75, 100, 150, 200, 300	200, 240, 300	12 to 1,500 [†]	75 to 300
Bits-per-pixel settings	4	6	4	4	4, 8	2, 4, 6
Image scaling (percent)	25, 33, 50, 66, 75, 100	1 to 100	25 to 100	13 to 200	4 to 200	25 to 400
Location of scanned image	disk	RAM	RAM	RAM	disk	RAM
Zoom	no	yes	yes	yes	yes	yes
Brightness/contrast	yes	yes	yes	no contrast	yes	yes
Gray-scale editing	no	yes	no	no	no	yes
Prints directly from program	no	yes	yes	yes	yes	yes
Printer halftone control	no	yes	no	no	no	yes
On-line help	yes	no	no	yes	yes	no
TIFF compression scheme	no	yes	no	yes	yes	no
File formats	TIFF, EPSF, MacPaint, PICT2	TIFF, PICT, EPSF, Paint, noncompressed	TIFF, PICT, MacPaint	TIFF, EPSF, MacPaint, SuperPaint, PageMaker 1.2	TIFF, PICT, MacPaint, EPSF, Clipboard	TIFF, PICT, PICT2, EPSF, MacPaint, Illustrator, Archiver, ThunderScan

* Text Processor is a board/software combination; if purchased with scanner, total package price is \$2,250.

[†] Addressable (not sampling) resolution, based on interpolation.

[‡] Images scanned at 300 dpi and then scaled to selected resolution; resolutions over 300 dpi do not have greater detail.

scanners we tested, requiring the most adjustments to produce optimum results.

Space and Time

Once you get your hands on a gray-scale scanner, you may be tempted to scan everything at the highest resolution

New Image MacScanPro	Xerox Imaging Systems Datacopy 730GS
\$2,495	\$1,995
yes	yes
MacScan	MacImage
TextScan, \$395	AccuText, \$995 MacOCR, \$695
no	no
1 year	1 year
300	300
8	6
256	64
8.5 x 11	8.25 x 11.75
1 Mb	1 Mb
Canon	Ricoh
white incandescent	green fluorescent
SCSI (interface box)	SCSI
240 watts	156 watts
21.6 x 14.5 x 3.8	19.5 x 11.4 x 4.1
25 lb	10.5 lb
none	none
no	yes
no	yes
75, 150, 200, 300	60 to 450*
4, 6, 8	4, 6
none	1 to 600
RAM	RAM
yes	yes
no contrast	yes
yes	yes
yes	yes
no	yes
yes	no
yes	yes

TIFF, PICT, EPSF, MacPaint, SuperPaint, PostScript, PageMaker 1.2

TIFF, RIFF, PICT, Paint, SuperPaint, PostScript, EPSF, PageMaker 1.2

and maximum number of grays. Don't. You'll be sorry.

Huge data files are the bane of gray-scale scanning (see Table 2). An 8.5-x-11-inch image scanned at 300 dpi with 64 gray levels takes up more than 6 megabytes. Even a 4-x-5-inch image with a mere 16 grays claims a whopping 900K. Most of the scanning programs have compression schemes that reduce TIFF-file sizes, but although compression works well on 1-bit images, compression ratios for multibit images are fairly low. You'll probably wind up using shareware file-compression utilities such as StuffIt or PackIt to conserve disk space.

Most scanning programs can save files in other formats, such as Paint, PICT, and EPSF. These formats are accepted by more programs than are TIFF files, but they can't be edited in gray-scale applications. Furthermore, EPSF images are even bigger than TIFF files—up to four times as large! (For more information on file formats, including a table of programs and the formats they accept, see "Graphic Examples," April '89).

Obviously, you'll need a substantial hard disk to accommodate these space hogs. It takes only three 6-megabyte images to fill a 20-megabyte hard disk. Removable media are another alternative, especially if you make trips to a service bureau.

You'll also need lots of RAM. Six of the scanners send images to RAM: only the Hewlett-Packard and Abaton models scan data directly to disk. Several scanners ran out of RAM (on an 8-megabyte Mac II) while scanning an 8.5-x-11-inch photograph. The software for the AGFA, Datacopy, and Microtek scanners avoids this pitfall by telling you how much space

a given scan requires. Datacopy's MacImage also shows you how long a scan will take—a nice touch. Gray-scale images also take a long time to scan, save, retrieve, edit, and print. Abaton's Scan 300/S was the tortoise to Microtek's hare during our testing. Dest's PC Scan 1000 fared well during scanning, but it took an astounding seven minutes to save the 8.5-x-11-inch gray-scale image to disk.

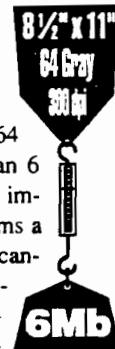
If your service bureau charges by the minute, printing gray-scale images can bankrupt you in a hurry. Most scanners let you pick the scan resolution and number of bits, so use the lowest resolution and fewest grays you can without jeopardizing image quality. Use the smallest possible image area, and crop your images *before* test-printing them.

Soft Sell

Since scanners are controlled entirely through software, the programs that come with your scanner are as important as the machine itself. Scanning software is as diverse as the hardware is similar, so test-drive the scanner *and* software before taking the financial plunge.

The software we tested ranged from the minimalist offerings of Abaton and Dest to the supermarket of selection in Datacopy's MacImage (see Table 1). Editing power and tools vary widely from scanner to scanner. All the programs except Abaton's PanelScan offer basic paint tools, but none has the gray-scale-editing sophistication of Digital Darkroom or ImageStudio. Rather than compete, Microtek has implemented its scanner driver as plug-in modules for both Digital Darkroom and SuperPaint, which come bundled with the scanner.

Some scanner companies are making it easier to scan from within other pro-



Gray-scale files are real space hogs. These file sizes (in kilobytes) are for images scanned at 300 dpi and saved as uncompressed TIFF.

Table 2: File Sizes (Kilobytes)

Image size	Number of bits			
	1	4	6	8
4 x 5 inches	225	900	1,350	1,800
8.5 x 11 inches	1,050	4,200	6,300	8,400

Capsule Reviews



PHOTOGRAPHY: PETER ALM/GORED

Our gray-scale scanner lineup demonstrates that flatbed models aren't pretty much the same. Left column: MacScanPro, PC Scan 1000, ScanJet Plus. Center: Scan 300/S, MSF-300QS. Right: Focus S800GS, Datacopy 730GS, Apple Scanner. Three of the scanners come with external SCSI interface boxes, like the one shown for MacScanPro (top right).

Scan 300/S

By implementing its scanner driver as a cdev, Abaton has made scanning from within applications convenient. Although 4 bits isn't enough to achieve the continuous gray tones necessary for photographs, superior text extraction makes it a good choice for OCR. Abaton also markets a \$1,495 model with a smaller scan area and an external SCSI interface.

Pros: Bundled with Digital Darkroom. PanelScan, the cdev, scans directly to disk, using less than 100K of RAM during scans. Easy to use, simple software. **Cons:** Poor resolvability; limited control of scanning; can't scan at resolutions below 300 dpi; poor-quality previews; no image-editing capabilities; no file-compression scheme; slow scanning times; no print option.

Abaton Technology
48431 Milmont Drive
Fremont, CA 94538
(415) 683-2226
\$1,785

Focus S800GS

At two to three times the price of 300-dpi scanners, AGFA's 400-dpi scanner offers the superior resolution required for high-end, all-digital publishing. It interpolates to

achieve addressable resolutions of up to 800 dpi. Its professional-quality MC View Plus software has gray-scale editing features and numerous printing options. AGFA also markets the S600GS, a 300-dpi scanner with a 600-dpi addressable resolution.

Pros: Superior resolvability; good halftone quality. Extensive postscan editing features. Vectorizes line art and halftones. Can control screen frequency and angle of printer halftones. Knows output formats of several DTP programs. Prints sections of scans. Displays RAM requirements for scans. Continuously checks for viral infections. **Cons:** Expensive. Not easy to learn; uses photographic and publishing terminology.

AGFA Compugraphic
90 Industrial Way
Wilmington, MA 01887
(508) 858-5600
\$6,080 with software and cables

Apple Scanner

Apple has produced another well-designed plug-and-play product. It's the easiest scanner to learn and use, with intuitive controls. A good choice for general scanning, although 4 bits isn't enough to achieve continuous gray tones.

Pros: Bundled with AppleScan and HyperScan, which scans images directly into Hyper-

Card stacks. Excellent manual and tutorial. Remote Scan button. Can have two scan windows with different resolutions and scan modes within same scan. Scans irregularly shaped areas. Customizable halftone patterns. Can save Startup Prefs for scan parameters. User-adjustable threshold control. Adaptive filter converts scanned gray-scale images to halftone. Prints sections of scans. **Cons:** Poor detail thresholding for line art; worst overall at text extraction. AppleScan can't open TIFF files (only PICT). No file-compression scheme.

Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 836-1010
\$1,849 with cables

PC Scan 1000

Dest's 4-bit scanner is the least expensive model we tested. Sixteen grays aren't enough to achieve the continuous gray tones necessary for photographs, but this scanner's good choice for OCR. Publish Pac software includes rudimentary OCR, but it's intended for low-end DTP only. Dest also offers a sheetfed model.

Pros: Good text extraction. Optional hardware/software package, Text Processor, fast, speedy OCR. Automatic sheet feeder available.

Cons: Resolvability only fair. Displays gray-scale scans as halftones. No contrast adjustment; limited image editing. Very slow at saving images to disk. External SCSI interface box.

Dest Corporation
 1201 Cadillac Court
 Milpitas, CA 95035
 (408) 846-7100
 \$1,750 with interface box

ScanJet Plus

This 8-bit scanner provides high performance at a very reasonable price. By implementing its scanner driver as a desk accessory, Hewlett-Packard has made scanning from within applications more convenient. The Desk Gallery Plus software includes two DAs, DeskScan and Zedcor's DeskPaint. The scanner can interpolate to achieve addressable resolutions of up to 1,500 dpi.

Pros: Unique Live Preview, which shows full-gray image and allows interactive adjustments to scan parameters. Excellent resolvability of text and line art; good text extraction for OCR. Easy-to-use software with superior on-line help. Scans directly to disk, avoiding RAM overload. Compensates for changes in light intensity. Automatic sheet feeder available. **Cons:** No gray-scale editing tools. External SCSI interface box. Somewhat limited gray range for an 8-bit (256 grays) scanner.

Hewlett-Packard Company
 700 71st Ave.
 Greeley, CO 80634
 (303) 350-4000
 \$2,250 with interface box and cables

MSF-300QS

Microtek, one of the first scanner manufacturers, has implemented its driver as plug-in modules for Digital Darkroom and SuperPaint 2.0, which are bundled with the scanner. Microtek also markets several other scanners, including sheetfed and 8-bit models.

Pros: Excellent gray-scale editing and printing tools available in Digital Darkroom. Can have up to four scan windows within same scan that mix line-art and halftone modes. Good range of grays. Shows image size and available RAM. Fast scanning times. User-adjustable threshold control. **Cons:** Extremely poor extraction of "difficult" text. No file-compression scheme. Scanner light always on.

Microtek Lab, Inc.
 16901 S. Western Ave.
 Gardena, CA 90247
 (213) 321-2121
 \$1,995

MacScanPro

New Image Technology doesn't even relabel the Canon IX-12F scanner; it just adds its own interface box and MacScan software. It has upped the ante to 8 bits (256 grays), though. New Image also offers a sheetfed version and less expensive 1-bit scanners.

Pros: MacScan software can drive the Sharp JX-450 color scanner and Fujitsu high-speed scanners. Can change default scan settings. Can convert 300-dpi halftones into 75-dpi gray-scale images. Can type PostScript instructions in Print dialog. User-controllable light calibration. **Cons:** No preview scan. Extremely poor extraction of "difficult" text. No contrast setting or image scaling. Small scanning area (8.5-x-11 inches). External SCSI interface box.

New Image Technology, Inc.
 9701 Philadelphia Court
 Lanham, MD 20706
 (301) 731-2000
 \$2,485

Datacopy 730GS

This compact scanner is an excellent choice for all types of scanning. It offers the best software, MacImage, which sports a panoply of scan-control and image-editing features. The newest scanner from Xerox-Datacopy, it occupies the low end of that company's 300- and 400-dpi gray-scale scanner line.

Pros: Excellent halftone quality. Superior gray range with good shadow detail. Good interface, with Short Menu option. Can customize dither patterns and save scan parameters. Mixed Line Art mode for capturing halftones and line art in one scan. Edge-detection feature for outlining line art. Gray-scale editing features, including gamma correction and numerous contrast effects. Excellent printing options, including control over halftone screen frequency and angle, and ability to print sections of scans. Displays time and memory requirements for scans. **Cons:** Resolvability and text extraction only fair. Confusing overlap of functions in Scan Selection, New Scan, and Imaging Styles commands. Small scanning area (8.25-x-11.75 inches).

Xerox Imaging Systems
 Datacopy Corporation
 1215 Terra Bella Ave.
 Mountain View, CA 94043
 (415) 865-7800
 \$1,995

grams by creating their drivers as cdevs or desk accessories rather than as stand-alone programs (see "Scannectivity" sidebar). Hewlett-Packard's software package, Desk Gallery Plus, consists of two DAs. DeskScan and Zedcor's DeskPaint. Abaton's scanner comes with PanelScan, a cdev that can be accessed from within any application. PanelScan scans directly to a prenamed file on disk, so it needs only about 100K of RAM. Unfortunately, it has no postscan view or editing tools of any sort.

Be sure that your scanner software offers a preview — a quick, low-resolution scan that helps you select which part of the image you want for the actual, full-strength scan. Typically, previews are dithered images that don't work for adjusting contrast or brightness. The exception to the rule is DeskScan's Live Preview, which sacrifices detail for an actual gray-scale image. If you adjust the contrast or brightness, the preview reflects the changes without requiring a rescan.

At the other extreme, PanelScan's previews are so poor that they are practically worthless — gray-scale images appear as solid black blobs. New Image's MacScan offers no preview at all, a crippling oversight. Instead, you use rulers to guess at the location of the section you want and perform repeated scans and repositionings until you locate it precisely. If you ever scan in a halftone and then wish it were gray scale, however, MacScan is the only program you can use to convert 300-dpi halftones to 75-dpi, 4-bit gray-scale images.

All the scanners have settings for line art, halftones, and gray scale. The Microtek, Apple, and Datacopy scanners let you mix halftone and line-art modes in a single scan for those times when text and continuous-tone graphics share the same page. With Microtek, you select the overall image to be scanned and then select up to three smaller areas that can be set to line art while the rest of the image is halftoned, or vice versa. AppleScan has two nonoverlapping windows, which can have different resolutions as well as different scan modes (including gray scale). Datacopy has only one window, but its Mixed Line Art mode lets you capture line art and halftones in one scan.

All the programs except MacScan let you scale images during the scanning process to match the size you need for placement in a document or for printing — you usually end up with better image quality than if you resize the image later within an application. Scaling an image down also helps conserve RAM and disk space. PanelScan is the only program lacking a zoom feature for closeup views of scanned images.

Special Features

Datacopy's MacImage and AGFA's MC View Plus have the best-rounded set of features, including a broad range of scan settings and dither patterns, and postscan control over brightness, contrast, and gamma correction. (Actually, Microtek has the most powerful software, if you count Digital Darkroom.) By contrast, Dest's Publish Pac has no image editing and can display gray-scale im-

ages only as halftones.

Both MacImage and Apple's AppleScan let you customize dither patterns and save scan parameters for later use. MacImage enables you to burn (darken) and dodge (lighten) selected gray regions of scans. MC View Plus knows the right output format for a variety of page-layout programs, and it's the only package that continually checks for viral infections (it told us when we became infected with nVIR).

If you like the auto-tracing features of programs such as Illustrator 88, you'll appreciate the Edge Detection mode of MacImage, which outlines line art during the scanning process. MC View Plus has a more sophisticated version of this feature, called vectorization, which can convert line art and halftones into object-oriented images with Bezier curves, images that can be saved as Illustrator files.

PanelScan is the only program that

cannot print images directly. MC View Plus and MacImage have particularly strong printing features, including halftone settings and the ability to print sections of scanned views. (Again, Microtek's use of Digital Darkroom gives it a leg up in this area.)

The Apple Scanner is bundled with AppleScan and HyperScan, which scans images directly into HyperCard stacks. You can move images from scanners into HyperCard without it — via the Clipboard or Scrapbook — but HyperScan makes it easy. AppleScan lets you scan irregularly shaped areas, and an adaptive filter converts scanned gray-scale images into halftones. Amazingly enough, AppleScan can save but not open TIFF files; it opens only PICT-format files.

Four scanners have optional OCR packages. Dest's Text Processor is a board-based system that provides faster scanning times than does software-based OCR. Datacopy's AccuText rivals stand-alone OCR packages; as for the others, you're better off buying OCR software separately (see "Light Reading" sidebar).

Scannectivity

Scanning can sometimes be a frustrating experience. Usually you must leave the application you're working in, open the scan program, scan the image, save it, exit from the program, reopen the original application, and — finally — import the scanned image. Abaton and Hewlett-Packard save you all that effort by having their scanners scan from the Control Panel (in the case of Abaton's PanelScan) or a DA (HP's DeskScan). But a movement is afoot for a more general solution. The Apple Scanner's software interface (the specifications controlling application-to-scanner communication) is slowly but surely becoming a standard, making it possible to drive any scanner from within any application.

For this system to work, both the applications and the scanners must implement the interface. Then they can automatically "see" each other and communicate effortlessly. More and more programs — Digital Darkroom, ImageStudio, SuperPaint, QuarkXPress, OmniPage, Read-It! — can now drive the Apple Scanner. On the hardware side, Abaton, Dest, Microtek, New Image Technology, and Xerox Imaging Systems plan scanner interfaces that follow Apple's specifications.

In theory, you should be able to mix and match these applications and scanners at

will, but we haven't tested that yet — Apple-spec interfaces on non-Apple scanners are just beginning to emerge.

A Chooser-selectable scanner is another potential solution — perhaps the cleanest one — to the plethora of scanner drivers. You would select a scanner from the Chooser just as you do with a printer. Then, by issuing a command from the menu, you'd get a Scan dialog much like the current Print dialog. Unfortunately, this idea hasn't caught on, although Nuvo Labs (San Luis Obispo, Calif.) is developing Chooser-selectable scanner drivers that it hopes to market to scanner manufacturers.

In lieu of a standard, software developers Silicon Beach and Letraset have reworked Digital Darkroom and ImageStudio to accept user-installable "plug-in" scanner drivers (the modules are free for the asking from the scanner makers). Once you've dropped the appropriate module into the program's folder, it knows how to run your scanner, and you have scanning control from its menus. Digital Darkroom works with plug-in modules for Apple, Microtek, Abaton, and New Image scanners. ImageStudio works with only one module so far, for the Apple Scanner, but it will eventually work with scanners from Microtek and Xerox Imaging Systems.

— Peter Weiss

Testing, Testing

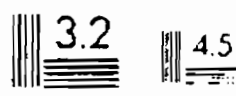





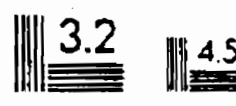
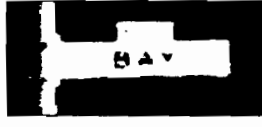


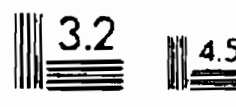
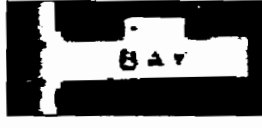
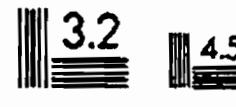
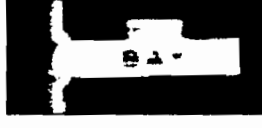
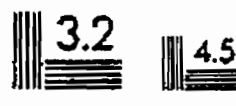


AGFA's Focus S800GS, with its all-metal case, is the heaviest and sturdiest scanner we tested. (It's also the noisiest, but just during scans.) The Datacopy 730GS is the sleekest, with the smallest footprint — a mere 222 square inches, compared with AGFA's 389.

All the scanners connect to the Mac's SCSI port, although three — the Dest, Hewlett-Packard, and New Image models — require special interface boxes and cables because they come with non-SCSI connectors. Dest's interface box is particularly cumbersome, with a 90-square-inch footprint, a separate power supply, and a tangle of cords and plugs.

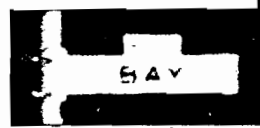
We evaluated the scanners in five major areas: image sharpness, gray range, halftone quality, OCR capabilities, and ease of use (see Table 3). All scans were at 100-percent scaling, 300-dpi resolution (400 for the AGFA), and default contrast and brightness values. Then, to get the best performance possible from each scanner, we ran additional scans at optimized settings. All images were saved as uncompressed TIFF files.

Apple
ered
ation.

Comparative Scans in Line Art and Gray-Scale Modes

Abaton	abcdefghijklm		
AGFA	abĉefghijklm		
Apple	abcdefghijklm		
Dest	abcdefghijklm		
HP	abcdefghijklm		
Microtek	abcdefghijklm		
New Image	abcdefghijklm		
Xerox Datacopy	abcdefghijklm		
Original	abcdefghijklm		

Here are some of the test results, so you can judge for yourself how well each scanner reproduces text, line art, and photographs. All images were enlarged from their original size in order to see the fine details. The examples include 4-point type, two sets of line art (originally 3.2 and 4.5 line pairs per millimeter), and a street sign from the San Francisco photo, which was printed on a Linotronic 300. This ability to manipulate halftones is a scanner's strength. Don't expect it to replicate the quality of a traditional halftone, because it won't.



Enlarged section of halftone



Traditional halftone, original size

MACUSER LABS

Unresolved Differences: To determine resolvability (how well the scanners picked up details), we scanned the Image System Test Target in the line-art mode. This test sheet, available from the Patent and Trademark Office, contains a series of shapes, line pairs, and text of varying sizes. We looked for blurring in the smallest line pairs and deformities in the four-point type to determine the minimum feature size each scanner could clearly see.

As expected, the AGFA left the other scanners in the dust: its 400-dpi resolu-

tion enabled it to resolve even the finest details of text and line art. Hewlett-Packard's ScanJet Plus had the sharpest image of the 300-dpi scanners, and Abaton's Scan 300/S had the worst.

Grading the Grays: Most scanners "see" only a limited range of grays, so we gave them a vision test. We scanned 16 blocks of a Kodak Gray-Scale Test Strip, which has 20 blocks of gray of increasing intensity, and counted the number of gray levels each scanner sensed. As expected, the 4-bit scanners (Abaton, Apple, Dest) didn't see as many grays as the 6- and 8-

bit units did. The 6-bit Microtek scanner actually picked up more grays than did the 8-bit ScanJet Plus.



Halftone Quality: Nearly everyone who uses a scanner scans photos, and we're no exception. We repeatedly scanned black-and-white photos of a country cabin and of San Francisco in both gray-scale and halftone modes to see how well the scanners handled grays and how accurately they dithered halftones.

Then we printed two halftone images for each scanner, one at default settings and the other optimized. The 300-dpi halftones were output on a LaserWriter IINTX; the AGFA's 400-dpi output went to an AGFA P3400 PS laser printer. In a blind test, a five-person panel judged each picture's shadow detail, highlights, fine detail, and contrast.

The AGFA's high resolution again put it atop the heap. The Datacopy 730GS also did well, displaying a wide range of grays and good shadow detail.

Text Extraction: OCR is a popular use for scanners, so we evaluated how well each one could separate text from its background. Scanners that are better at thresholding extract text more successfully and thus provide images that OCR software can read more accurately.

We used the scanners' own software to scan newspaper articles and examples of "difficult" text — poorly printed, low-contrast, and colored text on colored backgrounds. The scans were done in the default line-art mode and again at optimized settings. We then read the scanned samples with Caere's OmniPage and compared its output with the actual text, using the percentage of correct words to rate the scanner's thresholding skill.

The Abaton and Hewlett-Packard scanners excelled at text extraction, distinguishing even the most difficult text with ease. The AGFA's 400-dpi resolution provided superior results when picking up the fine type in a phone book, even after it had been photocopied twice. Unfortunately, the higher resolution worked against it in the other tests, because it picked up too many background details.



Light Reading with OCR

Man does not communicate by pictures alone — that went out with the Egyptians — but until recently, that's about all Mac users could do with their scanners. No more. Optical character recognition (OCR) has become a hot property, and scanners have now become viable text-entry devices.

The sheer diversity of Mac OCR products now available is a clear indication of how important this market has become. For the casual user, there's Olduvai's Read-It! (see this month's Quick Clicks), at \$495. For businesses that input tens of thousands of pages every month, Calera (Santa Clara, Calif.) has the networkable Compound Document Processor (CDP) 9000, a hardware/software combination that offers impressive speed and goes for a whopping \$29,950. The software, TopScan/Mac, is another \$695. And there are at least half a dozen other packages that fall between these extremes.

The Mac's first OCR program (Read-It!) wasn't a watershed. That distinction goes to OmniPage from Caere (Los Gatos, Calif.). Even though the \$695 program had limitations — lots of them — it represented a major advance in Mac OCR technology. It was fast and accurate and could recognize most plain fonts, so you didn't spend enormous amounts of time teaching it the alphabet (see Quick Clicks, March '89). Apple quickly saw the program's potential and jumped on the bandwagon, and that extra push got Mac OCR moving. The latest incarnation of OmniPage, version 1.1, directly drives scanners from Apple, Dest, Hewlett-Packard, and Microtek.

Caere's accomplishments came at a price, however. OmniPage was inflexible. Not only could it not recognize styled fonts or unfamiliar characters, but you couldn't teach it ei-

ther. What was missing was a high-powered, teachable OCR package. Enter TextPert, the \$695 package from CTA (New York, N.Y.) that reads styled fonts and foreign characters and can be taught new characters as necessary, provided you are willing to spend 15 minutes to an hour doing so.

Software-based OCR such as TextPert is flexible, but the trade-off is that it's slow. To maximize speed, developers are turning to hardware-based OCR, and Calera is a leader in this trend. Calera's CDP 9000 has no character-learning capabilities, but by using four Motorola 68000 processors, it can scan and recognize a formatted, letter-size page in less than 15 seconds — usually much less. Dest's Text Processor (\$995) is another hardware-based system that trades flexibility for speed.

To an extent, OmniPage presaged this development too. By requiring a Mac II and 4 megabytes of RAM, Caere was clearly pointing toward a much more powerful level of OCR. And that's exactly where things are headed.

AccuText, from Xerox Imaging Systems (marketed through Datacopy), is a \$995 software package with enough built-in artificial intelligence (thus the new acronym ICR, for intelligent character recognition) that it can read and preserve italics, underlining, type-size changes, indents, columns — even skewed text and fax transmissions. AccuText can drive the Datacopy scanners (natch), plus the Apple Scanner and Hewlett-Packard's ScanJet and ScanJet Plus.

Although most scanners are still being used as image-entry devices, OCR's success may change that. As the Egyptians found out, sometimes words are more powerful than pictures.

— Russell Ito

The Microtek and New Image scanners bottomed out in the difficult-text department: they had trouble separating text from shaded or colored backgrounds, and there was much blurring and touching of letters. The Apple Scanner actually did worse on the newsprint than on the difficult text, and we spent more time optimizing its scans than those of the other scanners.

You can probably improve on these results by fiddling with the scan parameters, but we do wish scanner manufacturers would include a scan mode specifically for text extraction.

Users could specify whether the printed matter was newsprint, colored text, or background; the font size; and so on. The scanner would then pick the ideal threshold and resolution settings to optimize text extraction under those conditions.

Ease of Use: No mystery here — how friendly, how easy to use, how powerful is the software that comes with each scanner? Three first-time users rated each scanner on its ease of use (for controls such as brightness, contrast, scaling, and zoom), image-editing power, and help-

fulness of "help" information.

The Apple Scanner was the favorite in this category for its excellent manual, tutorials, and intuitive controls. Although they pack a lot of power, both the Datacopy 730GS and ScanJet Plus are easy to learn and use, with good manuals and nice interfaces. The ScanJet Plus also has an impressive on-screen help file, and the Datacopy has a Short Menu option for users who want to keep it simple.

Scanning the Future

Will the scanner you buy today be obsolete six months or a year from now? Since 256 levels of gray is enough for most scanning purposes, you don't have to worry about grayer machines appearing on the scene. Instead, the trend in high-end scanning is toward greater and greater resolution. With higher resolution, you'll see finer detail, and jaggies will become a historical footnote. Siemens, which competes with AGFA and Microtek in the expensive 400-dpi market, plans to have a 600-dpi scanner within a year or so.

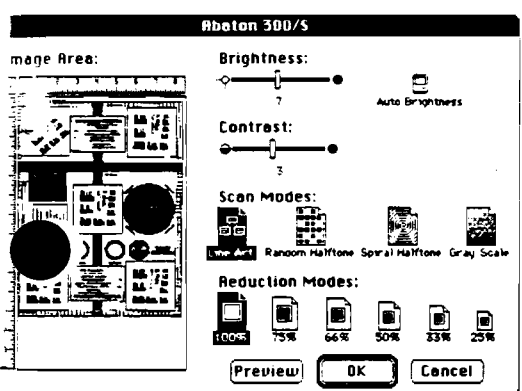
Look to laser printers, not scanners, for the next revolution in desktop-publishing. Companies such as DP-Tek and Seikosha are pioneering printer technologies that use variable dot sizes and/or true grays. Such breakthroughs will truly revolutionize the appearance of halftones, line art, and text printed on a 300-dpi printer — or on a high-resolution typesetter.

MacUser Labs Editor Aileen Abernathy showed some amazing grays herself during the course of this report. Peter Weiss is a free-lance wordsmith, specializing in science and technology topics.

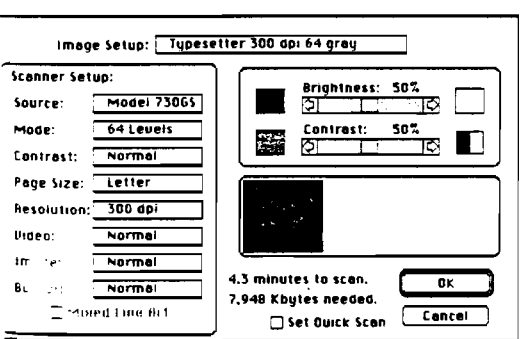
Kudos

MacUser Labs would like to thank technical consultant Ken Holt, project leader Jeff Pittelkau, and the members of our advisory panel: Dean Buck, Hewlett-Packard; Dave Rose and Jim McNaul, Xerox Imaging Systems; Stan Fry, Dest; and John Kozlowski, Microtek. The pictures of San Francisco and the cabin were used with the permission of photographer William E. Reister.

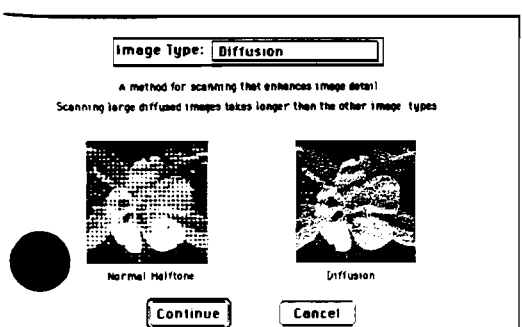
Selecting the Software



Abaton's PanelScan is a cdev that lets you scan from within any application, but it has only one dialog, with a poor-quality preview and the bare minimum in features.



Datacopy's MacImage is a supermarket of selection — and this is just the Image Setup window. It has an extensive list of scan settings and even tells you the scanning time and resulting file size.



Hewlett-Packard's DeskScan comes with excellent on-line help that visually explains scanning terms and special effects.

Testers' Choice

For the best combination of price and performance, you can't go wrong with either the **Datacopy 730GS** or Hewlett-Packard's **ScanJet Plus**. The 6-bit Datacopy (\$1,995) is a compact machine with a superior gray range and excellent halftones, making it a good choice for most desktop-publishing needs. Datacopy's MacImage is the best scanning software we've seen: it contains an impressive array of features for both prescan (customizable dither patterns, mixed line art) and postscan (gamma correction, printer halftone control) maneuvers.

For \$250 more, you can move up to the 8 bits (256 grays) of the ScanJet Plus. This versatile machine offers excellent resolvability of text and line art, equally fine text extraction, and good halftone quality. Its scanner driver, DeskScan, is implemented as a DA, which makes scanning from within applications easy. It has the only gray-scale preview and the best on-line help.

If you want 64 grays and hanker for more editing power, consider Microtek's **MSF-300QS** (\$1,995). Its driver is a plug-in module for Digital Darkroom and SuperPaint 2.0, both of which are bundled with the scanner. Although the MSF-300QS is not in the same league as the Datacopy and ScanJet Plus machines, its features and the power of its bundled software make it worth a look.

If your primary need is OCR and you don't need the bells and whistles (or prices) of the 6- and 8-bit scanners, check out Abaton's **Scan 300/S** or Dest's **PC Scan 1000**. The Scan 300/S (\$1,795) had the highest scores on text extraction, and its driver, PanelScan, is a

cdev, which means you can scan from within any program. The PC Scan 1000 (\$1,750) provides good text extraction, and it has an optional sheet feeder and hardware-based OCR package, Text Processor, for fast, high-volume OCR. The package price including Text Processor is \$2,250, a combination that might be hard to beat.

For a simple plug-and-play scanner, a no-frills unit that's easy to learn, check out the standard-because-of-its-name **Apple Scanner** (\$1,849). Sixteen grays don't provide high-quality halftones, but it's a solid, midrange scanner. Its Remote Scan button provides one-touch scanning; you can have two resolutions and scan modes in a single scan; you can scan irregularly shaped areas; and HyperScan lets you scan images directly into HyperCard.

We really can't recommend the New Image **MacScanPro** (\$2,495). It has some nice features — its MacScan software can drive other scanners, and it does postscan editing — but we feel its lack of a preview scan is a crippling defect.

Finally, there's our 400-dpi entrant, the AGFA **Focus S800GS** (\$6,090). Its combination of superior resolvability, excellent halftone quality, and good text extraction make it the publisher's dream machine, albeit a pricey one. Its professional-quality software, MC View Plus, provides excellent scan control and a variety of postscan editing effects. We can't recommend it for everyone, but if you do high-end DTP or are scanning highly detailed images that require great precision — say, aerial photos — the AGFA may be the scanner for you.

Table 3: Scanner Ratings (scale of 1 to 10)

	Resolvability	Gray range	Halftone test	OCR: newsprint	OCR: difficult	Ease of use
Abaton Scan 300/S	4	6.3	6			7
AGFA Focus S800GS	10	9.4	6.5			7
Apple Apple Scanner	6	6.9	5.5			8.5
Dest PC Scan 1000	5	7.5	5.5			7
Hewlett-Packard ScanJet Plus	7	8.8	6			8
Microtek MSF-300QS	6	10	5.5			6
New Image MacScanPro	6	10	5.5			6.5
XIS Datacopy 730GS	5	10	6.5			7.5

The test results for each scanner were converted to a 1-to-10 scale, with 10 being a perfect score.

Resolvability: The Image System Test Target was scanned in line-art mode. Lower scores indicate a blurring of line pairs or defects in letter shapes.

Gray range: Sixteen blocks of a Kodak Gray-Scale Test Strip were scanned; the number each scanner reproduced was converted to a 10-point scale.

Halftone quality: A five-person panel judged the image quality of two photos scanned in halftone (dithered) mode and output on a laser printer. The two best scores were averaged for each scanner.

OCR: The text-extraction test evaluated a scanner's ability to separate text from its background. Text was scanned in the optimal line-art mode. The

percentage of correct words read by OmniPage was converted to a 10-point scale. The newsprint test used a 200-word newspaper article; the second test used unusually difficult samples, including photocopied, colored, and blurred text.

Ease of use: We averaged the evaluations of three testers who rated the scanning software on ease of selecting a scan area, accessibility of scanning from within other applications, the power and intuitive logic of the controls and editing tools, and the number of clicks it took to carry out a simple scan.

Note: MacScanPro 1.49 doesn't work with OmniPage; version 1.26 was used instead.

Scanning views: Microtek, Data Copy

Midrange scanners show sophistication

By Rick Valdez

Macintosh-compatible scanners have been multiplying as the Mac evolves into the leading graphics microcomputer. Early models scanned images at 16 levels of gray and were built for the IBM PC's serial port. This required Mac users to attach a sluggish serial-to-SCSI converter box to such scanners. More-recent entries have been built for the Mac's SCSI port and

scan at much higher resolutions.

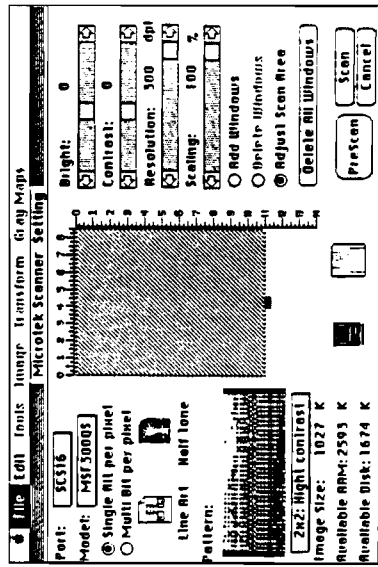
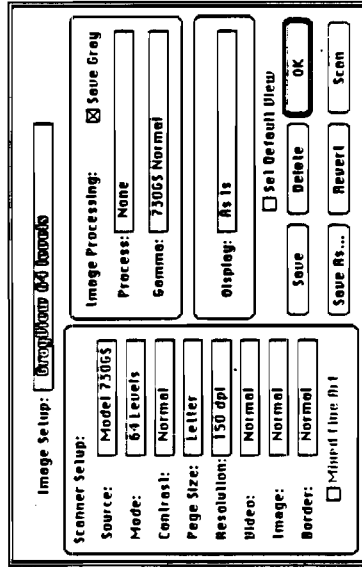
We took a look at a couple of products in the midrange scanner market, the Microtek MSF-300QS and the Data Copy 730GS. Both come from companies experienced in the scanner field and both are quite sophisticated. These two devices produce 64-level, gray-scale scans at 300 dpi (up to 450 dpi for the Data Copy) and include many features that are becoming standard in the Mac scanner market.

Scanner primer. The latest Macintosh scanners typically include direct SCSI hookup. The

difference in total scanning time between direct SCSI and serial-to-SCSI connection is significant. What once required minutes is accomplished in seconds. After you scan in, review and adjust your image a half-dozen times, the savings can be measured in hours. Both the Microtek and Data Copy scanners reviewed here have direct SCSI connectors.

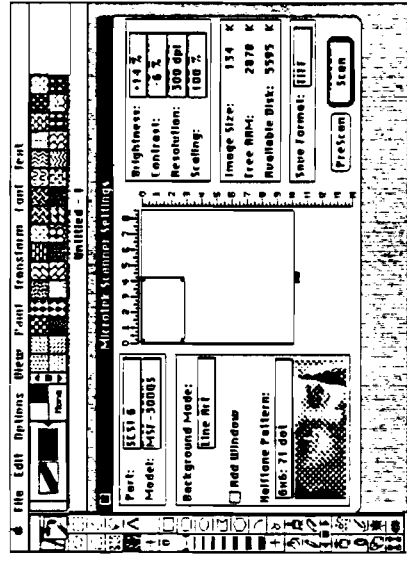
Scanner software has also improved as manufacturers write applications and drivers that more fully utilize the Macintosh interface. As often as not, older scanners came with software ported directly from the MS-DOS world that typically allowed little manipulation of images after scanning. The applications included with both the Data Copy and the Microtek scanners allow image editing. While the software may raise the price of the machine, image editing is absolutely necessary for good scan results.

Most gray-scale scanners can also scan images as line art or halftones. These formats use only black and white to produce an

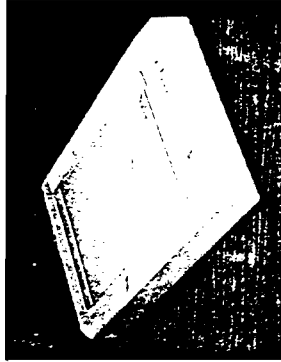


Microtek's Digital Darkroom driver provides all the scanning options available in the desk accessory, except for staining in gray-scale format. Gray-scale images are transferred to Digital Darkroom for retouching and saving. Halftones and line art are saved directly.

The opening scan window from Data Copy's MacImage software hides much of the program's complexity. Note that every option has an associated pop-up menu, and the settings can be customized beyond the given menu choices as well.



Microtek bundles its Scanner desk accessory with Silicon Beach's SuperPaint 2.0, although it can be used with any application. The DA allows several scanning options but can only save TIFF files.



Microtek MS-F300QS

Microtek Lab Inc.
680 Knox St.
Terrence, Calif. 90502
(213) 321-2121

List price: \$1,995

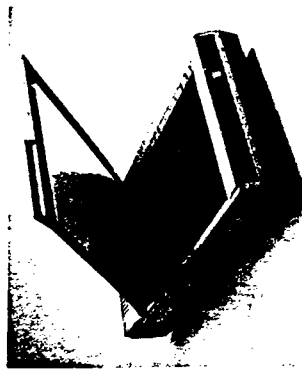
➔ Silicon Beach's Digital Darkroom and SuperPaint 2.0 are bundled with program; DA allows for scanning within any application; easy to set up.

— Digital Darkroom module can't scan images larger than available RAM; poor documentation for DA.

image. Technical drawings and text fall into the line art category. Halftone scans vary the density of the black pixels to simulate levels of gray, so any gray-scale image can also be scanned as a halftone. These formats use less memory than true gray-scale scans.

True grays are accomplished at a more basic level by assigning more than one bit of information to each pixel. Sixty-four levels of gray require six bits per pixel. It pays to think ahead about which of the three formats — line art, halftone or gray scale — best suits a particular job because as the levels of gray multiply, memory becomes critical.

Saving grays. Only a certain number of gray values can be simulated by modern black-and-white printing techniques. This number is certainly higher than the 16 levels available on earlier desktop



Data Copy 730GS

Data Copy Corp., a Xerox company
1215 Terra Bella Ave.
Mountain View, Calif. 94043
(415) 965-7900

List price: \$1,300 for scanner alone; \$695 for MacImage software.

➔ Very advanced image control; scan density of up to 450 dpi; small unit; easy to set up.

— Poor documentation of predefined settings; setting random image sizes is confusing; hard to reach technical support.

scanners. On the other hand, 256 levels of gray may be overkill for the relatively low-quality printing techniques used by most desktop publishers.

Compared with a traditional photographic halftone, raw scanner output doesn't quite measure up. However, photo images must pass through several steps before they end up in a magazine or newsletter. In the process, subtle distinctions are often lost. To readers, there may be no noticeable difference between the traditional halftone and the computer-produced one. Since the number of gray scales a scanner produces is directly proportional to its price, consider the print quality of your ultimate output before making a buying decision.

Another important consideration in buying a scanner is hard disk space. While a full-page halftone or

Scanners

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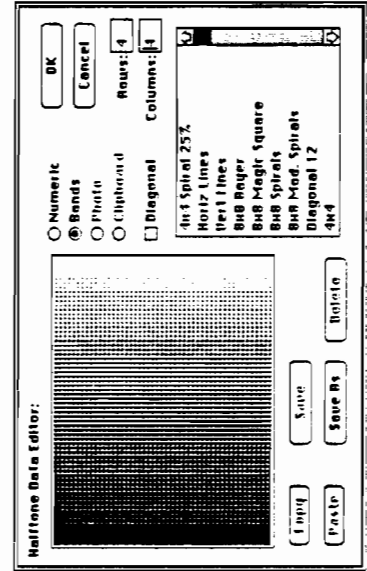
line-art illustration takes a mere 2000 Kbytes, a full-page scan with 64 levels of gray can occupy more than 8 Mbytes of hard disk space. You may need to purchase more storage along with a scanner.

Microtek MSF-300QS. The Microtek scanner is simple to set up and operate. You simply plug the machine in and plug the accompanying SCSI cable into the Mac. The cable comes with a terminator attached—a nice touch. A longer SCSI cable would have been nice, too; 18 inches greatly restricts your placement options.

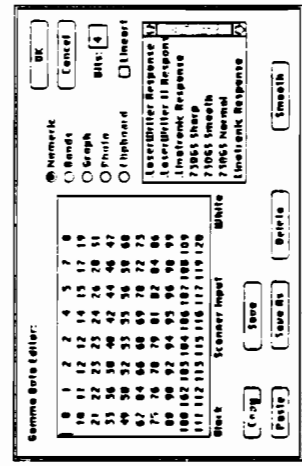
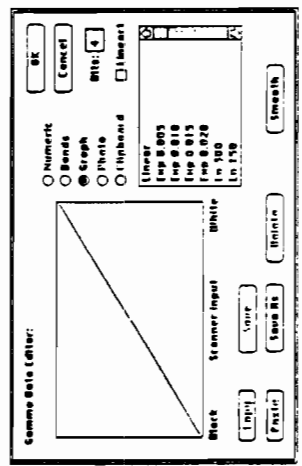
The Microtek is bundled with two related applications, Digital Darkroom (see MacWEEK, Sept. 27, 1988) and SuperPaint 2.0, both from Silicon Beach Software of San Diego.

The Digital Darkroom package includes two ways to scan images: a special software plug-in module and a desk accessory scanning utility. With the module placed in Digital Darkroom's "punch" folder, you can control the scanner directly from the application. The image area, resolution and scale factor can be entered, and the resulting scan produces a Digital Darkroom file. Digital Darkroom has many powerful and unique image-enhancing features, and its inclusion with the Microtek scanner improves the value of the overall package significantly. A driver for Letraset's ImageStudio will be bundled with the scanner soon.

The only fly in the ointment is that if an image is too large for available RAM, it cannot be scanned at all using the plug-in module because the Digital Darkroom scanning software doesn't support virtual memory. Therefore, a 300-dpi, letter-size scan could not be input directly, since it would require more than 8 Mbytes of RAM (the Macintosh's current limit on System-accessible memory).



Data Copy's halftone data editor (at left) allows for precise control of halftone output. Numerous options are provided in the scrolling menu. As can be seen below, output can be customized more by either redrawing the diagonal graph or individually changing the numeric values that describe the graph. Each change of value results in different output results.



The Microtek desk accessory, however, does allow images too large to fit into RAM to be scanned to disk. It is a nice utility that allows the scanner to be operated from within any application. A scan may be set as line art or halftone. While these images are not brought into Digital Darkroom directly, they can be saved as tag image file format (TIFF) files and imported into Digital Darkroom, SuperPaint 2.0 and almost any page-layout program.

A selection of 12 halftone options are available in the DA. Some options are designed to reproduce the original picture as accurately as possible; others allow for special effects such as posterization.

Both the Microtek and Data Copy software too often force you to select discrete values when they should permit any value within a given range. For instance, the brightness and contrast settings can be selected from a pop-up menu, with each option a few percentage points different from the previous one. A more accurate and convenient approach would be to type in specific values or set them with sliding scales like those found in Apple's AppleScan software (see MacWEEK, Oct. 4, 1988).

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Reviews

Scanners

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Data Copy 730GS. The Data Copy scanner is one of the smallest and lightest of the page-size, flatbed scanners. Its low-profile and small size make it truly portable. The Data Copy also comes with a SCSI cable that is more than 4 feet long.

The Data Copy is as simple to set up as the Microtek; you just attach the cable and load the software. Only one piece of software, MacImage 2.1, is supplied with the scanner, but its degree of sophistication is amazing. For those interested in the maximum number of tweakable options, MacImage is the most complete scanner control package available for the Mac.

For the less stout of heart, MacImage has a short menu option that contains half a dozen predefined scan settings. These were all quite good and produced fine scans. But it's the advanced program capabilities that will delight the scanning aficionado.

MacImage's multiple features allow you to customize your image in hundreds of ways. Every setting has at least three options. Of course, you can set the scanning type, including two "HyperCard" formats, which are misleadingly labeled Line Art and GrayView even though they simply create 72-dpi dithered halftones.

The Data Copy can scan at variable resolutions up to 450 dpi, and, according to the company, this maximum is the true hardware resolution rather than simply 300 dpi with digital extrapolation. At 450 dpi, though, memory management becomes critical. One page-size image can weigh in at more than 10 Mbytes.

If none of the given settings quite satisfies, the View Edit command, which appears in several places throughout the program, allows an even greater degree of customization. For example, the Mode option specifies the number of bits per pixel saved by the scanner, and the remaining options define the special formations of bits that will define each pixel. The separate patterns can be viewed, and if a particular pattern isn't right, it can be edited by displaying it as a matrix of numbers. The numbers and the pattern they define can then be changed and saved to reflect any desired halftone.

Users may also change such complex variables as the gamma of the output image. The gamma is the relationship between gray levels in the scanned image and gray levels output to paper. A linear gamma curve means that the grays print exactly as they were scanned in. A logarithmic gamma curve shifts the grays toward lighter tones, making the printed image lighter than the original. The gamma may be displayed as bands of grays, as numeric information or as a linear graph. The graph may be redrawn by hand, creating custom special effects, and numbers can be changed in the numeric graph to create more-precise effects. In an exacting production environment, the specificity of MacImage is a real boon.

With software keyed to the same settings, the two scanners produced identical results.

One problem with Data Copy's otherwise excellent software is that you can't simply drag the mouse to select the area of the page to be scanned. There are several predefined options, from full letter size down to 2 inches by 4.5 inches. To get a custom size, however, you must choose the Frame command. Most other scanner packages are more intuitive.

Several custom saving and printing options complement the scanning options. A file format is provided for almost any application that might be using the image, including bitmap, PICT, TIFF, RIFF, SuperPaint and PageMaker 1.2's special Foto format. Printing options are provided for the number of lines per inch, screen angle and resolution of final output. A separate printing option allows output to be optimized for the LaserWriter, LaserWriter II or Lanotronic.

Conclusions. With software keyed to the same settings, the two scanners produced virtually identical quality scans. Neither was difficult to set up or to operate; both were quick. The Data Copy's smaller footprint, much lighter weight and long SCSI cable make it easier to handle on a crowded desktop. It also can scan at a greater resolution. But in many circumstances the difference between 300 dpi and 450 dpi is not critical or apparent. Both scanners will do a good job for most desktop publishers.

Since the hardware produces similar results, the software is a more important criterion in deciding between these two scanners. Microtek's bundling of both SuperPaint and Digital Darkroom make it an excellent value for those who do not already have those or similar products and who want to expand their software library. For newcomers to scanning, the Microtek MSF-300GS total package can't be beat. The software provided with the Data Copy 730GS is also first-rate, but is clearly slanted toward heavy-duty scanner users who need special effects. For them, the Data Copy is the better choice. □

Scanners: Going gray gracefully

Scanners eliminate the tedium of having to duplicate work. Choosing a scanner appropriate to your job requires weighing your needs against the many options for resolution, time, cost and memory.

By Philip Robinson

Scanners close the computer-to-paper loop, allowing users to input, store and manipulate hard copy, graphics and text images in a computer. That capability can be extremely attractive for designers, managers or anyone who wants to avoid having to duplicate work.

But choosing the right scanner can be confusing, and it is all too easy to pay for more than you need. A properly tailored purchase will take into consideration the type of documents being scanned as well as the necessary resolution, scanning speed and software.

For gray-scale scanners, for example, options range from four shades of gray through 64 shades and up to 256. Then there are the issues of deciding the optimum resolution, performance and software to fit your needs and budget. And users opting for increased capabilities need to recognize a correlating increase in memory requirements, time and cost.

Shades of gray. The first scanners were judgmental devices, thinking only in terms of black and

white. Each spot on the page was one or the other. If it was actually somewhere in between, the scanner and its software rounded it off to one of the extremes.

This two-shade, one-bit style of scanning makes for compact image files and fast scans, and it works decently for preview scans or even for final scans of crisp line art. But it doesn't work particularly well with shaded or colored images. Such details as highlights, shading and lighting in the original image will be missing from the stored file.

Intelligent scanners can work with a more flexible scale of values. The state of the art in gray-scale scanning has grown from four shades (two bits per pixel) to 16 (four bits), 64 (six bits) and now to 256 (eight bits per pixel).

The Apple Scanner is a 16-shade device, as is Hewlett-Packard's ScanJet Plus and the latest models from Microtek, Thunderware Inc. and Xerox Imaging Systems Inc. In addition, specialized scanners called video digitizers can capture images from videotape or use a video camera as their optics. Koala Technologies' MacVision, for instance, can scan at 256 shades of gray at a resolution of 640 by 480 pixels. The BarneyScan Slide Scanner can scan photographic color slides and convert them to black-and-white slides or negatives at a minimum of 1,000 dpi.

Increased gray-scale ability leads to higher scanner prices and longer scanning and processing times, as well as larger files. A 256-shade file can often reach 4 to 5 Mbytes. Still, it's better to capture more information at the outset than pining for it later. But while people have a tendency to "need" 256 shades of gray just because it's the latest thing, not every job requires such subtlety.

This gray's for you. At Image Express in Orange, Calif., Glenn Cruzen divides graphics scanning tasks into four types. First is the line-art work, which most scanners handle. Then comes 16-level shaded images. "The best you could ever call these is 'for position-only,' showing how a picture crops, how big it is and whether it is upside down — which sounds like a joke until it happens." At 16 levels, the files are small and the quality "real low," according to Cruzen.

Next come images with 64



The image of Notre Dame cathedral at left was scanned with Microtek's MSF-300G scanner at 300 dpi. The image below was scanned at 400 dpi using the Microtek MSF-400G. The contrast and brightness in both images was enhanced with Digital Darkroom, which is included with Microtek's scanners.

shades of gray. For Cruzen, this "exceeds the quantity of gray levels on paper laser printers, but not by a lot." He said that he sees 64-level scanners as practical for "guys who turn out catalogs on newsprint, who in the past had to have a Velox shot of pictures."

But, said Cruzen, "if somebody wants to use 133- to 150-line screens in printing on a Linotronic or other phototypesetter, you need 256 levels [of gray]."

Fortunately for users who need high-end machines, the price curve for more shades of gray isn't overly steep. For example, Microtek's one-bit scanner lists for \$1,600, the six-



bit (64 shades) scanner costs \$1,750, and its 256-shade scanner is \$2,195. DEST's 16-shade scanner lists for \$1,750, while the 256-level scanner carries a \$2,250 tag. These were the prices before DEST filed for protection under Chapter 11.

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OCR and document recognition

OCR software and a scanner can input text directly, but don't expect the document to be error-free.

Translating scanned images of text on a page into word processor or spreadsheet files is a matter of adding the right software to a scanner/computer system.

Almost any scanner can be used for this work, and scanned images can be stored on disk as

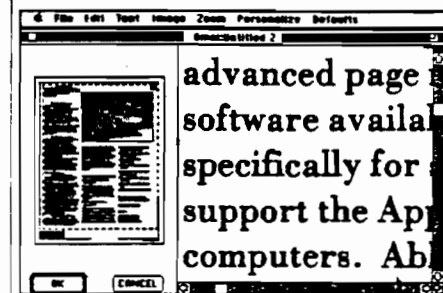
graphics and later translated into text without reference to the original scanning hardware.

This translation work used to be called optical character recognition (OCR), but that phrase is too narrow for today's tasks. Character recognition programs now not only identify letters and numbers, but also understand a profusion of fonts and recognize page formats, such as multiple columns and centering.

Some people find the new level of OCR technology just the ticket for bypassing typists. Others, even though conscious of the real improvements in OCR, are not convinced that it has reached a practical level.

The name you hear over and over in character recognition is OmniPage from Caere, although Olduvai Corp. with

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OmniPage software can show the full view of the scanned page plus an enlarged view that permits fine adjustment of the scanned image.

The BarneyScan Slide Scanner and XP image processing software converts photographic color slides to gray scale at 1,000 dpi.



Gray scale *Continued from Page 70*

Resolution is an issue. A scanner bounces light off a page to see and remember where the light and dark areas are. The more spots it looks at, the more RAM and disk space you'll need to store the information and the more time it will take to process it. Still, if it doesn't cost too dearly in time and memory, you may be better off capturing more information than settling for less. Anything extra can always be trimmed or compacted, but missing information can only be guessed at.

Today, 300 dpi is the standard resolution for desktop scanners. Some portable scanners scan at 200 dpi while some recent (and more expensive) desktop scanners can handle 400 or even 1,500 dpi. Keep in mind that a 400-dpi scanner doesn't just up the resolu-

tion 33 percent. It actually provides 160,000 dots per square inch, compared with 90,000 for the 300-dpi scanner. That's nearly twice as many points of information.

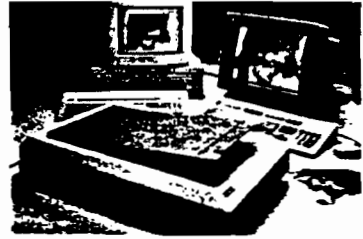
Improved resolution can be expensive. Microtek, for example, charges nearly twice as much (\$3,995) for its 400-dpi scanner as for its comparable 300-dpi scanner (\$2,195).

When looking at a high-resolution machine, it's important to know how the claimed resolution is achieved. Some scanners actually inspect the scanned page at the stated resolution. Other scanners optically scan at 300 dpi,

then electronically interpolate other values in between. This second method does not guarantee as much concrete information as the true, optical high-resolution scan.

Higher resolution scans are certainly useful when capturing sophisticated images such as photographs. They can also help when recognizing text by offering more detailed images of characters and when scanning line art by offering smoother-edged images.

It's important to remember that if you plan to scan and then enlarge any image, you'll be decreasing its final effective resolution. Scan



The Microtek BSF-4000 can scan at up to 400 dpi.

OCR *Continued from Page 70*

ReadIt and Xerox Imaging Systems with AccuText hope to take away some of Caere's market preeminence.

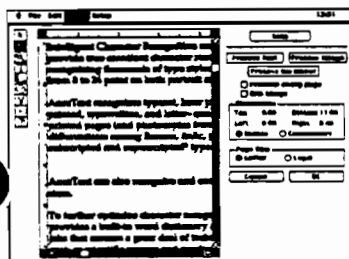
Glenn Cruzen, who works with Image Express of Orange, Calif., said he likes OmniPage, even though OCR is not his preferred route to information. "I've always described OCR with this analogy: You can record music off a radio by plugging a jack into the back or by holding a microphone in front of a speaker. OCR is the microphone method," with attendant noise and mistakes.

Phil Paull has encountered disappointment with OmniPage at Whole Earth Electronics, a computer dealer based in Berkeley, Calif. "Some of the most important scanner users are people who need OCR, such as lawyers, patent attorneys or geologists who have documents they want to input in character mode," he said. But, according to Paull, "that whole technology is on the edge. [Users] all want to be able to stick a document on a scanner and zap it, it's in the memory of the machine as text, without errors. But [many people] don't understand the real success rate." One geologist had a "30 percent failure rate" and was not pleased, he said.

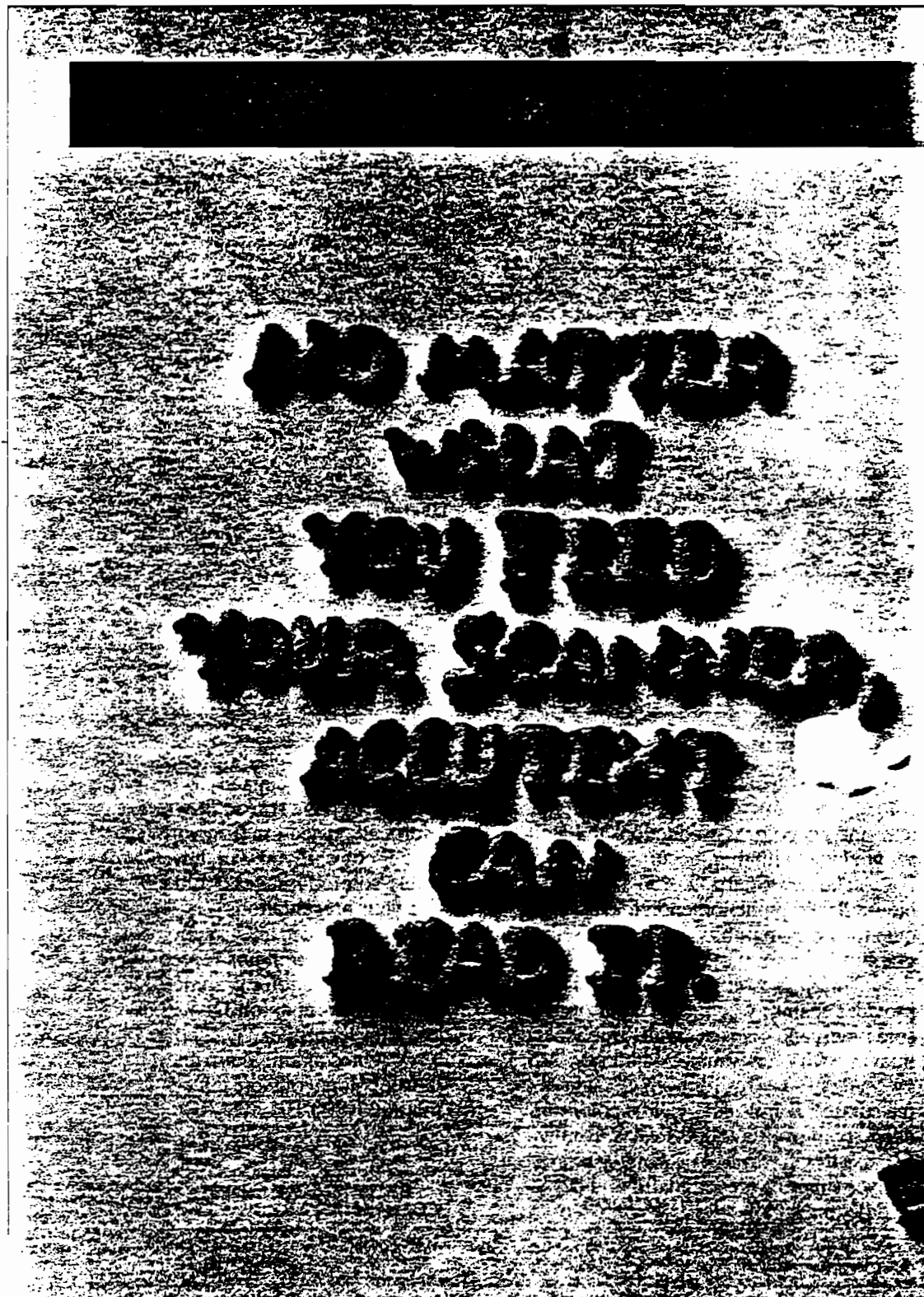
"I think people are under the misconception that scanning is foolproof," said Abhas Arif, manager of desktop publishing at San Francisco's Krishna Copy. "Instead, 10 percent to 20 percent errors is usual, which is not what they expect."

A happier tale can be heard at Dartmouth College in Hanover, N.H. Anne Huggins of Dartmouth's personal computing services department uses OmniPage and said she feels that "it's really quite good." OmniPage has been put to such unusual uses as "scanning three bound volumes of poems from a nun who lived in the 17th century. The researcher was not eager to pay somebody to type them in for him, in Spanish, which might result in even more mistakes. He's so pleased with OmniPage and the Mac."

— By Phillip Robinson



AccuText from Xerox Imaging Systems uses artificial intelligence-based technology to capture typofaces, complex document structures and word processing commands.



at 300 dpi, enlarge by a factor of four and print on a laser printer, and you may well see the jagged edges of a 75-dpi image.

You can beat this effect by scanning at a higher resolution initially or by tracing the art with a graphics program to convert the bit-mapped graphics into smooth lines. The effect can also be used in reverse, printing a scaled-down copy of a scanned image to increase its apparent resolution.

If you're merely capturing an image to use in a program such as HyperCard that can only display on screen at 72 dpi, you

won't care as much about resolution.

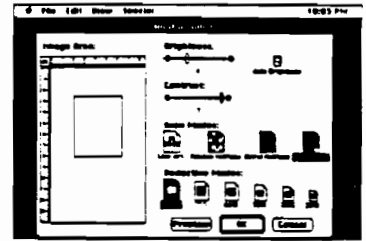
To achieve higher resolution, Abbas Ariff, manager of desktop publishing at Krishna Copy in San Francisco, suggests using Adobe Illustrator 86 when tracing line art, then printing at 25 percent to 50 percent of original scale to improve the resolution.

Speed vs. time and money. Scanners need from 10 seconds to a minute or so to physically slide the inspection optics across a page. More time is needed to send the information to the computer and collect it in a

file. If you scan hundreds of images a week, saving even 20 or 30 seconds on each scan can be significant.

David Asgard of Westbrook, Maine-based ETC & Co. scans "tons of" images — 200 to 300 a week — and although he hears a lot about gray scale these days, 75 to 80 percent of his scans are line art. For his work, he likes the Abaton 300/S scanner, which he said is almost twice as fast as the Apple Scanner.

The software factor. Software is as big an issue in scanning as hardware is. Every



PoniScan for the Abaton 300/S scanner provides scanning controls that are simple and easy to use.

scanner will need programs to easily grab, manipulate, compact, store and print scans, as well as programs to interpret images by tracing (such as Illustrator and Streamline).

Then there's the issue of "ease of use." Users generally don't mind having control software with lots of settings and options, but they want the programs to be quick and obvious. And even experienced scanner hands want features such as scan previewing that will save them time in finding the optimum resolution and contrast settings for a particular task.

Apple's HyperScan utility puts the standard HyperCard interface to work to make scanning a simple click and wait operation.

Anne Huggins, who works in personal computing services at Dartmouth College of Hanover, N.H., said she likes the Apple Scanner's software "because it's easy to use, particularly the preview option for checking contrast and brightness."

Few control programs have the sophisticated features needed to actually edit line art images, much less gray-scale scans. Instead, line art can be edited by programs such as Illustrator or FreeHand. The scan is first saved as a PICT or Encapsulated PostScript Format (EPSF) file, then opened or traced in the graphics program.

Dick Skover, a free-lance illustrator in Milwaukee, uses both Adobe Illustrator and Streamline for tracing. "It's much easier to scan either a drawing my customer supplies or a sketch I do and then use that as a template," he said.

If Skover traces over that template in Illustrator, he has a graphics file he can store, modify and print at any resolution. The tracing process used to mean lots of mouse labor, but it is now partially automated by Adobe's Streamline utility. Streamline can recognize the edges of an image, searching for the significant changes from white to black and laying down a PostScript curve at that edge. For Skover, Streamline is "terrific."

For gray-scale work, you'll be mousing about with programs like Silicon Beach Software's Digital Darkroom or ImageStudio from Letraset USA. But working with such large amounts of information can be time consuming.

Said Asgard, "ImageStudio and Digital Darkroom are excellent programs for transforming images. But it takes them time — minutes sometimes — to simply re-scale a huge file."

In sum, choosing the appropriate level of hardware and software means asking yourself how you intend to use it. Will you scan line art, simple pictures or photographs? Do you have a lot of time to learn complex commands or do you need a simple set of controls?

The answers will determine what speed, resolution and gray-scale level you'll need in hardware and what type of software should accompany it. □

Phillip Robinson is a free-lance writer who specializes in computer graphics and CAD.

XEROX

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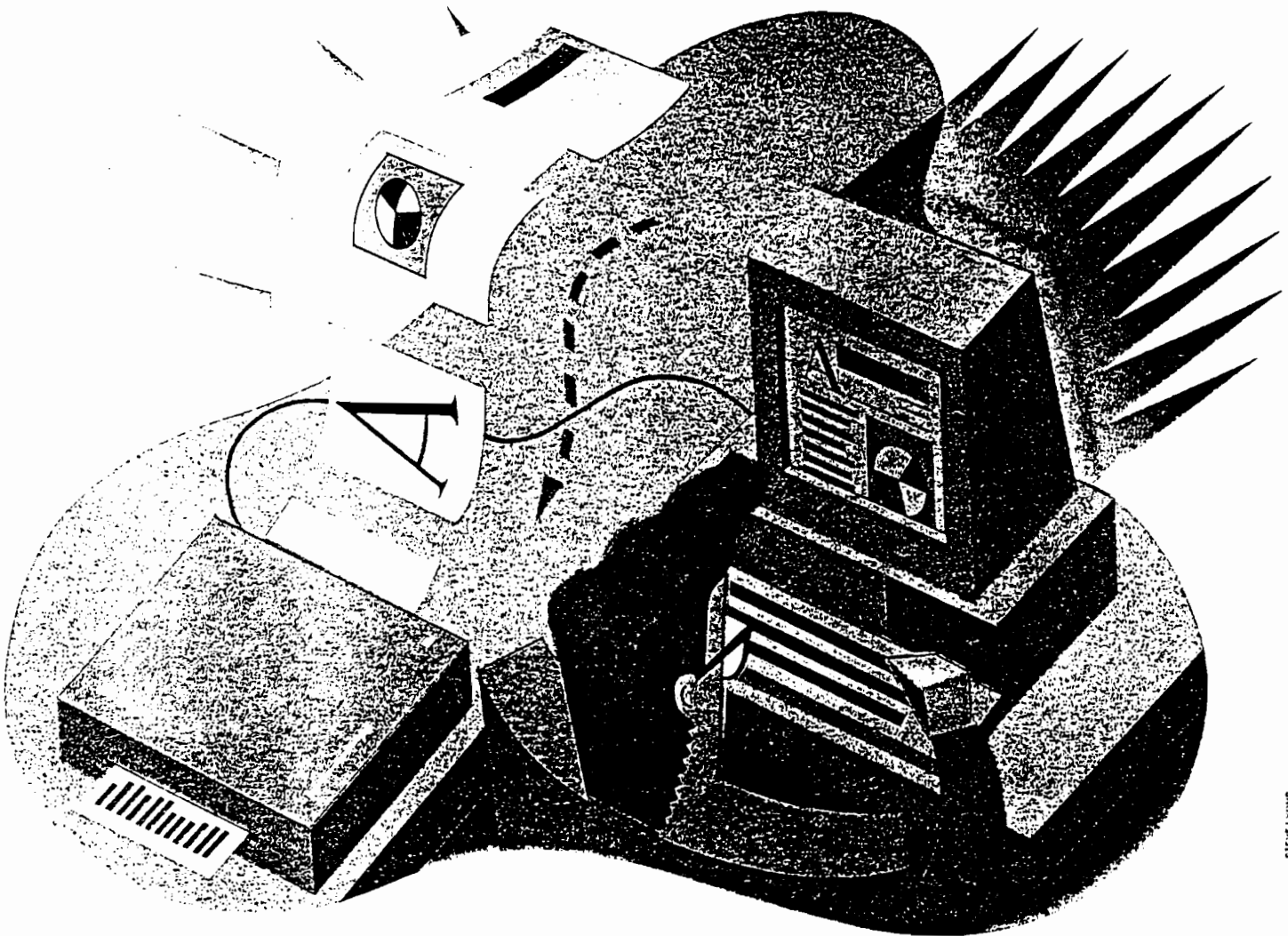
accidental errors don't become visible in the output.

It's which means that the proofreading process is replaced with a scan.



Datacopy

PERSPECTIVES



A Technology Comes of Age

Users are taking a second look at text scanning as years of high costs and poor performance give way to less expensive and more versatile products.

BY ROBERTA FURGER

It's a great idea, but . . . That's the typical response when talking to users about scanning documents into their PC or Mac. Everyone can appreciate the potential hours saved by not having to rekey pages and pages of text, but the expectations have historically far exceeded reality.

Until recently, character recognition has been either too expensive for general office use or incomplete and inaccurate. Advances in the technology and increased competition, however, have resulted in improved performance and lower prices — a combination that's generating renewed interest in a technology that is more than a decade old.

Optical character recognition (OCR), intelligent character recognition (ICR), page recognition, and document recognition — each of these terms is used to describe the process of scanning textual information. It's not surprising, then — given the variety of terms thrown about — that there's more than a little confusion about both the process and the products. Basically, though, products can be divided into three groups: OCR, "teachable" OCR, and ICR.

Each is designed to read text into a PC or Mac, but they do so in different ways

and with varying degrees of accuracy. In fact, although OCR and ICR have been used interchangeably, the technologies they refer to are a world apart in both their capabilities and potential for revolutionizing office tasks.

BUILT-IN LIMITATIONS. While not obsolete, OCR's method of discerning characters is of limited practical use. Its matrix-matching technique essentially stores pictures of fonts in memory for recognition later. Although it's fast and accurate, this approach has one serious flaw — it is limited to a predetermined number of fonts that must be matched precisely for the software to correctly read the text, according to Jim McNaull, vice president for strategic planning for Xerox Imaging Systems Inc. For example, if the type is smudged or the font is not an exact match, the accuracy level drops significantly.

Given OCR's dependence on specific fonts, its uses are limited even in the best of circumstances. The deficiencies have become even more apparent with the proliferation of laser printers and the accompanying multitude of fonts they brought to the office, according to McNaull.

"Limited-font OCR still has a role to play, though," said Steve Hayden, presi-

President and CEO of Calera Recognition Systems, a manufacturer of scanning hardware and software. "If you're using Courier 10 type, for example, you'll get a high degree of accuracy." And you don't have to spend a lot of money on expensive hardware and software, since a scanner and a basic OCR package can cost as little as \$1,500 to \$2,000.

OCR's relatively low price has made it the most widely used type of character recognition product. Many users bought the software at the same time they purchased an image scanner, figuring they could get two uses for one low price. Rather than bolstering interest in character recognition, though, OCR's limited capabilities has made many users skeptical about the viability of the technology. High expectations were met by poor performance, and character recognition got a bad rap that most vendors say they are still fighting to correct.

A MORE INTELLIGENT APPROACH. Vendors are countering years of bad press with alternative approaches to text scanning that go beyond simply providing a list of recognizable fonts.

The first such alternative to traditional OCR could be called matrix matching — with a difference. The difference is that while off-the-shelf packages are limited to reading a specific number of fonts, users can "teach" this software to recognize other typefaces. Because the process can be time-consuming, however, teachable OCR makes sense only if users need to scan a high volume of documents with dictatable typefaces, according to Jenni Mitchell, senior industry analyst in the electronic publishing market analysis service of Dataquest, a market research firm in San Jose, California. "In the general office environment where there may be only a sporadic need to scan, people don't want to take the time to train a package," she said.

Although many believe teachable OCR packages are an improvement over traditional OCR products, they are still limited by the matrix-matching techniques used to recognize characters. What's really driving the market, then, are higher-end products that Mitchell classifies broadly as ICR (although not all vendors agree on the terminology).

Rather than using strict matrix matching, ICR reads text into a document based on sophisticated artificial intelligence tools, such as contextual analysis, page analysis, and the use of lexicons. Because of these tools, even if an ICR package can't identify a word early on in a document, it will often go back and correct earlier errors as it learns more about a particular document and the typefaces used. The speed of the scanning also typically increases as the recognition engine gets further into a document, since there may be less analysis required, according to Larry Miller, director of office products for Caere Corp.

Additional AI tools enable these products (with varying degree of success) to preserve the format of the original document, including such features as indentations, centering of text, columns, and drop caps, for example. "Having to go back in and reformat a document can take a tremendous amount of time," said Xerox's McNaul. Most of the ICR products available also claim to handle complex documents — distinguishing graphs, multiple columns, and embedded tables, for example.

Even with the improvements made possible by ICR, there are still documents that cause problems, however. Depending on who you talk to, you'll get a

areas that text-recognition developers are still puzzling over. Some of the more commonly cited problem areas include:

- Detailed document-structure analysis, which Calera's Hayden describes as "the next big challenge." "You have to build enough intelligence into a system to take a complex page [with text and graphics] apart and do that quickly," he said.

- Stylized logos (such as might appear on a business card) are a problem area, since most packages have difficulty when there's a "fine line between what is text and what is graphics," according to Mitchell.

- Degraded copies of documents —

"Xerox copies of Xerox copies of Xerox copies of Xerox copies are a problem," according to Xerox's McNaul.

AN IMPERFECT SCIENCE. "Even when OCR was font specific it didn't work as well as users would have expected," Hayden said. "OCR is an imperfect science because we humans are imperfect."

One of the most difficult problems for OCR vendors, Hayden said, is that users expect perfection — even if it's a fifth-generation photocopy that an *individual* would even have trouble reading. Many users, though, are beginning to say that while they would prefer 100 percent accuracy rates, for some uses they can

settle for something less than perfection.

Dan Armstrong, senior project coordinator for Lebhar-Friedman Inc., a New York publisher of directories, said he's "looking for 100 percent accuracy, but I know that's unrealistic." He said that since employees must verify (for later publication) all the information scanned into the computer, the 95 percent accuracy rate that he's encountered is satisfactory.

"There are always going to be a few errors," said Dan Fanucci, a software engineer with a Silicon Valley start-up firm. Fanucci is in the process of transferring a large volume of paper to electronic form for eventual inclusion on

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CD ROM. Regardless of the use, Fanucci says, "most of the [user's] time is going to correcting the errors, so everyone has to look at their own needs to determine what [error rate] is acceptable."

SYSTEM DEMANDS. One downside of the advanced AI tools is the higher hardware platform they demand. And, since the recognition engines hold a single page in memory until the scanning process is complete, systems need to be equipped with an average of 4 megabytes of RAM — not an inexpensive proposition.

Because of the tremendous system requirements, it took the introduction of 68020 and 386-based machines before

desktop systems could handle the demands of ICR, Mitchell said. Prior to that time, ICR was available only on dedicated minicomputers, she added. Recently, though, we've seen a proliferation of ICR products for the Mac and PC — some of which have been brought down from mini systems, others specifically designed for desktop computers.

Among the products now available, there are basically two ways of implementing ICR — software-only solutions, which require a sufficiently powerful hardware platform, and software/hardware solutions, which include an accelerator board that Mitchell describes as a "complete PC on a card." Although it's

more expensive than software-only solutions, the hardware/software combination is the only way AI-based scanning is feasible on a sub-80386 or sub-68020 system. And, since the scanning is off-loaded to the processor on the add-in card, the scanning can often run in the background while the system completes other tasks, according to McNaul.

And both alternatives cost considerably less than similar systems of only a few years ago. Three years ago, according to McNaul, omnifont technology sold for between \$30,000 and \$40,000. "It did a nice job, but was complex and costly. Now, the same level of technology or better is available for between \$5,000 and

\$16,000," he said.

As the price has come down and the performance has improved, users are beginning to take a second look at text scanning. Many observers, in fact, think it will be text, rather than image scanning, that ends up driving the market.

"As much as we talk about images, the world still communicates in text," said Cathy Dingman, manager of image systems research for BIS CAP International. For that reason, she said, it is not a technology-driven market. "The need is there," Dingman said. "It's just a matter of developing a strong enough product at the right price point."

Despite lofty predictions about the future of the text-scanning market, many users are still in the education stage, according to Bob Johnson, product manager for Corporate Software. Years of bad press about the expense and inaccuracies are slowly fading, but skepticism and confusion remain.

In a survey he conducted of Corporate Software clients, Johnson found users interested in a variety of applications for text scanning. "The uses ranged from [information centers] to purchasing to sales to human resources," he said.

One sophisticated use of ICR has been developed for human resources departments by Resumix, a Santa Clara, California company. Designed for "efficient resume processing," the Resumix system consists of three parts: scanning in resumes; extracting and classifying personal information regarding job experience, educational background, etc.; and then, through the use of artificial intelligence tools, matching job requirements to qualifications.

AN ENABLING TECHNOLOGY. The Resumix system is just one example of the types of innovative uses possible when marrying text scanning with other technologies, Mitchell said. In fact, what most observers find exciting about character recognition is not simply the scanning in of a document, but the possibilities when text scanning is used in conjunction with other technologies.

Caiera's Hayden, for example, believes that in the "not too distant future" recognition and facsimiles will be combined so that incoming documents will automatically be scanned into a PC and then stored on magnetic media. Like others, Hayden said character recognition is more exciting when considered as a tool, rather than an application in and of itself.

The real challenge, Fanucci said, is not scanning in the information, it's finding ways to efficiently manage vast amounts of data after it's been scanned. For example, imagine a law office scanning in dozens of depositions for a trial, or a government office scanning in stacks of purchase orders, storing the information on an optical disc, then being able to systematically locate information in the large text database with sophisticated search and retrieval software. The combination is a powerful tool for white-collar workers, Mitchell said.

Character recognition, in fact, is frequently referred to as an enabling technology. When married with other advances, it offers solutions to problems that almost anyone can relate to — whether they are computer neophytes or power users.

The result is more than completing tasks in record time — although that certainly is a byproduct. It's being able to manage and analyze textual information in more innovative, productive ways. And after all, isn't that what technology is supposed to be about?



...all that thinking has paid off

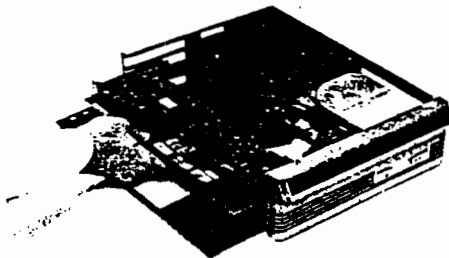
In a world that is literally awash with PCs, the entry of yet another PC into the market is not normally earth-shattering news.

However, the POWERLITE System from Advanced Digital is NOT just another PC.

It is often easy to overlook the obvious. That is why our engineers thought long and hard about the design of the POWERLITE System. The result of their thinking can be summarized as follows:

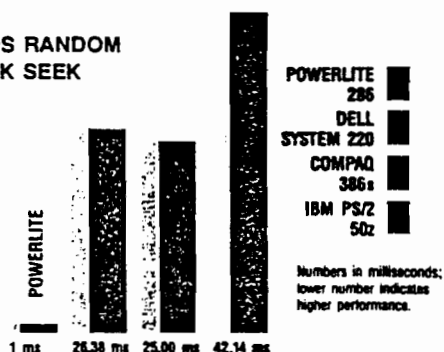
#1. Things change

The POWERLITE System is designed to grow with change, not to be a victim of it. Since the POWERLITE System is based on a modular design, upgrading to a new processor is only a matter of plugging in a board, not of buying a new computer.



Unlike other modular designs, the POWERLITE System integrates a VGA video controller, communication ports and keyboard interface onto the same board that contains the CPU and memory. Until now, it seems that no one noticed that graphics standards have advanced in parallel with processor and memory standards, and that keyboard interfaces also change (try plugging your old PC keyboard into your AT).

BIOS RANDOM DISK SEEK



POWERLITE 286 Model 141 used for comparison tests. Competitors' test data obtained from the manufacturers' product literature and PC Magazine.

#2. Bigger is not necessarily better

Of course, Advanced Digital is not the first computer manufacturer to notice that computer users like smaller computers (our thanks to Steve Jobs).

The POWERLITE System, since it is based on a highly integrated design, has one of the smallest footprints of any computer. It is half the size of conventional AT's, and about 30% smaller than the IBM Model 30.

However, inside this 11 1/4 x 15 inch package is some rather impressive computing power. In fact, it compares quite favorably to some very sizable competition.

Features include:

- 80386SX (16 MHz) or 80286 (20 MHz) CPU
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February 27, 1989

Hewlett-Packard Introduces the HP ScanJet Plus -- A New Price/Performance Level in the Desktop Scanner Market

Overview

Hewlett-Packard (HP) recently announced the HP ScanJet Plus, a 300 dpi/8-bit gray scale scanner that was codeveloped by HP and Canon. Priced at \$2,190, this scanner offers a major improvement in the price/performance for gray scale scanners. The HP ScanJet Plus provides the ability to capture up to 256 levels of gray at a cost that is only slightly higher than most of the 6-bit scanners (64 levels of gray scale) currently on the market. It offers interfaces for the IBM PC, PC XT/AT, and PS/2 machines, as well as interfaces for the Macintosh Plus, SE, and II machines. Software for image capture and editing is included in the price — Scanning Gallery Plus for the PC version and Desk Gallery Plus for the Macintosh version. OCR/ICR capabilities are provided through support for third-party software packages.

The introduction of the HP ScanJet Plus reflects HP's strategy to offer products compatible with multivendor platforms. The new HP emphasis is to offer a total solution to the customer, consisting of HP equipment and industry-standard computing equipment. Recent product introductions reflect the company's understanding of the market and its requirement for products designed to operate in a multivendor environment. Along with HP's recently introduced Type Director (codeveloped with Agfa Compugraphic), the HP ScanJet Plus is designed for both the Macintosh and PC, PS/2 markets. Many factors indicate that HP is working toward providing a total solution designed to coexist in a multivendor environment. These include HP's licensing agreement with Adobe Systems for the use of the PostScript page description language, its newly announced joint venture with 3Com (HP recently purchased a 5% interest in 3Com), and the adoption by software developers of object-oriented features inherent in HP's NewWave user interface.

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While HP has brought to market a promising product that is in keeping with its current strategy, the success of the HP ScanJet Plus will require an innovative marketing approach. HP can expect to encounter a series of marketing challenges with this product, including a relatively small installed base due to slow acceptance of desktop scanners, current memory restrictions in PC technology, and a highly competitive marketplace. It will certainly be interesting to see how this computer giant fares with the HP ScanJet Plus in such a difficult market.

HP ScanJet Plus Features

What makes the HP ScanJet Plus such a promising product is a number of its features. Below is a list of the product's key features followed by a discussion of their significance.

- **16 or 256 Levels of Gray Scale Recognition**

The HP ScanJet Plus provides users with the option of capturing either 16 or 256 levels of gray scale information. Once captured, the gray scale editing software offered by HP interprets the gray scale data to create a variety of different effects. The advantage of offering high levels of gray scale recognition is that it gives users the freedom to modify their scanned images without fear of distortion as is common with inflexible bitmap images. Furthermore, it allow users to take advantage of higher resolution printers and typesetters.

- **300 dpi Scan Resolution with High-Resolution Output Capabilities**

The 300 dpi scan resolution of the HP ScanJet Plus makes for a good match with the typical 300 dpi laser printer output associated with many desktop publishing systems. In addition, the HP ScanJet Plus provides users with the ability to adjust the resolution of an image from 12 to 1,500 dpi in one-dot increments in order to match the current output resolution — a feature which becomes critical if a user intends to output to a higher resolution printer or typesetter. Trade-offs between the number of gray levels and the halftone screen resolution do exist, however, when going to print a gray scale image. As the user increases the size of halftone cells in an effort to increase the number of gray levels, the halftone screen resolution decreases because the larger cells are unable to accommodate as many halftone screen lines per inch.

- **Support for Industry Standard Formats**

The HP ScanJet Plus provides support for de facto standard file formats such as TIFF, EPSF, MacPaint, PICT, GEM, and PC Paintbrush. Support for these file formats provides links to a wide variety of desktop publishing, paint, and draw packages. The ability to capture an image is one thing, but the ability to incorporate that image into a desktop publishing document or the ability to bring the image into a paint, draw, or illustration package for modification is, fundamentally, what makes a scanner useful in the publishing world. Without this ability, many publishers would have little use for a device that simply scans, stores, and outputs images (this is not to say that there is not an application for storage-and-retrieval systems that incorporate a scanner as part of the system).

- **Multiple Scanner Application Support**

Extensive support is provided for key third-party OCR/ICR software packages, including packages such as OmniPage from Caere Corp., ReadRight from OCR Systems, and TrueScan from Calera Recognition Systems. This support for a variety of text recognition solutions allows users to utilize the HP ScanJet Plus not only for capturing images, but for capturing a wide range of text as well. HP has also provided a means of utilizing the HP ScanJet Plus for fax applications via support for the resolution of the AppleFax modem.

CAP believes HP's support for a variety of third-party application packages for use with scanners signifies the company's understanding of the need to broaden the functionality of scanners in an attempt to expand the devices' appeal. To date, it has been difficult for many people to cost justify the purchase of a scanner. While potential users may have had a need to convert images to digital format for the purpose of incorporating them into documents, this was often only an occasional need. By providing support for a variety of third-party text recognition packages, as well as hooks for fax applications, HP has greatly increased the applicability of its scanner and, hence, potentially eased the process of cost justification.

- **General Productivity Features**

Both the HP Scanning Gallery Plus software and the HP Desk Gallery Plus software provide a prescan preview option that allows a user to view the image to be scanned prior to the actual, full-resolution scan. While viewing the prescanned image, PC and PS/2 users can interactively adjust its size and shape. Macintosh users have the added bonus of being able to interactively adjust the contrast and brightness of the image. The ability to receive instantaneous visual feedback provides a major productivity boost in the scanning process.

The HP Scanning Gallery Plus software for PCs and PS/2s provides a feature called "Launchable OCR." Designed with productivity in mind, this feature allows users to scan text from within the Scanning Gallery Plus software rather than having to exit the application and then open the OCR software application.

Within HP Scanning Gallery Plus software, minor modifications have been made by HP to Microsoft Windows, the graphical operating environment in which Scanning Gallery runs. These modifications were designed to improve the application's ease-of-use.

Marketing Challenges

The bulk of sales for the HP ScanJet Plus is expected to initially come from product substitution at the expense of competing brands. CAP expects that a percentage of scanner users will be motivated to switch from 4-bit or 6-bit scanners to the HP ScanJet Plus due to the relatively insignificant price differential. Those opting for the HP ScanJet Plus with its 8-bit gray scale capabilities are expected to be primarily graphic artists and professional desktop publishers. Unfortunately, sales from product substitution will be relatively small as the total installed base of scanners to date is low. Greater profitability and increased sales opportunity lie in HP's ability to successfully penetrate the nonprofessional publishing segment of the corporate market. The corporate publishing market holds great potential for the HP ScanJet Plus, however, reaching this market will not be easy. Several marketing challenges currently facing HP are outlined below.

- **Confusion Over Gray Scale**

The current confusion over gray scale among end users limits the use of high-level gray scale primarily to

graphic artists and professional desktop publishers. HP will find that technological innovation does not necessarily ensure market success. To add to the problem, most dealers who will be responsible for selling the HP ScanJet Plus also do not understand gray scale scanners, therefore, aggressive selling of the product is unlikely. In order to overcome this obstacle, HP will have to invest substantial resources in training its dealers as well as educating potential end users.

- **Limitations in Producing Quality Gray Scale Images**

Quality printing of gray scale images on standard 300 dpi laser printers has been a problem to date. With the fall 1988 introduction of Intel's Visual Edge System (a \$695 product that enables HP LaserJet II users to output gray scale image data as halftones with resolutions of up to 100 lines per inch) we are beginning to see a closer parity between the input and output aspects of gray scale. Products such as Intel's Visual Edge System serve to validate the use of gray scale scanners because they begin address the problem of producing quality gray scale images in hard copy form.

- **Inherent Memory Limitations of Current Personal Computers**

The memory restriction on most current PCs discourages the storage and use of graphic images, especially gray scale images. For example, an 8.5" x 11" image consisting of 256 levels of gray at a resolution of 300 dpi will require 8.4MB of memory. This places serious demands on the memory capacity of most existing PCs. From the end user's perspective, it is not only important to have a gray scale scanner that costs less than \$2,000, but also a realistic means to a system upgrade which includes 2-4MB RAM and a higher density (60-80MB) hard disk. Most existing PCs do not have these features as part of the standard configuration, therefore, potential scanner users must also explore the costs associated with upgrading their PCs in order to fully utilize a gray scale scanner.

The use of data compression is expected to help alleviate this problem. In addition, it is reasonable to expect that the evolution of current PC technology will help to broaden the appeal of high-level gray scale scanners in the near future. In the short run, due to memory con-

straints, the limited use of gray scale images on a PC will make the return on investment appear to be less attractive than comparable investments in other tools for the PC. HP will have to develop creative strategies in order to inspire users, especially first-time scanner buyers, to purchase the HP ScanJet Plus.

- **Increasing Market Competition**

CAP expects HP to experience serious competition from other vendors as competition in the scanner market is expected to intensify. Since the barrier to entry for this market is relatively low compared to other computer products, today's perceived product differentiation among scanners appears to originate in the product's software capabilities — which leads to the question of whether this is a hardware market or a software market. As other vendors respond with price/performance improvements to their gray scale products, gray scale scanners will become increasingly similar in terms of basic hardware functionalities (see Attachment A for a competitive comparison of scanners featuring 256 levels of gray). Market dominance will be achieved by those vendors who can incorporate the best set of technological features while simultaneously achieving optimal economies of scale in manufacturing and marketing.

- **Reseller Cooperation**

Dealer cooperation is critical. In the past, the inflated expectation of a scanner on every desktop induced numerous market entries. Much to many vendors' surprise, the market did not take off. Instead of large sales volumes, vendors were faced with excess inventory at the distributor/dealer level. Because of this, CAP believes many dealers are reluctant to stock additional scanner inventory. HP's solid relationship with the dealer network, strong brand name recognition, and end-user loyalty (all due to HP's LaserJet printers), will certainly help HP to obtain shelf space for the new HP ScanJet Plus. It should, however, be noted that HP's first scanner, the ScanJet, did not provide the dealer channel with the sort of sales volumes it was accustomed to with HP's printer line of products. Like all other scanner vendors, HP needs to devote the resources to training and supporting the dealer channel as they develop a broader market for scanners.

Summary

In summary, the success of the HP ScanJet Plus will be determined by the following market dynamics: understanding and acceptance of gray scale scanning as a viable application; expansion of memory capacities in PCs; the evolution of gray scale printing technologies; and the evolution of the scanner as a multifunctional device. Developments in any of these areas will help to stimulate demand for the HP ScanJet Plus as well as other scanners currently on the market.

The understanding and use of gray scale will become more widespread as enhanced power for graphic processing becomes available on PCs. Due to the nature of the installed base of Macintosh users, the Macintosh platform is expected to generate the initial demand for gray scale on desktop systems. As the technology evolves, PCs are expected to become more graphically oriented. CAP believes that OS/2 with Presentation Manager will become more solidly established in the corporate environment within the next 12 to 18 months. CAP believes this will generate additional momentum for the widespread acceptance of gray scale scanning applications.

More powerful memory capacity in PCs will also facilitate the acceptance of gray scale scanners. Performing applications that utilize gray scale, especially those utilizing 256 levels of gray data, requires immense memory not typically found in today's installed base of PCs. As technology advances and PCs possess greater memory capacity, sales of gray scale scanners will grow substantially. In addition, improved gray scale printing technologies will help to position gray scale scanning applications more attractively. As mentioned earlier, products such as Intel's Visual Edge System are beginning to come to market. This type of product allows for better quality output of gray scale image data and, as such, is expected to play an increasingly important role in the acceptance of gray scale scanners.

Multifunctionality will also be a major factor in the widespread acceptance of scanners, particularly in the corporate environment. At present, scanner use has been limited to a few niche markets due to the fact that few quality application programs existed for use with a scanner. We are beginning to see a variety of quality application packages being introduced that make scanners a viable tool for publishing, text recognition, and facsimile. As scanner technology continues to evolve toward multifunctionality

and as products begin to incorporate artificial intelligence, scanners will encounter fewer barriers in establishing themselves as communication and information processing tools for the general mass computer market.

CAP believes the HP ScanJet Plus is a product with a strong price/performance ratio. However, HP will face many obstacles in its quest to achieve high sales volumes. It will be interesting to see if HP, with the HP ScanJet Plus, can stimulate sufficient demand for scanners in order to achieve high sales volumes — a vision that the market's participants and critics had initially projected for this market.

Maggie Wu

Attachment A

Competitive Comparison of Scanners Featuring 256 Levels of Gray

Vendor	Model	Scanner Type	Resolution	Host Compatibility	Price	Items Included	Intro. Date	Engine	Graphic Format(s)	OCR/ICR	Compatibility w/ DFP Software	Paint/Draw
Context	Scanned Image Solution Pack	Flatbed	400 dpi	Apollo	\$18,000	scanner, imaging software	3Q/88	Ricoh	developed to work with Context	Yes	Yes	No
Datacopy	840	Flatbed	400 dpi	PC, Mac	\$6,800	scanner	10/87	Ricoh	Document Systems TIFF, PICT, RIFF, IMG, EPS	Yes	Yes	Yes
	840i	Flatbed	400 dpi	host is OEM	\$9,995***	scanner	10/87	Ricoh	same as above	Yes	Yes	Yes
DEST	PC Scan 2000	sheet feed	300 dpi	PC, PS/2 (30), Mac	\$1,495	scanner	8/87	DEST	TIFF, EPS, PCX, PICT, EPSF	Yes	Yes	Yes
ECRM	Autokon 1000	Flatbed	2,032 dpi	Mac, Sun Microsystems, Interleaf, Xyvision, etc. (30 OEMs)	\$62,500		9/84	ECRM	OEM's graphic format	No	Yes	Yes
	Autokon 2000	Flatbed	2,032 dpi	same as above	\$33,785		85	ECRM	same as above	No	Yes	Yes
Intelligent Optics	Speed Reader	sheet feed	300 dpi	PC, PS/2, Mac	\$5,995*	scanner, OCR software, & sheet feeder	4/89**		TIFF, PCX	Yes	Yes	Yes
	MSF-400G	Flatbed	400 dpi	PC, PS/2, Mac	\$3,995	scanner, interface, & software	3/88	Microtek	TIFF, PCX, EPS	Yes	Yes	Yes
	MSF-300G	Flatbed	300 dpi	PC, PS/2, Mac, Sun	\$3,495	scanner, interface, & software	1/88	Microtek	same as above	Yes	Yes	Yes
	LS-2400	Flatbed	400 dpi	PC, PS/2, Mac	\$10,000*	\$500 extra for UNIX interface	5/89**	Microtek	TIFF, AutoCAD, CAD/CAM formats	No	No	No
	LS-3600	Flatbed	400 dpi	PC, PS/2, Mac	\$15,000*	scanner, software, SuperPaint, Digital Darkroom	5/89**	Microtek	same as above	No	No	No
	LS-3600 turbo	Flatbed	400 dpi	PC/PS/2, Mac	\$60,000*	scanner, raster-to-vector conversion hardware, hard disk storage, SuperPaint, Digital Darkroom	5/89**	Microtek	same as above	No	No	No
Xerox	7650 ProImage	Flatbed	1,200 dpi	Xerox XPS-701	\$9,745	scanner & software	8/87	Xerox	dependent on OEMs	Yes	Yes	Yes

* Anticipated pricing on product introduction.

** Expected product introduction.

*** Average pricing. Actual pricing varies with each OEM.

OCR packages are latest EP&P tools

New offerings recognize typeset text without 'training'

**By James Cavuoto,
West Coast Editor**

TrueScan, from Calera Recognition Systems, is an optical character recognition package for AT compatibles. Like the AT version of Caere Corp.'s OmniPage, it is sold in the form of a full-length expansion board plus OCR software. The expansion board is needed because of the software's substantial hardware requirements, which include four megabytes of internal memory. The board permits use of the program on a computer with as little as 512K of RAM.

Calera Recognition Systems is a new name, but not a new company. Under its previous incarnation as Palantir Corp., the company developed high-end OCR hardware/software capable of automatically recognizing typeset text. The TrueScan software is derived from these earlier packages, offering the same kind of sophisticated text-recognition capabilities in a product that costs just \$2,495.

No pretraining required

Many OCR packages have the ability to recognize typeset text, but most must be trained by the user to read particular fonts. TrueScan, along with OmniPage and a handful of other packages, can recognize typeset text in multiple columns without pretraining. It can also scan images for use as TIFF or PCX files, but this is not its primary use.

We tested TrueScan on a 386

computer with a Hewlett-Packard ScanJet scanner. Calera offers an optional daughterboard to control the ScanJet. Because it attaches to the main expansion board, you can control the scanner without using an extra expansion slot in the computer. Daughterboards are available for the ScanJet, Canon IX-12, Canon IX-12F and Princeton Graphics LS-300. The package also supports scanners from AST, Datacopy, Dest, Microtek and Panasonic, but requires use of the scanner's native expansion board.

Installing the board is a breeze, even if you have to attach the daughterboard. With many expansion board products, you must often adjust dip switches to prevent memory address conflicts with other devices in the system. Calera's installation software, however, automatically figures out which memory address to use. The user has the option of changing this if desired. Once the board and software are installed, the system runs a self-diagnostic

every time you boot up the computer. This took a minute or two on the 386, and could be irritating if you like a fast reboot.

The pros and cons

Because the package competes pretty much head-to-head with OmniPage, comparisons are inevitable. In most respects, their capabilities are similar. We tested the program with a variety of document types—typeset, monospaced, photocopied, and so on—and found that its accuracy is comparable to that of the Caere product. Some documents were translated to perfection, but others, particularly photocopies and pages with unusual fonts, presented problems. The program, at the user's option, can place flag characters before any word of which it is unsure. We found that in most cases, the program correctly recognized even those words that it had flagged.

TrueScan supports most popular word-processing file formats for DOS computers. In addition, it can save tables in the Lotus/Excel WK1 spreadsheet format. It does not support the WKS format, however. This is a problem if you are using an old version of 1-2-3 or another spreadsheet program that supports WKS, but not WK1. The program does not support any database formats directly, but documents can be saved in one of two ASCII formats, from which they can be converted into a database file. Columnized ASCII files retain

At a Glance

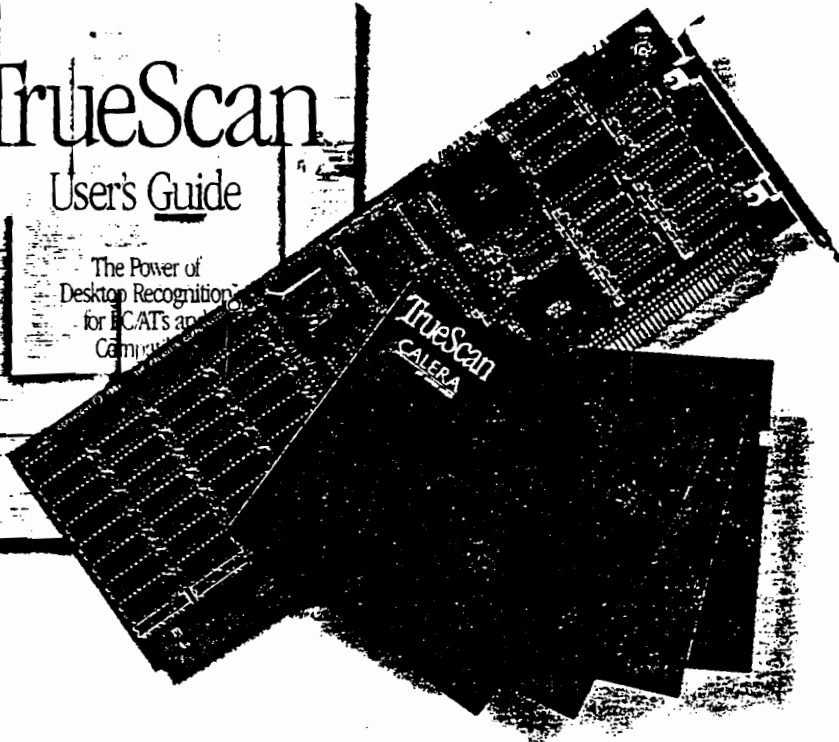
TrueScan
Calera Recognition Systems
2500 Augustine Dr.
Santa Clara, CA 95054
(408) 986-8006
(800) 544-7051

Requirements: Runs on IBM AT or compatibles with minimum 512K RAM. List price: \$2,495.
Circle 129 on Reader Card

TrueScan

User's Guide

The Power of
Desktop Recognition
for PC/AT's and
Compaq



multiple-column formats from the original document. Decolumnized ASCII files run multiple columns one below the other in sequence.

The time required to scan a document varies depending on page size and the amount of text to be scanned; but it averaged about one minute on our 386 computer. Because most of the processing is done on the

Although not a new technology, optical character recognition (OCR) software packages have just recently garnered much attention in the desktop/electronic publishing arena. Offerings such as TrueScan (above) feature sophisticated text-recognition capabilities usually found in more expensive products.

expansion board, performance on a slower AT would probably be comparable. You can scan as many pages as desired into a single output text file.

Beyond its core capabilities, TrueScan has certain strengths and weaknesses. For example, it can scan documents in landscape mode, facilitating its use with tables and other spreadsheet-type data. Imaging capabilities are also superior. In addition to saving images in TIFF format, you can save them in PCX format. TIFF images can include gray-scale information. Unless you select a portion of the page for scanning, the entire page is saved in the graphic format.

On the downside, TrueScan uses a text-based menu-driven user interface instead of a gra-

phic interface like Windows. This probably improves program performance, but adds certain inconveniences. You can select a certain portion of a page to scan, but you must do so by entering numeric measurements for top, bottom, left, and right margins. Most scanner control programs, on the other hand, allow you to do a preview scan, which produces an image of the page on the screen. You can then draw a box around the area to be scanned.

Who makes decisions?

Because the program cannot display a scanned page, the user cannot select certain columns or text blocks to be recognized, and cannot change the order in which columns are read. Instead, the program makes its own decisions about the sequence of text blocks. OmniPage, on the other hand, has an optional manual galley user control that allows greater user control over how the page is recognized. Also missing from the program is the ability to view or edit a page once it has been converted into a text file. This means that users must quit the program and open the file with a word processor to check on the accuracy of the scan.

Inconveniences aside, this is a solid program with much to recommend it. Accuracy rates are high, and the program is easy to install, learn and use. Conceivably, it could be used as the primary scanner control program for text and images, but its lack of a WYSIWYG display will prove inconvenient for many imaging applications. Users trying to choose between this product and OmniPage should take each program's strengths and weaknesses into account and decide which one best meets their particular needs. ■

Page recognition program bows

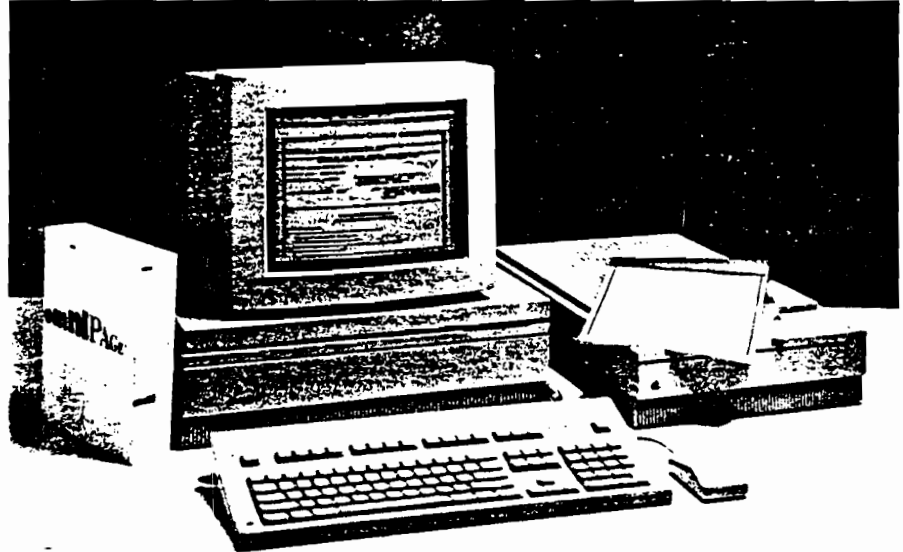
Package eases typeset document conversions

By James Cavuoto,
West Coast Editor

OmniPage, an optical character recognition (OCR) program from Caere Corp., is one of the most talked-about software packages to come along in recent months. Just as desktop publishing programs like Page-Maker and Ventura Publisher gave many users their first incentive to purchase a laser printer, OmniPage and similar programs are likely to spur the sales of desktop scanners. That's what a number of scanner manufacturers are banking on, at any rate.

The developers of OmniPage have positioned it as a "page recognition" product as opposed to a mere OCR package. OCR software, in conjunction with a scanner, converts text on paper into a text file on a computer. OCR packages for microcomputers have been available for several years, but early programs had many limitations. Many of the first packages on the market were capable of recognizing monospaced typewritten output only. Typeset pages from books, magazines, and newspapers were beyond their ability.

Later packages could recognize typeset output, but required that the user "train" them to read specific typeset fonts. You would load the page and identify the font, and then the software would refer to a font file when recognizing the text. Such trainable programs



worked well, but training them to recognize a font was time-consuming.

OmniPage transcends many of these limitations, providing capabilities once found only in scanning systems priced at \$10,000 or more. With it, you can scan a page containing multi-column typeset text and, without much in the way of preparation, have that page converted into a text file. The program can recognize mixtures of fonts on a page, as well as boldface and italics. In some cases, it can retain boldface and other formatting in the stored text file. Tables from newspapers, books, or magazines can be converted automatically into Microsoft Excel worksheets, complete with decimal alignment. The program can also automatically identify graphic

images and save them in TIFF (tagged image file format).

The capabilities found in a program like OmniPage require substantial hardware resources in the form of memory and processing power. The Macintosh version of the program, which costs \$795, uses the Mac's internal memory and processor. At least four megabytes of memory are required to run the program. A DOS version of the program is sold in the form of an AT expansion board that includes a co-processor and needed memory. No further hardware enhancements are required, but the board and software together cost \$2,495. We reviewed the package in its Macintosh version, but the AT version, which runs under Microsoft Windows, works pretty much the same.

In addition to computer hardware, you also need a scanner to effectively use the program. OmniPage directly supports several popular scanners, and new drivers are being added all the time. If your scanner is not directly supported by the program, you can still scan text pages and save them in TIFF format. OmniPage then performs its page recognition on the TIFF image rather than the original document.

Once it's set up to work with your scanner, OmniPage is easy to use. Scan settings such as contrast, resolution, and the ultimate text file format are selected from dialog boxes. These settings can be saved as a disk file if you think you might need to scan a similar page later.

After scanning . . .

After a page is scanned, OmniPage divides it into blocks, separating columns, graphics, and (in some cases) paragraphs. Each block is numbered consecutively, so that a right-hand column always follows a left-hand column and so on. At this point, the program begins character recognition according to one of three options selected by the user. The Auto Galley option causes the program to read each text block sequentially, producing a single-column text file even if the original page has multiple columns. The Auto Paste-Up option also causes the program to read blocks sequentially, but cannot be used for multiple column layouts.

The Manual Galley option requires that the user select the specific text blocks the program should recognize. This is used when you are only interested in certain sections of text, or where the automatic numbering process places blocks out of the desired order.

In addition to determining

how OmniPage recognizes a page, you can set it up to scan only a selected portion of a page. You can also scan a page and save it as a TIFF file, waiting until a later time to perform character recognition. OmniPage can save graphic images as TIFF files, but does not include grayscale support. This limits you to saving line-art images or dithered halftones. Two halftone dither patterns are available.

Once text is recognized, it is stored in the program's Transitional Editor. Characters that cannot be identified are indicated with a special character. If text is to be saved in an ASCII (American Standard Code for Information Interchange) format, you can edit it directly or use a search-and-replace function to locate errors. If text is to be stored in MacWrite or Excel formats, you cannot edit it here, but you can view it.

The program creates Excel files by means of a Financial Form feature. It aligns numbers according to decimal point and recognizes multiple columns as part of the same table. We were skeptical of whether this feature would work, but we tried it with

a table from the stock listings of our local newspaper and the conversion was flawless. Unfortunately, OmniPage cannot scan in landscape mode, limiting this feature to tables that are narrower than 8 1/2 inches.

Some drawbacks

This program goes a long way toward redefining the market for OCR software, but it is not perfect by any means. The program's accuracy is generally high, but it has trouble with certain typefaces. Baskerville, for example, has a high crossbar on the lower-case "e", causing the program to mistake it for a "c". Typefaces like this might be more accurately recognized by a trainable package, which can be set up to tell the subtle differences between the two characters.

OmniPage also suffers from low accuracy rates when scanning some forms of laser-printed or photocopied output, even with standard typefaces.

We also have some criticisms of the manual. OmniPage is not difficult to use, but the manual still seems a bit skimpy. One chapter describes business scenarios showing possible uses of the program, but provides no step-by-step instructions for how to actually do anything.

Still evolving

Caere Corp. sees OmniPage as an evolutionary product, and has already given indications of likely future versions. Some of them are pretty astounding.

Shortcomings aside, OmniPage is a significant, if not revolutionary, product. Many users who had no reason to purchase a scanner now have one. If you have a need to convert typeset documents, especially those with multiple fonts, into a computer text file, we recommend this program. ■

At a Glance

OmniPage
Caere Corp.
100 Cooper Ct.
Los Gatos, CA 95030
(408) 395-7000

Requirements: Apple Macintosh II or SE with 4 MB RAM. Runs under System 5.3 or 6.0. Supports Multi-Finder 6.0. Drivers for Apple Scanners and HP ScanJet included. Supports all scanners through black and white TIFF files. Price: \$795 (Macintosh); \$2,495 (IBM). Circle 126 on Reader Card.

Grayscale Scanning Gains Support from Hardware and Software Advances

Scanners are offering more grayscale capability at lower cost as new hardware options for printing and new grayscale editing software emerges in the PC environment.

by Robert Mueller

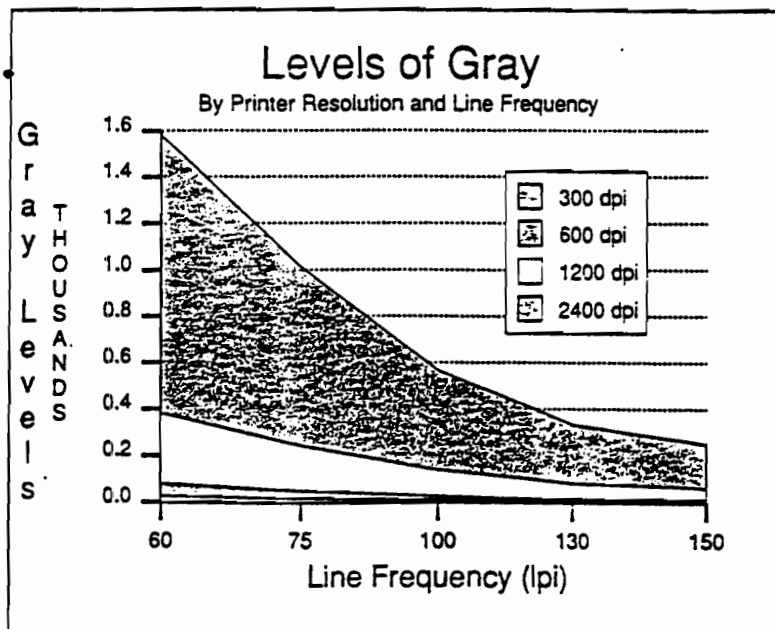
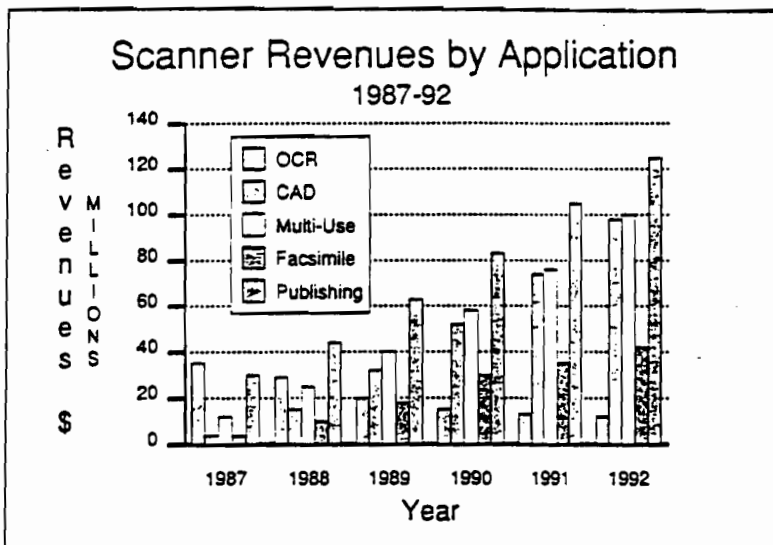
Just a year ago, grayscale scanning was an expensive novelty in the PC world. Prices for 8-bit scanners averaged around \$3,500 and 6-bit scanners averaged only a few hundred dollars less. The majority of grayscale scanners were 4-bit machines, and the consensus was that scanner technology was being stalled by the inability of laser printers to output decent grayscale images, the vast storage requirements of grayscale and the poor availability of grayscale editing software.

Although not all those problems have been resolved, the past few months have seen a flurry of significant hardware and software developments in grayscale manipulation and printing on the PC, and scanner makers have lowered prices and raised grayscale capabilities in anticipation of a veritable boom in grayscale use.

Grayscale and Perception

Essentially, grayscale scanning means bringing photographs into documents. Photos are continuous-tone images—that is, shading in a photo ranges from white to black over a near-infinite number of intermediate gray tones. The ability of the human eye to distinguish borders between one shade of gray and another, however, is not infinite. Depending on the individual, it ranges between 50 and 100 shades of gray. Somewhere in that range, people lose the ability to perceive the difference between one shade and the next lighter or darker shade. By converting continuous-tone images into enough shades of gray to exceed the perceptual threshold, grayscale scanners collect enough data to recreate the illusion of continuous-tone graphics.

Scanners scan images at various resolutions, specified in dots per inch much like laser printers. Originally (and still, in the case of inexpensive scanners), each scanned dot was converted into a single binary bit of data which could be either on or off, black or white. That worked fine in OCR (optical character recognition) and line art applications, but the black-or-white options didn't allow for reproduction of intermediate tones.



Top: Scanner applications are growing most rapidly in desktop publishing and multi-use applications. (Source: Datek Information Systems.)
Bottom: Higher printer resolution and coarser halftones yield more printable shades of gray.

Grayscale scanners work by assigning multiple data bits to each dot. The number of gray shades the grayscale scanner can interpret is a geometric function of number of bits assigned to each dot. A 4-bit scanner, for example, can reproduce 2^4 or 16 shades of gray. An 8-bit scanner can reproduce 2^8 or 256.

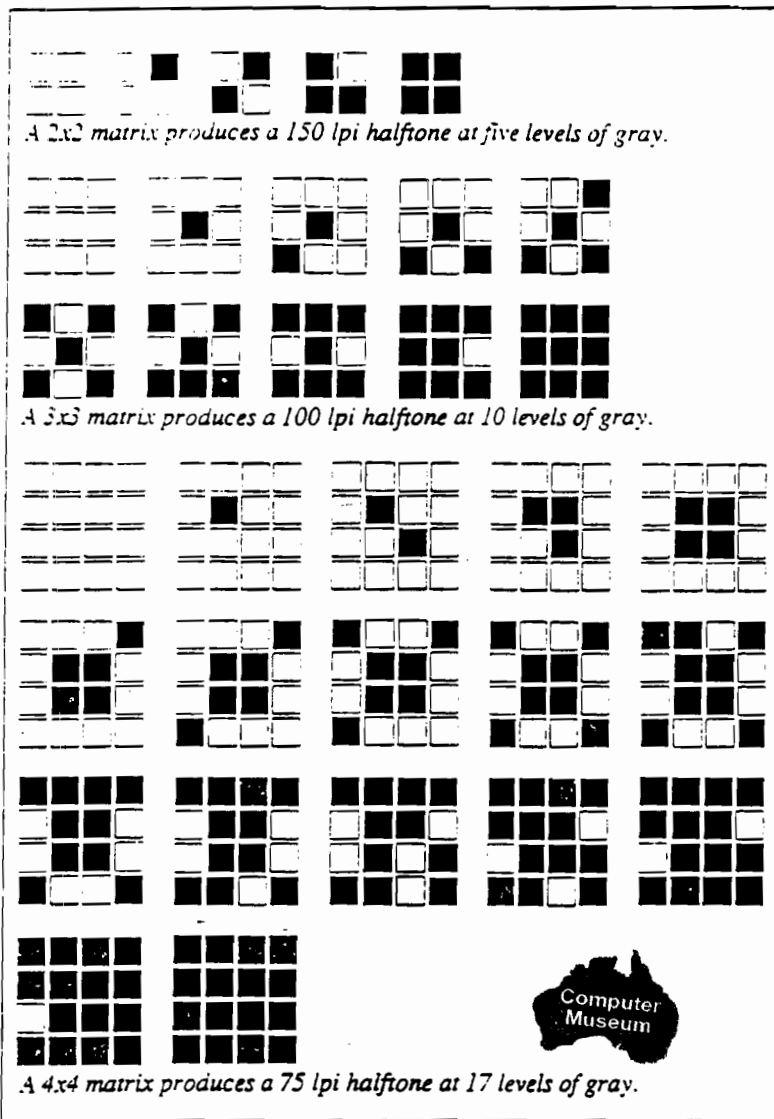
The problem so far has been what happens to that data once it's collected. The first problem is, there's a lot of it. An 8x10 black-and-white photo, scanned at 300 dpi and 256 levels of gray, creates a 7.2MB file. Although some file compression algorithms exist to shrink grayscale storage requirements, grayscale applications are still very storage-intensive. Some storage alternatives to hard disk are beginning to appear, but they're still a long way from common use. "We're solving some of the mass storage problems as costs come down there," observes Gary Kaiser, marketing section manager for Hewlett-Packard's Greeley Hardcopy Operation. "We're seeing optical become a reality, and it's just going to have to evolve along with other technologies."

Not only does all that data have to be stored, it also has to be processed, reminds Al Robins, scanner product manager for Ricoh. "You try loading an 8MB or 12MB image into a 25MHz 386, and even with a 19 millisecond access time drive and 8MB of memory in the system, you're still dealing with a three- or four-minute wait," he says. "If you stick that in Windows, you might as well go to lunch." New data compression chip sets and software algorithms are being explored by everyone involved in grayscale imaging, Robins adds, but so far there are no easy answers.

Printing Grayscale Images

Once stored, the next issue for grayscale images is printing. As with most printing technologies, laser printers and imagesetters make black dots or no dots. Conventional printing technology mimics continuous-tone art by making the dots larger or smaller—larger in darker areas, smaller in lighter ones. The effectiveness of the illusion depends on how close together the halftone dots are placed, in printers' terms, the screen density. A 75 line screen, about what's commonly used in newspapers, means there are 75 halftone dots per inch. Higher density (measured in lines per inch or lpi) yields a better-looking halftone. The black-and-white photos in *PC Publishing* are reproduced at 120 lpi.

With a few very notable exceptions—more on that in a moment—laser printers and imagesetters cannot alter the size of the dots they make. To approximate the halftone effect, therefore, they divide the image into a series of cells consisting of small grids, in turn made up of individual printer pixels. The size of the grid affects both halftone density and the number of gray



Laser printers simulate halftoning by dividing the printed area into matrices comprised of individual printer dots. The darkness or lightness of each matrix is controlled by the number of dots printed. Small matrices produce a finer halftone screen, but prints fewer shades of gray. Larger matrices print more gray levels, but produce a coarser halftone. (Source: Datek Information Services.)

Grayscale Scanners

This chart lists grayscale scanners only; manufacturers may have additional text and image scanners available. Some sheet feeder models have automatic paper feeders available as optional equipment. The maximum levels of gray are shown. The DPI resolution indicated is the highest optical scanning resolution possible. The file formats each scanner supports are listed; some scanners may support additional formats. Manufacturer's suggested retail list price is shown.

Mfr./Model	Levels of Gray	Sheetfed/Flatbed	DPI	File Compression	File Formats Supported	Price	Circle No.
Agfa Compugraphic Corp.							
S600 GS	64	Flatbed	600	Y	.IMG, TIFF, .PCX, EPS	\$6,390	100
S800 GS	64	Flatbed	800	Y	.IMG, TIFF, .PCX, TIFF	\$6,390	101
AT&T Information Systems							
OverView	64	Flatbed	300	Y	.PCX, TIFF	\$2,300	102
Canon U.S.A., Inc.							
IX-12	32	Sheetfed	300	N	.PCX, TIFF, .IMG	\$1,190	103
IX-12F	32	Flatbed	300	N	.PCX, TIFF, .IMG	\$1,740	104
Computer Aided Technology, Inc.							
CAT Image							
Scanner Plus	128	Other	400	N	.PCX, TIFF	\$239	105
Datacopy Corp.							
730GS	64	Flatbed	450	Y	.PCX, TIFF, .IMG, .EPS	\$1,995	106
830	64	Flatbed	300	Y	.PCX, TIFF, .IMG, .EPS	\$3,495	107
840	256	Flatbed	400	Y	.PCX, TIFF, .IMG, .EPS	\$7,495	108
730	16	Flatbed	300	Y	.PCX, TIFF, .IMG, .EPS	\$2,495	109
Jet Reader	16	Sheetfed	300	Y	.PCX, TIFF, .IMG, .EPS	\$1,995	110
Diamond Flower Electric Instruments Co.							
DFI HS 3000							
Handy Scanner	32	Hand Held	400	N	.PCX, TIFF, .MSP, .IMG, .CUT	\$299	111

levels that can be printed. The larger the cell, the coarser the halftone, but the higher the number of gray levels that can be printed. A 6x6 pixel cell, for example, produces a 50 lpi halftone on a 300 dpi printer (300 ÷ 6) at 37 levels of gray (6 X 6 + 1). A 4x4 cell produces a 75 lpi halftone at 17 levels of gray.

As printer resolution goes up, so do the number of lines per inch at a given gray level or the number of gray levels at a given number of lines per inch. On a 600 dpi printer, a 6x6 cell yields a 100 lpi halftone at 37 levels of gray and a 12x12 cell yields a 50 lpi halftone at 145 levels of gray.

By almost any standard, a 50 lpi halftone is unacceptable and 37 levels of gray falls well below the perceptual limits described above. Yet, says Jim McNaul, vice president-strategic marketing for Xerox Imaging Systems (née Datacopy and Kurzweil), that's about the best you can do on a 300 dpi printer.

Higher Resolution, Higher Cost

The obvious alternative is to go to a higher-resolution output device, such as a Linotronic or Compugraphic imagesetter. Printers of this sort do yield good-quality halftones at acceptable screen density and gray level, but there's a penalty. The imagesetters are expensive, and even service bureau output isn't cheap. It takes time to output a grayscale image, and when the bureaus see them coming, many turn off the per-page meter and turn on the per-hour meter. At the end of the day, it's probably cheaper to go down the street to a stat house or a printer and get a conventional halftone made for five or six bucks, and the quality will likely be better. "Most of the service bureaus will run their grayscale images at night, and maybe give you some kind of discount," says McNaul. "Still, I have to say that it's still most cost-effective if you have the time to go and do a photographic halftone."

Of course, that runs counter to one of the chief reasons users buy into desktop publishing—control over their documents. "There's no question if I were an in-house producer of documentation and I wanted to get the best, sharpest look on my photograph and if I wanted to spend the least amount of money, I'd just take my continuous tone photo over to my printer and halftone it," says John Kozlowski, director of marketing communications for Microtek Lab.

Scanning and Document Control

"But I think the people who buy scanners—and, an even bigger picture, the people who buy into desktop publishing—do so primarily because they want control over the production of their whole documents. For those people, money is not the biggest issue. I think most people can be happy with what comes out of a Linotronic machine. If they're the kind of people who have

more interest in maintaining control over the whole publication. grayscale definitely supports that."

DEST Corp.'s Larry Orr, vice president-marketing, agrees that control is a major motivator in grayscale use, and notes that laser printer vs. imagesetter use is rarely an either/or issue. "Grayscale scanning lets you use the same input and page composition for prepress and higher-quality output. When you see statistics on output between laser printers and Linotronics and so forth, the vast majority are laser printers. What that doesn't really reflect is that sometimes you want to do a number of different jobs on the same scanner, and you don't want to buy a separate scanner for the cases where you want to take your output to a service bureau."

Typically, Orr continues, users of high-resolution service bureau output proof their pages on laser printers. Even if their laser printers can't produce decent halftones, the ability to use the same grayscale scanner for both proofing and final output makes sense.

Halftones from 300 dpi Printers

Within the last few months, several laser printer enhancements have come on the market that vastly improve halftone output, and most scanner makers agree they are the first of many similar products that will be marketed this year. Microtek is selling a \$2,995 product called the GLZ, which bolts onto the bottom of Canon-based printers (most significantly, Hewlett-Packard LaserJets) and controls dot size to create true halftones. The GLZ produces 150 lpi halftones with 64 shades of gray, 75 lpi halftones at 128 shades of gray.

Intel offers a product called Visual Edge that works with LaserJet IIs to produce screens as fine as 70 lpi at 64 levels of gray. The Intel product is a controller card that resides in a PC slot, and goes for \$695 (although most LaserJet users will have to add memory to use the product—see *PC Publishing*, January, p. 9).

Although the products work on slightly different principles—the Microtek product controls dot size; the Intel product increases horizontal printer resolution and clumps pixels together—both products in effect produce dots of different sizes to create a true halftone effect. Both products send grayscale data through the add-on controller, type via conventional routes—which lets users integrate type and halftones in desktop publishing programs which can handle grayscale information.

"From a scanner vendor's standpoint, I think products such as these are very strategic," says Kozlowski. "This really completes the cycle, and it gives people a valid reason for buying these high-end grayscale scanners because now they can really use them to their full capability."

Grayscale Scanners

Mfr./Model	Levels of Gray	Sheetfed/Flatbed	DPI	File Compression	File Formats Supported	Price	Circle No.
Hewlett-Packard							
HP9190A (ScanJet)	16	Flatbed	300	Y	.PCX, TIFF, .MSP, .IMG	\$2,090	112
HP9195A (ScanJet Plus)	256	Flatbed	300	Y	.PCX, TIFF, .MSP, .IMG, .EPS	\$2,190	113
Intelligent Optics Corp.							
Model 200	256	Flatbed	300	Y	.PCX, TIFF	\$3,395	114
Kurzweil Computer Products, Inc.							
K5000	64	Flatbed	600	Y	Varies	\$15,950	115
Laser Connection							
IS-300	32	Sheetfed	300	Y	TIFF, .EPS	\$1,295	116
Logitech International							
ScanMan PC	32	Hand Held	400	Y	.PCX, TIFF	\$339	117
ScanMan PS/2	32	Hand Held	400	Y	.PCX, TIFF	\$399	118
Microtek Lab., Inc.							
MSF-400G	256	Flatbed	400	Y	.PCX, TIFF, Others	\$3,995	119
MSF-300G	256	Flatbed	300	Y	.PCX, TIFF, Others	\$3,495	120
MSF-300Q	64	Flatbed	300	Y	.PCX, TIFF, Others	\$2,295	121
Pentax Teknologies Corp.							
SB-A4301	16	Flatbed	300	Y	.PCX, TIFF, .IMG	\$2,195	122
Ricoh Corp.							
RS 312	64	Flatbed	300	Y	Varies	\$2,000	123
Shape, Inc.							
Shape Scan SS 300 Plus	16	Flatbed	300	Y	.PCX	\$795	124
Taxan U.S.A. Corp.							
Crystal Scan Model 300I	64	Sheetfed	300	Y	.PCX, TIFF, .MSP, .IMG	\$1,695	125

*In \$2,000 range

Scanners and OCR

Strictly speaking, OCR (optical character recognition) isn't a grayscale issue. But it's very much a scanner issue, and scanner makers point to recent technical developments in OCR as yet another addition to the growing arsenal of scanner applications.

OCR software for scanners has been around a long time, but much of what's been available has been only marginally accurate and most users of the low-end products have been unhappy with the results. What's got scanner makers excited now is the availability of a new group of products that bring the capabilities of OCR systems once priced well in the five-figure range down to PC levels. Among the most-cited products in this area are Caere's OmniPage and Calera's TrueScan, both \$2,495 products that use sophisticated software/hardware combinations to yield high accuracy rates (see *PC Publishing*, December, p. 10).

"This new technology, with its ability to read multicolumn and typeset text, opens up OCR to a whole new set of users," says Hewlett-Packard's Gary Kaiser. "There's still a ways to go in OCR technology, but this is a big step because it opens up a whole new set of documents that can be used to input information."

"People have always asked, 'Can I take a book or a magazine, lay it down on my scanner, and bring it into my PC?' The answer in the past has almost always been 'no' for desktop scanners because the software hasn't been sophisticated enough," says Microtek's John Kozlowski. The new generation of OCR products does give users that flexibility, he adds, and "It's going to be a boon to scanner vendors. Combine it with grayscale image capturing and editing and printing, and it just makes the scanner all that much more functional."

"I think it's going to open a market area we've barely penetrated," agrees Xerox's Jim McNaul. "You don't need a high grayscale scanner right now to use OCR, but it's entirely possible that in the future, these software algorithms will begin to use grayscale information to improve their accuracy."

Before, they bought them more or less like the guy who buys a Ferrari to drive around town. He's got all that power and speed, but he never gets a chance to use it."

Xerox's McNaul agrees that products such as Intel's will help promote grayscale scanner use. "This is another reason why it's important for people who are buying scanners to make sure they get at least a 6-bit scanner. You have to have that amount of grayscale information to make use of these products."

Despite its high cost relative to conventional halftoning, and ignoring for a moment the control issue, imagesetter output could make good economic sense in combination with electronic darkroom software. Conventional photo editing is a costly affair; outlines, drop-outs, air brushing and so forth require skilled labor and take time. Even if the final halftone is cheap to make, the processes leading up to it aren't. If the editing could be done in the computer, the extra cost of imagesetter output would be small in comparison.

Apple Macintosh users have been able to do

darkroom work on their computers for some time now, with products such as Image Studio and Digital Darkroom. Similar products are just beginning to emerge on the PC side.

The grand-daddy of grayscale editing software on the PC is probably Aldus' SnapShot. The product gives considerable control over grayscale images, but so far works effectively only with images collected on a video camera or stored on videotape, and won't work with scanners.

Two newer products, both only months old (at least in this country) are Picture Publisher, from a New Hampshire company called Astral Development, and Picasso, a product marketed by Moniterm and originally developed by an outfit called PIXIE Intelligent Computer Systems in Charlottenlund, Denmark. Interestingly, Microtek's GLZ product is manufactured by the company, but was also developed by PIXIE, and Microtek markets Picture Publisher under an OEM deal with Astral.

"You're going to see a lot of grayscale editing capability on the PC side this year," says Xerox's McNaul. "It's not as easy to do and display as it is in the Mac world. The Mac is just a graphics-oriented machine. But by the end of '89, I think you're going to see a lot of grayscale editing software."

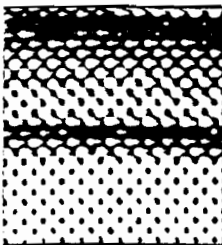
More Graphics Packages Going Grayscale

McNaul sees more of the binary image-editing packages moving into grayscale this year as well, much as Z-Soft's Publisher's Paintbrush and IBM's Image Edit already have done. "We're also building more grayscale processing capability into our scanners," he adds. "Our 730GS, for example, does the normal brightness and contrast control, but it also allows you to run some different gamma curves and do some convolution processing for edge enhancement.

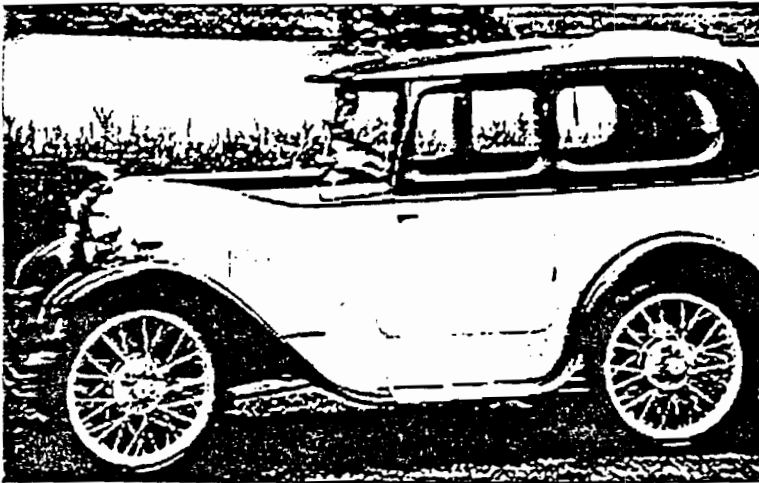
"The other trend is towards building more processing capability into the scanner software. Our Macintosh software has a tremendous amount of processing capability in it. We'll port that over to the PC as we see a higher population of 386 machines showing up."

DEST's Orr sees a similar trend, and adds, "What the market needs is a fairly easy-to-use and reasonably complete and cost-effective package, as opposed to something with a lot of exotic features." Such products have become available on the Mac side first because there's still the perception that the Mac is the machine of choice among graphic artists. "I think now that interest is at a turning point on the PC side. It won't be long before you see products like Image Studio on the PC side."

"The exciting thing that's happened just in the last few months is the ability to complete the cycle with grayscale in, grayscale editing and grayscale output on the laser printer," says



Intel's Visual Edge system produced halftone effects on 300 dpi printers by clustering printer dots together to produce halftone dots of different sizes. The photo above was printed at 70 lpi, 64 levels of gray on an HP LaserJet II with Visual Edge. The 500 percent enlarged view on the left illustrates the dot pattern produced by the product.



The Microtek GLZ bolts onto the bottom of Canon-based laser printers and works by controlling printer dot size to create true halftones. The photo above was printed at 150 lpi and 64 levels of gray on an HP LaserJet II using the GLZ. The 500 percent enlarged view on the left shows dot patterns.



Left: Enlarged view (500 percent) of Lino-tronic 100 (1270 dpi) output at 150 lpi and 256 levels of gray. Note that the higher-resolution device produces a much finer halftone pattern without loss of gray information.

Microtek's Kozlowski. "Each component makes the other two that much more valuable. When you put them all together as a system, they're geometrically more valuable."

Perhaps in anticipation of greater grayscale use, prices for multibit scanners are dropping dramatically. The 4-bit scanners that were the grayscale standard a year ago are gradually being replaced, at least on resellers shelves, by 6- and 8-bit scanners, and the issue now is which will become the industry standard.

6-Bit or 8-Bit Standard?

Hewlett-Packard, by most accounts the industry leader in terms of market share, leapfrogged the 6-bit machines last month when it announced an 8-bit, the ScanJet Plus, priced at \$2,190 with interface board. That's roughly \$1,300 less than the average for 8-bit scanners a year ago, and HP's Kaiser argues that at prices like that, 8-bit grayscale will become the standard. "The human eye can only detect a certain number of levels of gray. Eight bits covers those numbers. There's no reason to go any higher than that, and if you go lower, you're just trading that capability off," he says.

Ricoh has introduced its first grayscale scanner with 6-bit capability, and Xerox is also behind a 6-bit standard. "A lot of people are going to 256 levels of gray, but in desktop publishing applications, that's essentially overkill," comments Ricoh's Robins. Xerox's McNaull uses the same word, overkill, to describe 8-bit machines linked to 300 dpi output devices, still the standard. "If you're going to an imager and scaling up in resolution using PostScript or a software package, eight bits will buy you something. It helps in the scaling process and you can display more levels of gray in your halftones.

"But when you move to six bits from four or eight bits from six, you pay a penalty in your system," McNaull continues. "You're moving more data around. Your files become larger for storage. Your files for manipulation are larger. So it kind of forces you into at least a fast 286 machine or, better, a 386. And you'd better have a big disk."

Whatever the standard of the future, most scanner makers agree that the 4-bit desktop scanner, if not dead, isn't looking at all well. McNaull says they'll still be available, but the price differential between 4-bit and 6-bit machines is shrinking and savings on a 4-bit scanner aren't very great. HP's Kaiser notes that most people "won't be satisfied if they go with a 4-bit scanner. The only application I can see that would not require more levels of gray is OCR. What we've seen is that people who by scanners just for OCR is that a few months down the road, they see they can do different things with images and they realize it was a mistake to not go with a scanner with fuller capabilities." □

SHOPPING

for

SCANNERS



It takes the
right combination
of hardware
and software to
get the
quality and control
you need

by Steve Roth

This article focuses on scanners for the first four scenarios—the world of flat art (for the lowdown on OCR, see “The Reading Edge” in the February 1989 *Macworld*). For three-dimensional images you’ll want to look at video digitizers; they let you put a mountain in your computer, but they don’t do a very good job with flat art.

Once you know what you want to accomplish with a scanner, you can set about finding a unit with the features you need for that job.

How would you get by without photocopiers? Can you imagine not being able to make copies of anything, except with a camera? Scanners are fast becoming the computer equivalent of photocopiers, and once you start using them, they become just as essential as those old xerographic devices. All of a sudden the images lying around your office are yours to control. You can pull them into your little silicon world and have your way with them.

But first you need a scanner, and deciding which one you need isn’t easy. When you’re shopping for a scanner, as with anything else, you have to ask yourself what you want to do with it. If you just want to capture some images to place in a HyperCard stack, you won’t need as much scanner as if you want to produce magazine-quality halftones.

There are basically six scenarios in which you might want to use a scanner (for today, we’ll exclude color scanning):

- *to capture images for use as drawing templates in programs like Illustrator and FreeHand*
- *to capture low-resolution images for screen display or FPO (for position only) placement in publications*
- *to capture line art for publication*
- *to capture photographs for publication as halftones*
- *to capture text for use with optical character recognition (OCR) programs*
- *to capture images of three-dimensional objects for publication as halftones*

SCANNER HARDWARE

.....

The first question you should address is the appropriate format for your type of work. There are sheetfed units that draw the paper through the machine; flatbeds that let you place objects on the glass *platen*, as you do with a photocopier; *overhead* scanners that look like overhead projectors and capture images from above; and hand-held scanners that you roll over an image. Each has advantages and drawbacks.

■ *Sheetfed scanners* are inexpensive and fast (fast compared to hand-helds and overheads, at least). The sheetfed version of New Image Technology’s MacScan, for instance, costs only \$999, and it delivers speedy 300-dpi scans that are quite acceptable for many needs.

The disadvantages of sheetfed scanners lie in the limitations they place on what you can scan, their tendency to mar the original document, and problems with alignment.

Sheetfeds can scan only single sheets of paper, so they can’t do books or three-dimensional objects. If you want to scan only photographs, this might be OK, except that sheetfed scanners have a tendency to put rubber marks on the surface of, fold the edges of, or otherwise disfigure the print. This is a problem particularly when you have to scan several times.

**There are
—
basically six scenarios
—
in which you might
—
want to use a scanner**



The alignment problems come in when you scan line art. If you scan in a drawing and the roller mechanisms skew it slightly, straight lines come out slightly jagged. This effect is almost impossible to correct using a paint program.

So what is the bottom line? Sheetfed are good for FPO images or for low-resolution bitmaps for screen display.

They're also fine for use in OCR, especially in units like the Datacopy JetReader, which has a built-in automatic document feeder (ADF).

▪ *Flatbed scanners* are the best bet for scanning flat art. They give more flexibility than anything else, but they're expensive, starting at around \$2000 and ranging up to many thousands of dollars. For the price, flatbed scanners enable you to align images accurately, capture images from books and magazines, and even scan small, three-dimensional objects (like your hand). ADFs are often available for OCR work.

▪ *Overhead scanners* let you scan books and align documents precisely, but (unless the unit comes with a special holder) it's hard to get a book or magazine to lie flat on the copy stand. Because of this, the prime use for these machines is single sheets and some three-dimensional objects (they can also be used to place 3-D objects into photographs, by scanning the two together). Overhead scanners are generally slower than sheetfed and flatbeds.

The lower-priced overheads, such as Mirror Technologies' \$595 VisionScan, are dependent on room light for making exposures, so quality can vary widely. Truvel's much more expensive offerings include lighting units that ensure correct exposure. The Truvel units provide good quality, but it's doubtful whether most people will find the ability to scan small 3-D objects as well as flat art worth these machines' premium prices (see "Scanning the Scanners"). Since you can't attach an

ADF, overheads aren't recommended for OCR work.

▪ *Hand-held scanners* let you capture small images—generally 5 inches wide or less—at resolutions up to 400 dpi. The main advantage of a hand-held scanner is price (LightningScan from Thunderware and Logitech's ScanMan—both use the same scanning unit—sell for around \$500).

Their biggest problem is alignment; you need to slide the unit along a straight edge to capture line art properly.

Hand-held scanners are easy and convenient, especially for capturing

small line-art images as drawing templates. They're useful for bringing line art into publications, and for creating lower-quality halftones of small images. Hand-held scanners are perfect for FPO and screen display images. Since you can scan several pieces and put them together in a paint program, you aren't really limited to the 5-inch width, but if you are doing many large scans, the extra step quickly becomes annoying. It's difficult or impossible to assemble multiple halftone captures seamlessly.

▪ *ThunderScan*, from Thunderware, is in a class by itself. You plug this \$249 scanner into the position usually occupied by the ribbon cartridge on an ImageWriter printer, which means you use your printer to capture an image from the page, rather than to put one there. If you have an ImageWriter, ThunderScan is an attractive and inexpensive option. If you don't own an ImageWriter, it's not worth buying one to use ThunderScan.

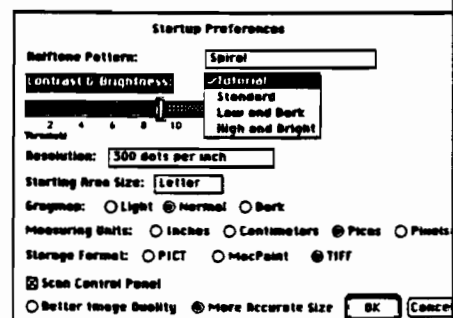
ThunderScan can provide very good quality, and the software is impressive. The unit is finicky, however, and its slow input speed is a major drawback. At low resolutions the speed is acceptable, but for high-quality line art or halftones, scans can tie up the Mac for half an hour or an hour. And you generally need to scan more than once to get it right. Don't even think about ThunderScan for OCR.

FLAT OR DEEP?

Once you've decided what physical type of scanner you need, you have to think about whether or not you want one that captures gray scales. The first generation of Mac scanners captured only bi-level, *flat*, bitmaps, in which each sample point is either black or white (as in a MacPaint image). Traditionally, bi-level scanners have the advantage of low price, but these days you can get gray-scale scanners for virtually the same money.

Gray-scale scanners capture more information for each sample point. Some capture 4 bits per sample point, which means they can produce images with 16 gray levels (2^4). The Datacopy 730GS, \$2000, captures 6 bits, for 64 gray levels (2^6). Others, such as the Datacopy 800 (\$7500) and the Microtek 400 (\$4000), go as high as 8 bits (256 levels of gray).

Bi-level scanners do the job for FPO images, drawing templates, and OCR work. They're perfect for line art. Not to say that you can't capture photographs with bi-level scanners; but if you do, all the halftoning is done at scan time, resulting in a dithered, bi-level image (see "What Does the Halftone?"). If the printer resolution is different from the original scan resolution when you print a dithered halftone, or if you size the image in your page-makeup program, the dither pattern turns into an ugly mishmash. Dithered bitmaps are almost impossible to edit in a paint program, you can't adjust the contrast or brightness once scanning is complete, and you can't take advantage of high-resolution output devices.



Preferences and Presets

AppleScan manages to fit the most commonly used features of scanning software into a sleek, intuitive interface.

SCANNING THE SCANNERS

Scanner	Price	Type ¹	Max. Optical Resolution (dpi)	Gray Levels/ Bits per Sample	Dither Patterns	Bundled Software	Maximum Image Size (in inches)	ADF Avail.	
Abaton	300 S	\$1795	FB	300	16/4	2	PanelScan, Digital Darkroom	8 1/2 x 14	no
Apple	Apple Scanner	\$1799	FB	300	16/4	4 ² 30 ³	AppleScan, HyperScan	8 1/2 x 14	no
Datacopy	Datacopy JetReader	\$1995	SF	300	2/1	2	MacImage	8 1/2 x 14	yes ⁴
	Datacopy 730	\$2495	FB	300	16/4	2	MacImage	8 1/2 x 12 ⁵	yes
	Datacopy 730GS	\$1995	FB	300	64/6	7	MacImage	8 1/2 x 12	no
	Datacopy 830	\$3495	FB	300	64/6	5	MacImage	8 1/2 x 12 ⁵	yes
	Datacopy 840	\$7495	FB	400	256/8	0	MacImage	8 1/2 x 12 ⁵	yes
Dest	PC Scan 1000	\$1795	FB	300	16/4	4	PublishPac, SuperPaint	8 1/2 x 11 ⁵	yes
	PC Scan 1020	\$2695	FB	300	16/4	4	PublishPac, SuperPaint	8 1/2 x 11 ⁵	yes
	PC Scan 2000	\$1495	SF	300	256/8	4	PublishPac, SuperPaint	8 1/2 x 14	yes
	PC Scan 2020	\$2495	SF	300	256/8	4	PublishPac, SuperPaint	8 1/2 x 14	yes
Hewlett-Packard	ScanJet	\$2090	FB	300	16/4	4	Desk Gallery	8 1/2 x 11 ⁵	yes
	ScanJet Plus	\$2190	FB	300	256/8	6	Desk Gallery Plus	8 1/2 x 11	yes
Logitech	ScanMan	\$499	HH	400	2/1	3	ScanMan DA	4 wide	no
Microtek Lab	MSF 300C	\$1595/\$1795 ⁶	FB	300	2/1	8	SuperPaint 2.0, VersaScan	8 1/2 x 14	yes
	MSF 300A	\$1895/\$2095 ⁶	FB	300	2/1	12	SuperPaint 2.0, VersaScan	8 1/2 x 14	yes
	MS 300A	\$1895/\$2095 ⁶	SF	300	2/1	12	SuperPaint 2.0, VersaScan	8 1/2 x 14	yes
	MSF 300Q, QS ⁷	\$2495	FB	300	64/6	12	SuperPaint 2.0, Digital Darkroom, GrayScan	8 1/2 x 14	yes
	MSF 300G, GS ⁸	\$3995	FB	300	256/8	12	SuperPaint 2.0, Digital Darkroom, GrayScan	8 1/2 x 14	yes
	MSF 400G, GS ⁸	\$3995	FB	400	256/8	12	SuperPaint 2.0, Digital Darkroom, GrayScan	8 1/2 x 14	yes
Mirror Technologies	VisionScan 200	\$597	OH	200	2/1	1	VisionScan, DeskPaint	8 1/2 x 11	no
	VisionScan 300	\$797	OH	300	2/1	1	VisionScan, DeskPaint	8 1/2 x 11	no
New Image Technology	MacScan	\$999/\$1995 ⁹	SF/FB	300	2/1	2	MacScan	8 1/2 x 11 ¹⁰	no
	MacScan Pro	\$1599/\$2895 ¹¹	SF/FB	300	256/8	2	MacScan	8 1/2 x 11 ¹⁰	no
Siemens Information Systems ¹²	HighScan 400	\$4900	FB	400	256/8	6	HighScan	8 1/2 x 12	yes
	HighScan 600	\$5800	FB	600	256/8	6	HighScan	8 1/2 x 12	yes
	HighScan 800	\$6800	FB	800	256/8	6	HighScan	8 1/2 x 12	yes
Thunderware	LightningScan	\$549	HH	400	2/1	3	ThunderScan	4 wide	no
	ThunderScan	\$249	PH	288	32/5	1	ThunderScan	11x14	n/a
Travel	TZ 3	\$5995	OH	900	256/8	1	TruScan	11x17	no
	TZ 3T	\$8495	OH	900	256/8	1	TruScan	11x17	no
	(transparencies)								
	TZ 3X (x-rays)	\$12,495	SF	700	256/8	1	TruScan	14 wide	no
	TF 3X (x-rays)	\$11,495	SF	256	256/8	1	TruScan	14 wide	no

¹ SF = Sheerfed, FB = Flatbed, PH = Printhead.

HH = Hand-held, OH = Overhead.

² AppleScan.

³ HyperScan.

⁴ 14 with ADF.

⁵ and price includes SCSI interface.

⁷ GS has built-in SCSI interface; Q has separate SCSI interface.

⁶ GS has built-in SCSI interface; G has separate SCSI interface.

⁹ Software and interface only, \$648.

¹⁰ 8 1/2 x 14 with sheerfed model.

¹¹ Software and interface only, \$1295.

¹² Pre-release; information on this product may change.

With gray-scale images, the halftoning happens only on printout, so you can scale the image with impunity, adjust contrast and brightness after scanning (if your software allows it), and take advantage of high-resolution output devices such as phototypesetters. For most publication-quality halftone work, get a gray-

scale scanner. Four bits is fine for laser output, but to get the best off the Linotronic, use an 8-bit scanner.

The downside of gray-scale images is unwieldy file size. An 8-by-10-inch image at 300 dpi with 8 bits per sample, saved uncompressed, eats 8 megabytes of disk and takes forever to scan, display, and print.

RESOLUTION

The next question to consider is how many dots per inch you need to capture. Most of the sheetfed and flatbed scanners weigh in at 300 dpi. A couple of the flatbeds (the Microtek MSF-400G and the Datacopy 840) go to 400 dpi. The handheld scanners coming on the market go as high as 400 dpi. ThunderScan hits 288 dpi if you have the time, and some of Truvel's overheads hit 900 dpi if you have the disk space.

The Hewlett-Packard ScanJet and a couple of other scanners use software algorithms to interpolate between scanned dots and go beyond their true optical resolution. Interpolation is useful if you need a specific scanning resolution to avoid patterns when printing dithered halftones, or when you want to make a gray-scale halftone of a small photographic image and print it at a larger size. Interpolation doesn't enable you to pick up finer detail, however.

If you are capturing images for FPO placement, screen display, or templates for drawing, resolution is not so important. For FPO and screen display work, 75 (or 75) dpi will be fine; 150 dpi usually suffices for drawing templates. High resolution is important for publishing line art without jaggies, and for halftones that provide both high screen-frequency and a good number of gray levels.

How high is high enough? If you typically print halftone images that are the same size as the original or smaller, you won't need more than 300 dpi—even if you produce a high-quality publication. At 300 dpi you can print 150-line halftones and still *oversample* by a factor of two. (Oversampling up to two-to-one yields sharper images; see "A Halftone Handbook," in the October 1988 *Macworld*). For line art also, 300 dpi should be sufficient. If the curved and diagonal lines are too jaggy for you, don't bother going to a 400-dpi or higher scanner, because the difference won't be that significant, and the files are immense (see "So Fine?"). For either line art or halftones, the only reason for going to higher-resolution (over 300 dpi) scanners is if you are going to be scaling images up.

Bi-level Scan, Any Printer

The scanner does the halftoning, delivering a flat, dithered bitmap that uses less disk space than gray-scale images.

The software simply passes the bitmap through to the printer. Brightness and contrast correction are impossible, and scaling is problematic.

The problem: the halftone dot pattern has been tailored for a 300-dpi printer. If you try to use a higher-resolution device or to scale the image, patterns are the likely result.

Gray-Scale Scanner, Non-PostScript Printer

The scanner saves data about the gray level of each sample point.

101	281	421	421	871	33
551	951	021	331	581	38
661	841	671	291	471	83
081	021	371	291	661	52
511	691	321	301	861	90
221	811	601	531	911	99
101	261	371	481	591	67
031	361	421	421	871	33

The software translates the gray-scale data into a 300-dpi bitmapped halftone of whatever frequency and angle you choose, perhaps applying gamma correction and scaling in the process.

The printer simply regurgitates the dots as delivered by the software.

Gray-Scale Scanner, PostScript Printer

Again, the scanner captures gray-scale data for each sample point.

101	281	421	421	871	33
551	951	021	331	581	38
661	841	671	291	471	83
081	021	371	291	661	52
511	691	321	301	861	90
221	811	601	531	911	99
101	261	371	481	591	67
031	361	421	421	871	33

The software applies brightness and contrast correction, and scaling if you want, but does not fix the halftone dots.

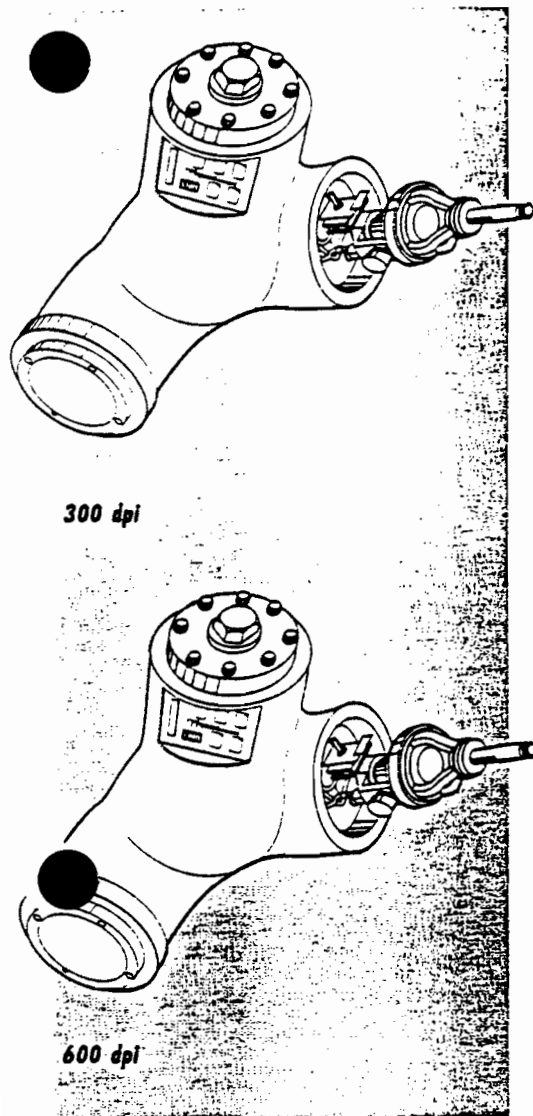
Laser output

Linotronic output

The PostScript output device does the halftoning, at whatever scaling, frequency, and angle you desire, at print time. Patterns should not appear, regardless of the printing resolution.

Who Does the Halftone?

One big question when you're creating halftones with the Mac: When does the halftoning actually take place? Does it happen in the scanner, the software, or the printer? The hardware and software determine when you do the halftoning, and how much flexibility you have with scanned images.



So Fine?
The same image scanned on a Dest machine at 300 and 600 samples per inch. As you can see, the difference in quality is barely noticeable.

SCANNER SOFTWARE

So far we've talked mainly about the capabilities of scanning hardware. But the power and convenience of your scanning system depends on both hardware and software. Datacopy's MacImage software, for instance, is incredibly flexible, but used with the company's 840 scanner program forces you to scan at 256 gray levels and 400 dpi—major overkill for many jobs. Some systems have the opposite problem—they don't let you tap all

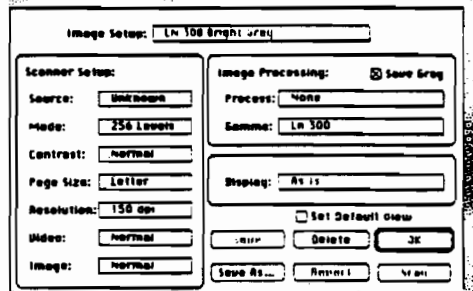
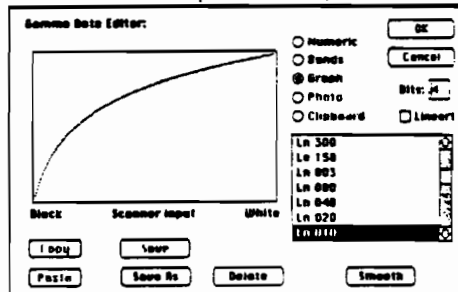
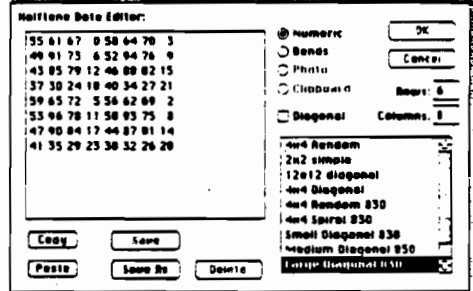
the features of the scanner hardware. You might have access only to light, normal, and dark brightness controls, for instance, instead of a full range.

Scanning software can be divided into two classes: image capture and image modification. Some scanner software (such as Datacopy's MacImage) gives you control over both, enabling you to adjust the scanning parameters, scan the image, and then modify the captured image. Other programs force you to move to a separate program (SuperPaint, ImageStudio, Digital Darkroom, QuarkXpress, or PageMaker, for instance) to modify a captured image. Some of the companies with the latter type of scanning software supply you with an editing program (Abaton and Microtek, for example, are bundling special versions of Digital Darkroom with their scanners). Other companies expect you to buy your own editor.

SCANNING CONTROL

While the wondrous software now available for editing and manipulating scans is all very well and good, for the best-quality images—especially with gray-scale images—you want to create a scan that looks right from the start. To achieve this, you'll need software with flexible scanning controls. When you evaluate scanners, be sure to look for the following controls among the software features.

▪ **Resolution** While the scanning hardware determines the maximum optical resolution of your scans, you don't always need maximum resolution. The software should let you choose other resolutions, to keep file sizes down and to fine-tune scans for special situations. Some programs provide only three or four common resolution settings. Others go somewhat further: the software that comes with Microtek's 300-dpi scanners, for example, lets you select settings in 15-dpi increments. The ideal are scanners—such as the HP ScanJet—that let you adjust reso-



As You Like It
MacImage, Datacopy's scanning and image modification software, offers downright complete features, including explicit controls for contrast, brightness, gamma curves, and even the halftone cell shape.

SCANNER SOFTWARE

	GENERAL FEATURES					PRESCAN CONTROLS			G T
	App., DA, CDEV	Show Space Req./Avail.	Disk or RAM Limited	Scan Area/ Preview Scan	Scaling	Avail. Resolution/ Increments (dpi)	Bits per Sample	Brightness/ Contrast	
AppleScan (Apple Scanner)	app.	yes/yes	disk	yes/yes	yes	75, 100, 150, 200, 300	1 or 4	yes/yes	no
Desk Gallery (HP ScanJet)	app., DA	no/no	RAM	yes/yes	yes	38-600/1	1 or 4	yes/no	no
Desk Gallery Plus (HP ScanJet Plus)	app., DA	yes/no	disk	yes/yes	yes	12-1500/1	1, 4, 8	yes/yes	no
Digital Darkroom (Mikrotek and Abaton gray scanners)	app.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EditScan (Abaton scanners)	app.	no/no	disk	yes/yes	yes	25-300/25	1 or 4	yes/yes	no
GrayScan (Mikrotek gray scanners)	app.	yes/yes	disk	yes/yes	yes	75-300 or 100-400/3 or 4 ¹	1 or max. only ¹	yes/yes	no
HighScan (Siemens Highscan)	app.	yes/no	disk	yes/yes	yes	10-400/1 also 600 and 800	1 or max. only	no/no	no
HyperScan (Apple Scanner)	app.	no/no	disk	yes/yes	yes	dependent on scaling	1	yes/yes	no
MacImage (Datacopy scanners)	app.	yes/no	disk	yes/yes	yes	75, 100, 120, 150, 180, 200, 240, 300, 400	1, 4, 6, or 8 ²	yes/yes	yes
MacScan (New Image scanners)	app.	no/no	RAM	yes/no	no	75, 100, 200, 300	1 or max. only	yes/no	no
PanelScan (Abaton scanners)	CDEV	no/no	disk	yes/yes	yes	25-300/25	1 or 4	yes/yes	no
PublishPac (Dest scanners)	app.	yes/no	disk	yes/yes	yes	200, 240, 300 ² 72-300/1 ³	1 or max. only	yes/yes	no
ScanMan (Logitech hand scanner)	DA	yes/yes	RAM	yes/no	no	100, 200, 300, 400	1	yes/yes	no
TruScan (Truvel scanners)	app.	no/no	RAM	yes/yes	yes	75-256, 700, 900/1 ¹	1 or max. only	yes/yes	no
ThunderScan (Thunderware scanners)	app., DA ¹⁰	yes/yes	RAM	yes/no	yes	72-288/1 ¹¹ or 100, 200, 300, 400 ¹¹	1 or 5	no/no	no
VersaScan (Mikrotek b&w scanners)	app.	yes/yes	disk	yes/yes	yes	100-400/20 or 75-300/15 ¹	1	yes/yes	no
VisionScan (Mirror VisionScan)	app., DA	no/no	RAM	yes ¹³ /no	no	100, 120, 150, 200	1	no/no	no

¹ Depending on scanner.² Limited by scanner.³ Can be adjusted but not printed or saved in current version.⁴ Only with custom postscript.⁵ Cannot print gray-scale images with standard Apple print driver.⁶ No printing available.⁷ Line-art mode.⁸ Half-tone mode.⁹ Through SuperPaint.¹⁰ Some features are missing in DA version.¹¹ With ThunderScan; controlled through scaling.¹² With LightningScan.¹³ Controlled with markers on scanner, or numerically.¹⁴ Through DeskPaint, bundled with VisionScan.

lution in 1-dpi increments. This is especially useful if you know your final scan and output resolution, and you want to scan at an exact multiple of that.

▪ *Number of Gray Levels* If you have a multibit scanner, it's very useful to be able to scan with less bits per sample than your machine's maximum—to save on disk space and printing time for images that don't require maximum quality. Unfortunately, only a few exceptions among

POSTSCAN CONTROLS

PRINTING CONTROLS

Brightness/ Contrast	Gamma	Gray to Dither/ Dither to Gray	Print Tools B&W/Gray	Display Gray	Angle/ Freq.	Scaling
yes/yes	no	yes/no	b&w	no	no/no	yes
no/no	no	no/no	b&w	no	no/no	yes
no/no	no	no/no	b&w	yes	no/no	yes
yes/yes	yes	yes/yes	b&w/gray	yes	yes/yes	yes
no/no	no	no/no	b&w	no	no/no	no
no/no	no	no/no	none	yes	yes/yes	yes
yes/yes	no	yes/no	none	yes	no/no	yes
no/no	no	no/no	b&w	no	n/a	yes
yes/yes	no	yes/yes	none	yes	yes/yes	yes
no/no ¹	no	no/no	b&w	yes	no ⁴ /no ⁴	yes ²
no/no	no	no/no	none	no	n/a ³	n/a
no/no	no	no/no	none ¹	yes	no/no	yes
no/no	no	no/no	b&w	n/a	n/a	yes
no/no	no	no/no	none	yes	no/no	no
yes/yes	yes	yes/yes	b&w	no	yes/no ⁴	yes
no/no	no	no/no	b&w	n/a	n/a	yes
no/no	no	no/no	none ¹⁴	n/a	n/a	no

the current crop of hardware and software give you this control.

▪ *Scan Area* It's quite common to want to scan only a portion of an image, to save on disk space and printing time. Most scanner software lets you do a quick preview scan, then draw a box around the area you want to capture. This is the most normal way to work. Some programs don't have the preview feature, and some even require you to key in the coordinates

of the scanning area. Avoid such software.

▪ *Disk Space and Memory* In some cases, scanning software tells you how much space is required for an image before you scan, and whether or not you have enough space to complete the scan successfully. Some software can't capture an image that's bigger than available RAM memory, while other programs use available disk space to capture large images. Needless to say, for high-resolution scans,

especially with gray scales, software that uses the disk is preferable.

▪ *Scaling* If you're scanning line art or dithered halftones and know in advance how big the final image will be, it's useful to scale the image during scanning. This prevents the disturbing patterns that result when you scale dithered halftones, and avoids the clogging between thin lines that results when you reduce line art.

▪ *Brightness, Contrast, Threshold* It's important to adjust brightness and contrast before (rather than after) scanning, no matter what type of images you're capturing. With dithered halftones, you simply can't change these parameters once the dither pattern has been laid down. With gray-scale images, it's best to get brightness and contrast as close to what you want as possible at scan time, because whenever you use image-editing software to change the gray-map curve, you throw away information. This may be information you can't spare, particularly if you have only a 4- or 6-bit scanner.

With line art, the operative concept with respect to brightness and contrast is *threshold*. When you set the threshold, you select the point at which the light grays in an image will go to white, and the dark grays will go black. Even if the image you're scanning is just black and white to begin with, adjusting the threshold lets you screen out noise caused by such things as paper texture and color. AppleScan, MacImage, and some other programs let you explicitly control the threshold point for line-art scans, rather than using contrast and brightness settings. This method is much easier to understand and use than having to work through brightness and contrast controls.

A sophisticated method for adjusting contrast and brightness is called gamma correction. Again, MacImage stands out here as the best of the lot. Rather than just adjusting contrast and brightness sliders, you can edit the contrast/brightness curve before scanning (see "Gamma Correction in Action"). Other programs offer the same control, but only over previously captured images.

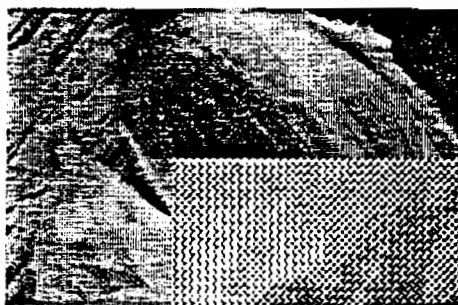
▪ *Dither Pattern* For capturing dithered halftones, most scanners offer more than one dither pattern. Being able to

AFTER YOU SCAN

control the dither pattern isn't a must; these patterns sometimes help to bring out details in an image, but mostly the changes they make are a matter of aesthetics or special effects (see "In a Dither"). Apple's HyperScan offers 30 canned dither patterns, which can be useful to bring out an image given HyperCard's 72-dpi, bi-level limitation (see "HyperDither").



4-by-4-pixel halftone cells, spiral dither



4-by-4-pixel halftone cells, random dither



Error-diffusion dither pattern

In a Dither

Different dither patterns can bring out nuances in images and create a variety of special effects. Here you can see the same image printed at 300 dpi with three different dither patterns (all created with MacImage). The inset areas are enlarged to show the patterns. The first two emulate the appearance of traditional halftones, while the third creates a mezzotint effect.

Once you've captured an image, you generally want to view, edit, and modify it. You may want to use paint tools to cut, paste, and paint on the image, or you may want to adjust the overall image for brightness, contrast, or halftone effect. At the very least you will want to view the image on screen. If you are capturing gray-scale images and have a color or gray-scale monitor, you'll be able to see these files in their full, photographic-quality glory if you have a program that can display the gray levels on screen. Amazingly, some can't, and use a dither pattern on screen to represent the image.

▪ *Paint-Tools Image Editing* Some of the scanning programs (MacScan, EditScan, and VersaScan are examples) let you edit black-and-white images within the program, using a limited set of paint tools. This is handy, but a better approach is to use a full-featured paint or image-processing program like SuperPaint or DeskPaint (for bi-level images), or Image Studio or Digital Darkroom (for gray-scale images). Bear in mind that image editing is primarily useful for line art and gray-scale images. Editing 300-dpi dithered halftones with paint programs is pretty unworkable; about the only things you can really do are cut and paste and some rudimentary touch-up.

▪ *Brightness, Contrast, and Gamma Correction* While you'll want to be able to set brightness and contrast before scanning, being able to make changes to completed gray-scale scans is also important. ThunderScan, MacImage, Digital Darkroom, Image Studio, and some other programs let you modify gray-scale images after they've been captured. Some programs just give you a couple of buttons for light, dark, and normal; some give you sliders for contrast and brightness; and others give you explicit control over the gamma curve.

▪ *Gray Scale to Dither, and Dither to Gray Scale* Some packages (MacImage, LightningScan) let you take gray-scale images and convert them to dithered halftones, with varying degrees of control over the dither pattern. Others (LightningScan, ImageStudio, MacImage) take

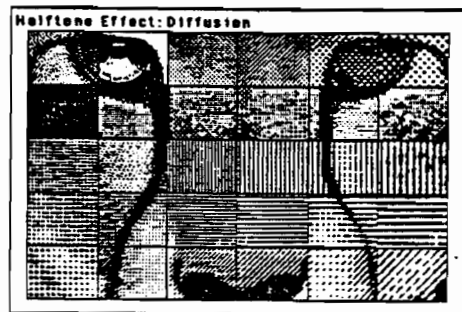
dithered halftones and deduce gray scales from them to produce lower-resolution images that include gray scales.

The ability to convert scans from gray scale to dither patterns is especially useful for screen display, and for any image where you want explicit control over special-effect halftoning. The dither-to-gray-scale conversion is less useful because the images that result usually retain some traces of the dither pattern, and the resulting halftones are not of publication quality.

▪ *Printing options* are important in scanning software, even though you may print your final copy from a page-make-up program. Before you decide to save your image, you may want to try out different printing options and see the results, then go back for another scan or further modifications if necessary. The printing controls in scanning software range from nonexistent (VisionScan, PanelScan), to rudimentary (MacScan), to quite robust (AppleScan, MacImage). With VisionScan, for instance, you need to save the image on disk, open it with DeskPaint (bundled with the scanner), and print it from there.

With MacScan you can print from within the program, but you have no control over scaling; output size is entirely dependent on image resolution and output-device resolution. If you print a 150-dpi scan on a 300-dpi printer, for instance, it comes out at half size, which is ridiculous. (MacScan's CopyScan option is useful, however; it scans and prints all at once, so you can try different parameters and see the results right away.)

AppleScan takes that CopyScan approach and makes it even more useful. You specify a test area on the image, and



HyperDither

HyperScan lets you choose from 30 dither patterns when you are scanning images.

Hewlett-Packard ScanJet Plus

SYNOPSIS

The ScanJet Plus is an enhanced version of Hewlett-Packard's popular ScanJet. Hewlett-Packard (HP) introduced the ScanJet in 1987, and it quickly became one of the best-selling models on the market. In January 1989, Hewlett-Packard added the ScanJet Plus, an eight-bit-per-pixel scanner for only \$100 more than the original ScanJet. We expect Hewlett-Packard to drop the ScanJet by the end of 1989. The ScanJet Plus comes with extensive graphics software for the Macintosh and PC, much of which Hewlett-Packard developed or customized for the scanner.

Vendor: Hewlett-Packard Co., Business Computing Systems, 19091 Pruneridge Avenue, Cupertino, California 95014. Telephone (800) 752-0900.

In Canada: Hewlett-Packard Canada Ltd., 6877 Goreway Drive, Mississauga, Ontario L4V 1M8. Telephone (416) 678-9430.

Model: ScanJet Plus.

Date Announced: January 1989.

Type: Flatbed desktop charge coupled device (CCD) scanner.

Configurations: IBM PC/XT/AT and compatibles (including the Hewlett-Packard Vectra); and IBM PS/2 Models 30/50/60/70/80—640K bytes of RAM, one free expansion slot, and MS-DOS Version 3.0 or higher; and Apple Macintosh Plus, Macintosh SE, and Macintosh II—at least 250K bytes of memory and a SCSI interface.

Price: \$1,595.

ANALYSIS

Hewlett-Packard's strategy in the microcomputer area reflects the company's versatility. Its greatest success in microcomputers has been in peripherals rather than systems. Its scanners are part of this pattern. Hewlett-Packard attempted to enter the microcomputer market with its Vectra computer in the mid-1980s but was unable to compete with IBM and the numerous makers of IBM clones. Unlike Digital Equipment Corporation, which had a similar experience with the Rainbow microcomputer, Hewlett-Packard did not write off microcomputers altogether. Instead, it moved to peripherals, such as the LaserJet printer it introduced in 1984. Well over 1 million LaserJets have been sold, more than all competing models combined. Hewlett-Packard parlayed its success with the LaserJet into other printers, notably the DeskJet ink jet printer, which it introduced in 1988.

It introduced its first scanner, the ScanJet, in 1987 and has become a leader in that market. All in all, peripherals accounted for about 28 percent of Hewlett-Packard's sales in 1988.

Hewlett-Packard's laser printers and scanner are both made by Canon. The new ScanJet Plus was designed jointly by Hewlett-Packard and Canon but is sold only by Hewlett-Packard.

Hewlett-Packard's move is part of a larger trend in which the major computer vendors are vying for the fast-growing scanner market. IBM has steadily extended its line of scanners. Apple introduced its first scanner in 1988. Xerox bought Datacopy, a small but very popular company in the scanner market.

Hewlett-Packard ScanJet Plus

dpi. on the ScanJet Plus, 1,500 dpi. Even after the interface card is added, the ScanJet Plus costs \$2,190, less than \$200 more than the Model 730 GS.

- Apple. The ScanJet Plus presents serious competition for Apple, especially among users needing many levels of gray. Apple's scanner records only four bits per pixel, or 16 levels of gray, while the ScanJet Plus records eight bits per pixel, or 256 levels of gray. The ScanJet Plus also has a diffusion halftone pattern, good for images that contain fine lines. While the ScanJet Plus can be connected to IBM and IBM-compatible microcomputers, Apple's scanner communicates only with the Macintosh. Apple's scanner's main advantages are its acceptance of legal-size originals, whereas the ScanJet Plus only accepts letter-size originals, and its image capture program for Hypertext. At \$2,190 (including interface kit), the ScanJet Plus costs only \$341 more than the \$1,849 Apple Scanner (including cable). Considering the difference in gray scale and sophistication of software, the price difference is small.

- Microtek. Going to the source does not always save money. Though Microtek manufactures scanners for other vendors, Hewlett-Packard's ScanJet Plus is more competitive than Microtek's eight-bit-per-pixel MSF-300G. The MSF-300G has more halftone patterns and more levels of brightness and contrast, but it does not have the image rotation and diffusion pattern available with DeskScan. It also costs more than the ScanJet Plus: \$3,495, plus \$195 for the PC interface or \$295 for the Macintosh interface.

ADVANTAGES AND RESTRICTIONS

Advantages: The ScanJet Plus is inexpensive and has extensive gray scale sensitivity and easy-to-use but powerful software, especially on the Apple Macintosh.

Restrictions: Hewlett-Packard does not offer a wide selection of scanners. The Macintosh interface requires a special SCSI adapter with its own external power supply.

CHARACTERISTICS

TEXT FUNCTIONS

Hewlett-Packard does not include character recognition software with the ScanJet Plus. The scanner can be used with OCR Systems ReadRight software, which Hewlett-Packard sells, and with other third-party character recognition programs.

VIEW MODES

- DeskScan—Preview scan displays the entire image at the screen resolution (approximately 38 dpi). The user can zoom in on any part of the image and enlarge it to fill the view area, which is about half the screen on the Macintosh Plus and Macintosh SE and the full screen on the Macintosh II. Once the preview is displayed, the user can crop it before the final scan. The user can also preview the image with different halftone patterns and different levels of brightness and contrast. The results approximate those obtained in the final scan.

- Scanning Gallery—Preview scan captures the image quickly, but at low resolution. The user then crops it before doing the final scan.

IMAGE MANIPULATION

- DeskScan—Converts gray scale images to halftones.
- DeskPaint—Includes all of the MacPaint tools, such as the pencil, brush, paint bucket, and eraser, as well as spray can (scattered dots), and charcoal crayon. DeskPaint can also add text in the Macintosh screen fonts. It does not support PostScript fonts. Graphics can be created at any resolution from 1 to 2,400 dpi to match the resolution of the captured image. Separate functions operate on segments of the image that the user defines. This includes functions that scale, skew, and warp the defined portion and a function that adds the illusion of perspective. A cropping tool outlines elements of an image for cloning elsewhere in the image or copying into other images, using either DeskPaint or another program that accepts images from the Macintosh clipboard. Users can rotate any

Hewlett-Packard ScanJet Plus

NETWORKS: None.

OPTIONS

- Interface kit for the Apple Macintosh—SCSI adapter box (includes a power supply and cables); Desk Gallery Plus (DeskPaint and DeskScan software).
- Interface kit for the IBM PC/XT/AT—Half-length parallel interface card for the computer (the scanner cannot be connected to the parallel printer port), cable, and Scanning Gallery Plus.
- Interface kit for the IBM PS/2 Model 50/60/70/80—same as for the PC/XT/AT, but with a Microchannel Architecture (MCA) card.
- Accessory kit for the IBM PS/2 Model 30.
- Automatic Document Feeder.
- ReadRight OCR software.

SPECIFICATIONS

PHYSICAL: Measures 4.2 inches high by 13.6 inches wide by 18.9 inches deep and weighs 9.0 pounds. The

Automatic Document Feeder measures 2.9 inches high by 13.5 inches wide by 20.1 inches deep and weighs 12.7 pounds.

ELECTRICAL: 110 to 115 V AC 50 or 60 Hz. The European model runs on 220 to 240 V AC, 50 Hz.

ENVIRONMENT: The ScanJet Plus operates under office conditions: temperatures from 41 to 104 degrees Fahrenheit and 10 to 90 percent humidity, non-condensing.

PRICING

List prices in U.S. dollars.

- ScanJet Plus—\$1,595.
- Macintosh Interface Kit—\$595.
- IBM PC/XT/AT Interface Kit—\$595.
- IBM PS/2 Models 50/60/70/80 Interface Kit—\$595.
- Accessory kit for IBM PS/2 Model 30—\$68.
- Automatic Document Feeder—\$595.
- ReadRight OCR Software—\$595. □

Scanners and Character Recognition Devices: Market Overview

SYNOPSIS

Scanners are rapidly making the transition from a costly specialty item to an affordable mainstream product. Although scanners have existed for some time, they have until recently served as adjuncts to expensive commercial printing and dedicated word processing systems. Microcomputers gave scanner developers a more standardized product platform, and the emergence of desktop publishing fueled demand, creating a booming market.

The market continues to grow as sales of current models increase and more new products appear. Our survey shows 37 vendors offering 62 models, most of

which debuted in the last two years. This remarkable growth has resulted in an inevitable shakeout. The small vendors specializing in scanners are facing increased competition from large vendors with many different product lines. This situation, along with manufacturing and design advances, has caused prices to decline and technology to become more sophisticated.

A comparison column description is followed by the scanner vendor list and comparison columns of the scanner models.

ANALYSIS

A Booming Market

The market for scanners is growing in size and sophistication as it becomes part of the mainstream computer market.

Strong Sales. Market researchers agree that, over the last year, sales of scanners have been strong and will continue to grow. Opinions differ, however, when trying to determine the exact extent of the expected growth. Datek Information Services shows placements of scanners rising from 50,000 in 1988 to over 100,000 in 1989. Interestingly, it shows a still bigger boom between 1990 (about 150,000 placements) and 1991 (about 325,000 placements). A west coast market research firm, microPublishing, shows \$400.0M in sales in 1988, rising to about \$650.0M in 1989 and \$1.1B in 1990.

Product Introductions. Our own figures for product offerings argue for a strong market. Of the models in

our survey, 51 percent were introduced in 1988 or 1989, and another 19 percent in 1987. In other words, most models are new.

Mainstream Vendors. We believe that scanners are becoming a mainstream peripheral. The strong sales are a sign that the installed base is increasing and that buyers see more of a need for scanners. Another sign of acceptance is the fact that the large systems vendors are introducing more scanners. Apple Computer, for example, finally introduced its first scanner this year. IBM, historically conservative about technology, added a new scanner this year to the models it introduced in 1986. IBM also uses scanners in its electronic document storage system, as does Wang. Hewlett-Packard is in its second generation of scanners, with the ScanJet Plus. Xerox deepened its commitment to scanners this year by buying Datacopy, which makes mostly graphics scanners. Xerox coupled Datacopy with Kurzweil, a veteran maker of character recognition systems that Xerox purchased in 1980, in the Xerox Imaging Systems Division (XIS). Three large Japanese vendors dominate the

Scanners and Character Recognition Devices: Market Overview

Gray scale and color scanners will continue to thrive, thanks to increasing processing power and inexpensive storage. As character recognition scanners become capable of recognizing more fonts with fewer errors and as their price continues to drop, they will become more popular. A few models can recognize (in a limited way) handwriting. Computerization should, in principle, reduce the need for character recognition, since more documents will be available in electronic form. In reality, word processing, desktop publishing, and other computer applications have only increased the number of documents and added to their complexity. The general acceptance of all types of scanners—more people will have already used them—will further increase sales. PostScript scanners are already in the works, and network scanners will probably follow. We expect scanners to become even more mainstream as they are integrated more closely with copiers and facsimile machines. Digital copiers from Canon and Ricoh are forerunners of what some pundits predict will become a hybrid machine, combining scanner, copier, facsimile machine, and laser printer.

COMPARISON COLUMN DESCRIPTIONS

The accompanying comparison columns summarize the key characteristics of 62 scanner models from 37 vendors. Datapro mailed product inquiries to over 50 vendors and followed each request with at least two telephone calls. We believe these columns represent a comprehensive overview of the current scanner market. *The absence of a company or a product from the comparison columns indicates the company failed to respond to our repeated requests for information, the product is no longer actively marketed, or the company is no longer in business.*

The comparison column entries are explained in the following paragraphs:

VENDOR NAME

The name of the firm that markets the scanner. This may differ from the manufacturer.

PRODUCT NAME

Major variations of a model with different prices appear separately. All models are listed alphabetically, numerals first.

Type. The kind of product offered by the vendor—either scanner with software or scanner without software. Most vendors of microcomputer scanners include scanning software with their product. If the vendor includes an expansion card, a note to that effect appears in the Comments section.

Applications. The functions for which the scanner is best suited. DTP stands for desktop publishing.

Date Introduced. Month and year of product announcement. May precede the shipment date.

Distribution. The channels through which the vendor sells its products. OEM stands for Original Equipment Manufacturer. VAR/VAD stands for Value-Added Reseller/Value-Added Dealer.

Technology. The sampling device used by the scanner to input data—either Charged Couple Device (CCD) or laser. A Light-Emitting Diode (LED) is the source of light for some handheld scanners.

Interfaces Available. The interface circuitry determines which computers a scanner supports. Most scanners have industry-standard interfaces, but some have special custom or proprietary interfaces. Some scanners interface with an expansion card in the computer.

Scanner Configuration. Scanners come in handheld, desktop, freestanding, and printhead configurations. Printhead scanners are devices that attach to a microcomputer printer. Desktop scanners are models that fit on a desk but are not handheld or printhead.

Software Included. The type of software the vendor provides with the scanner.

TEXT RECOGNITION FUNCTIONS

Most microcomputer scanners can recognize text. The text recognition may occur in the hardware (the scanner or an expansion card) or the software. When the text recognition features of the scanner are software dependent, a note to that effect appears in the Comments section.

Recognition Speed. The amount of time required to perform character recognition, described in either characters per second or seconds per 8½-by-11 inch page. These units are abbreviated as cps and sec./8.5 x 11.0 in. pg.

Scanners and Character Recognition Devices: Market Overview

COMMENTS

Other significant or unusual features or capabilities not represented in the standard entries and additional information on existing entries.

OTHER TERMS USED WITHIN THE COLUMNS

If the vendor did not supply us with all of the requested information, or if the question was not pertinent to a particular scanner, the following terms, listed below with an explanation, were used.

- *Vendor did not specify*—the vendor did not supply this information.
- *None*—a feature or characteristic is not available on the product.
- *Not applicable*—the stub entry is not applicable to the product.

SCANNER VENDORS

Advanced Vision Research
2201 Qume Drive
San Jose, CA 95131 (408) 434-1115

AGFA Compugraphic Corp.
200 Ballardvale Street
Wilmington, MA 01887 (508) 658-5600

Apple Computer, Inc.
20525 Mariani Avenue
Cupertino, CA 95014 (408) 996-1010

AT&T, Audiographics Communications System
185 Monmouth Parkway
West Long Branch, NJ 07764 (201) 870-7137

Bell & Howell, Document Management Products Co.
6800 McCormick Road
Chicago, IL 60645 (312) 675-7600

Calera Recognition Systems, Inc.
2500 Augustine Drive
Santa Clara, CA 95054 (408) 986-8006

Chinon America, Inc.
660 Maple Avenue
Torrance, CA 90503 (213) 533-0274

Cognitronics Corp., Scanning Systems Div.
4569 Mission George Place, Suite C
San Diego, CA 92120 (619) 282-8184

DEST Corp.
1201 Cadillac Court
Milpitas, CA 95035 (408) 946-7100

ECRM
554 Clark Road
Tewksbury, MA 01786 (508) 851-0207

Epson America, Inc., Computer Products Div.
2780 Lomita Boulevard
Torrance, CA 90505 (213) 539-9140

Everex Systems, Inc.
48571 Milmont Drive
Fremont, CA 94538 (415) 683-4540

Forefront Graphics Corp.
500 Sheppard East, Suite 309
Willowdale, ON, Canada M2N 6H7 (416) 226-4434

Glorious Union Information Systems, Inc.
14 Floor, 207 Tun Hwa North Road
Taipei, Taiwan, 94080 ROC (02) 715-3356

Hewlett-Packard Co., Business Computing Systems
19091 Pruneridge Avenue
Cupertino, CA 95014 (800) 752-0900

Houston Instruments
8500 Cameron Road
Austin, TX 78753 (512) 835-0900

Imagitex, Inc.
77 NE Boulevard
Nashua, NH 03062 (603) 889-6600

Intelligent Optics Corp.
4 Heritage Park Road, P.O. Box 712
Clinton, CT 06413 (203) 669-3650

International Business Machines Corp. (IBM)
Old Orchard Road
Armonk, NY 10504
Contact your local IBM representative.

KYE International Corp.
769 Pinefalls Avenue
Walnut, CA 91789 (714) 594-9234

Scanner and Character Recognition Device Comparison Columns

VENDOR NAME	Advanced Vision Research	AGFA Compugraphic Corp.	Apple Computer, Inc.	AT&T
PRODUCT NAME	AVR-302 scanner	Focus Scanner S800GS	Apple Scanner	Overview Scanner
Type	Scanner with software	Scanner with software	Scanner with software	Vendor did not specify
Applications	DTP	CAD/CAM, commercial printing, database services, DTP, facsimile input, forms processing, presentation graphics	CAD/CAM, commercial printing, database services, DTP, facsimile input, forms processing, presentation graphics	Database services, DTP, presentation graphics, teleconferencing
Date Introduced	1985	September 1988	August 1988	March 1988
Distribution	VAR/VAD	Retail	Retail	VAR/VAD
Technology	CCD	CCD	CCD	CCD
Interfaces Available	Proprietary 37-pin video	SCSI 1, SCSI 2	SCSI 1	Proprietary parallel
Scanner Configuration	Desktop	Desktop	Desktop	Desktop
Software Included	Text recognition, graphics, facsimile	Text recognition, graphics	Graphics	Graphics, teleconferencing
TEXT RECOGNITION FUNCTIONS				
Recognition Speed	44 sec./8.5 x 11.0 in. pg., 50 cps	Not applicable	Not applicable	Not applicable
Recognition Method	Matrix matching, feature extraction	Not applicable	Not applicable	Not applicable
Error Correction Method	Batch	Not applicable	Not applicable	Not applicable
File Formats	ASCII, WordStar, WordPerfect	Not applicable	Not applicable	Not applicable
Text Type Identified	Draft, NLO, typewritten, typeset, foreign characters	Not applicable	Not applicable	Not applicable
No. of Fonts Recognized	Vendor did not specify	Not applicable	Not applicable	Not applicable
GRAPHICS FUNCTIONS				
Scanning Speed (sec./pg., 8.5" x 11.0")	9.0	62.0 at 800 dpi	20.4	14.0/8.0" x 11.0" at 80 dpi
Graphics Type	Line art	Line art, continuous tone	Line art, continuous tone	Line art, continuous tone
Resolution (H x V, dpi)	300 x 300	100 x 100 - 800 x 800	75 x 75 - 300 x 300	80 x 80
Halftone Screen Resolution (lpi)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Color Support	Not applicable	Not applicable	Not applicable	Not applicable
Gray Scale Levels	None	64	16	Vendor did not specify
Graphics Formats	TIFF, PICT, PCX, CCITT III, IMG, MSF	TIFF, PICT, CCITT III, EPSF, Paint, Non-Compressed, TIFF Uncompressed	TIFF, PICT II	TIFF, PCX
MEDIA HANDLING				
Media Type	Paper, transparency, 3-D	Vendor did not specify	Paper	Paper, 3-D
Media Area (H x V, inches)	5.0 x 5.0 - 8.5 x 14.0	Max.: 8.5 x 13.0	Max.: 8.5 x 14.0	8.0 x 6.0 - 8.0 x 10.0
Media Thickness (inches)	Vendor did not specify	Not applicable	Vendor did not specify	Vendor did not specify
Feeder System/No. of Sheets	Flatbed, sheetfed/100	Flatbed	Flatbed	Overhead
DIMENSIONS (H x W x D, inches)	5.20 x 15.90 x 20.10	Vendor did not specify	4.40 x 13.60 x 21.80	Vendor did not specify
SERVICE AND PRICING				
Length of Warranty	90 days	90 days	90 days	1 year
Serviced by	Dealers	Vendor, dealers	Dealers	Vendor
Retail List Price (US, \$)	2,695	5,495	1,799	2,000
COMMENTS	Halftone screen res. depends on monitor, exp. card included	Halftone screen resolution is user selectable	—	Expansion card included

Scanner and Character Recognition Device Comparison Columns

VENDOR NAME	Calera Recognition Systems, Inc.	Calera Recognition Systems, Inc.	Chinon America, Inc.	Cognitronics Corp.
PRODUCT NAME	Compound Document Processor Model 3000XF	Compound Document Processor Model 9000	DS 2000/3000	Complex Image Processor CIP/200
Type	Scanner with software	Scanner with software	Scanner with software	Scanner with software
Applications	Commercial printing, database services, DTP, facsimile input, forms processing	Commercial printing, database services, DTP, facsimile input, forms processing	CAD/CAM, commercial printing, database services, DTP, facsimile input, forms processing, presentation graphics	Database services, DTP, forms processing
Date Introduced	May 1986	November 1987	Vendor did not specify	December 1987
Distribution	VAR/VAD	VAR/VAD	VAR/VAD	OEM
Technology	CCD	CCD	CCD	CCD
Interfaces Available	RS-232-C, Ethernet	RS-232-C, SCSI 1, Ethernet	RS-232-C	Direct memory access
Scanner Configuration	Desktop	Prnthead	Desktop	Desktop
Software Included	Text recognition	Text recognition	Text recognition, graphics, facsimile	Text recognition
TEXT RECOGNITION FUNCTIONS				
Recognition Speed	100 cps	270 cps	40 cps	1 sec./8.5 x 11.0 in. pg.
Recognition Method	Proprietary	Proprietary	Feature extraction	Matrix matching
Error Correction Method	Interactive, batch	Interactive, batch	Batch	Interactive
File Formats	ASCII, DCA/RFT, 40+ word processing & spreadsheet formats	ASCII, DCA/RFT, 40+ word processor & spreadsheet formats	ASCII, WordPerfect, WordStar	ASCII
Text Type Identified	Draft, NLQ, typewritten, typeset, laser print, other computer prints	Draft, NLQ, typewritten, typeset, laser print, other computer print	NLQ, typewritten	Draft, NLQ, typewritten, typeset
No. of Fonts Recognized	20,000	20,000	20	At customer's request
GRAPHICS FUNCTIONS				
Scanning Speed (sec./pg., 8.5" x 11.0")	Vendor did not specify	Interface dependent	Minimum 24.0	Not applicable
Graphics Type	Line art	Line art	Line art	Not applicable
Resolution (H x V, dpi)	75 x 75 - 300 x 300	75 x 75 - 300 x 300	75 x 75 - 300 x 300	Not applicable
Halftone Screen Resolution (lpi)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Not applicable
Color Support	Not applicable	Not applicable	Not applicable	Not applicable
Gray Scale Levels	None	None	None	Not applicable
Graphics Formats	TIFF, PCX, CCITT III, PDA	TIFF, PCX, PDA	TIFF, PCX, IMG	Vendor did not specify
MEDIA HANDLING				
Media Type	Paper	Paper	Paper, 3-D	Paper
Media Area (H x V, inches)	5.0 x 3.0 - 8.5 x 14.0	5.0 x 3.0 - 8.5 x 14.0	Max.: 8.5 x 11.0	3.0 x 5.0 - 8.5 x 11.0
Media Thickness (inches)	Vendor did not specify	Vendor did not specify	Max.: 0.500	Vendor did not specify
Feeder System/No. of Sheets	Sheetfed/50	Sheetfed/50	Overhead	Not applicable
DIMENSIONS (H x W x D, inches)	13.00 x 16.00 x 27.00	13.00 x 16.00 x 27.00	12.50 x 13.25 x 11.75	21.00 x 34.00 x 13.50
SERVICE AND PRICING				
Length of Warranty	90 days	90 days	90 days	90 days
Serviced by	Vendor, dealers, 3rd party	Vendor, dealers, 3rd party	Vendor	Vendor
Retail List Price (US, \$)	14,950	39,950	745	22,000
COMMENTS	—	—	—	—

Scanner and Character Recognition Device Comparison Columns

VENDOR NAME	Epson America, Inc.	Everex Systems, Inc.	Forefront Graphics Corp.	Glorious Union Information Systems, Inc.
PRODUCT NAME	EX Series Image Scanner Option Kit 8392W	Transimage 1000 EXO-02270-00	TEXNAI Color Scanner TX200	321
Type	Scanner without software	Scanner with software	Scanner with software	Scanner with software
Applications	DTP, presentation graphics	Database services, DTP, forms processing	CAD/CAM, commercial printing, database services, DTP, facsimile input, forms processing, presentation graphics, NTSC Video Applications December 1988	DTP, facsimile input
Date Introduced	May 1987	November 1988		March 1988
Distribution	Retail	Retail, VAR/VAD, system integrators	System integrators	Retail
Technology	LED	CCD	CCD	LED
Interfaces Available	RS-232-C	Full length PC board	RS-232-C, GPIB	Centronics parallel
Scanner Configuration	Prnthead	Handheld	Desktop	Desktop
Software Included	Graphics	Text recognition	Graphics	Graphics
TEXT RECOGNITION FUNCTIONS				
Recognition Speed	Not applicable	40 cps	Not applicable	75 cps
Recognition Method	Not applicable	Matrix matching, feature extraction	Not applicable	Feature extraction, AI
Error Correction Method	Not applicable	Interactive	Not applicable	Interactive, batch
File Formats	Not applicable	ASCII	Not applicable	ASCII, WordStar, WordPerfect
Text Type Identified	Not applicable	Typewritten, typeset, laser printer output	Not applicable	NLC, typewritten, typeset, ligatures, daisy wheel & laser printers
No. of Fonts Recognized	Not applicable	Vendor did not specify	Not applicable	7
GRAPHICS FUNCTIONS				
Scanning Speed (sec./pg., 8.5" x 11.0")	Vendor did not specify	Not applicable	100.0 max. at 200 dpi	6.0 at 200 dpi
Graphics Type	Line art, continuous tone	Not applicable	Line art, continuous tone	Line art, continuous tone
Resolution (H x V, dpi)	72 x 72 - 144 x 144	Not applicable	30 x 30 - 200 x 200	200 x 100 - 200 x 200
Halftone Screen Resolution (lpi)	Vendor did not specify	Not applicable	3 - 200	200
Color Support	Not applicable	Not applicable	Yes	Not applicable
Gray Scale Levels	64	Not applicable	256	16
Graphics Formats	GRY, proprietary; PIX, Inset; Windows Paint	Vendor did not specify	TIFF, PSF, PICT, PICT II, PCX, RGB Data, GIF, Targa, Vision, 9, custom	TIFF, PCX, MS Windows
MEDIA HANDLING				
Media Type	Paper	Vendor did not specify	Paper, transparency, 3-D	Paper
Media Area (H x V, inches)	Vendor did not specify	Vendor did not specify	Max.: 8.5 x 11.0	0.1 x 0.1 - 8.5 x 22.0
Media Thickness (inches)	Max.: 0.006	Vendor did not specify	Max.: 3.000	0.008 - 0.040
Feeder System/No. of Sheets	Sheetfed/1, tractor feed	None	Flatbed	Sheetfed/1
DIMENSIONS (H x W x D, inches)	4.70 x 17.60 x 14.90	6.28 x 2.85 x 1.75	5.10 x 13.20 x 16.10	4.33 x 11.50 x 9.85
SERVICE AND PRICING				
Length of Warranty	1 year	1 year	90 days, ext. warranty offered	1 year
Serviced by	Dealers	Vendor	Vendor	Dealers, 3rd party
Retail List Price (US, \$)	299	1,995	3,995	895*
COMMENTS	—	Handheld text scanner	Price includes software, card, cable	—



Scanner and Character Recognition Device Comparison Columns

VENDOR NAME	Imagitex, Inc.	Intelligent Optics Corp.	International Business Machines Corp.	International Business Machines Corp.
PRODUCT NAME	1800 Scanner	IOC Speedreader 700	3117 Scanner	3118 Scanner Model 010
Type	Scanner with software	Scanner with software	Scanner without software	Scanner without software
Applications	Commercial printing, presentation graphics, all high quality graphic arts	CAD/CAM, commercial printing, database services, DTP, facsimile input, forms processing, presentation graphics, international languages	Database services, DTP	Database services, DTP
Date Introduced	October 1986	December 1988	June 1986	June 1986
Distribution	Retail	System integrators	Retail	Retail
Technology	CCD	CCD	CCD	CCD
Interfaces Available	Imagitex host interface protocol	RS-232-C, RS-422, SCSI 1, SCSI 2	IBM 3117 adapter, 3117 ext. unit	IBM high speed adapter, others
Scanner Configuration	Freestanding	Desktop	Desktop	Handheld
Software Included	Software interface	Text recognition, graphics, spellchecker	None	None
TEXT RECOGNITION FUNCTIONS				
Recognition Speed	Not applicable	10 sec./8.5 x 11.0 in. pg.	Not applicable	Vendor did not specify
Recognition Method	Not applicable	Matrix matching, feature extraction	Not applicable	Vendor did not specify
Error Correction Method	Not applicable	Interactive, batch	Not applicable	Vendor did not specify
File Formats	Not applicable	ASCII, selected WP formats	Not applicable	Vendor did not specify
Text Type Identified	Not applicable	Draft, NLQ, typewritten, typeset, 8 - 24 point fonts	Not applicable	Vendor did not specify
No. of Fonts Recognized	Not applicable	Vendor did not specify	Not applicable	Vendor did not specify
GRAPHICS FUNCTIONS				
Scanning Speed (sec./pg., 8.5" x 11.0")	13.0 sec./inch at 1,132.0 sec./pg., 8.5" x 11.0"	6.0	30.0	12.0 at 240 dpi
Graphics Type	Line art, continuous tone	Line art, continuous tone	Line art	Line art
Resolution (H x V, dpi)	283 x 283 - 1,132 x 1,132	200 x 200 - 300 x 300	120 x 120 - 240 x 240	120 x 120 - 240 x 240
Halftone Screen Resolution (lpi)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Color Support	Not applicable	Not applicable	Not applicable	Not applicable
Gray Scale Levels	256	256	None	None
Graphics Formats	Imagitex data format	TIFF, PCX	TIFF, EPSF, IDS	TIFF, EPSF, IDS
MEDIA HANDLING				
Media Type	Paper, transparency, all negatives, positives, etc.	Paper	Paper	Paper
Media Area (H x V, inches)	1.5 x 1.5 - 18.0 x 24.0	5.0 x 5.0 - 8.5 x 14.0	Max.: 8.5 x 11.7	2.6 x 3.9 - 8.5 x 14.0
Media Thickness (inches)	None	Vendor did not specify	Vendor did not specify	Vendor did not specify
Feeder System/No. of Sheets	Flatbed	Flatbed, sheetfed/30	Flatbed	Sheetfed/1
DIMENSIONS (H x W x D, inches)	49.00 x 67.50 x 31.50	7.50 x 15.20 x 19.50	5.00 x 15.20 x 13.40	4.80 x 17.10 x 15.70
SERVICE AND PRICING				
Length of Warranty	90 days	90 days	1 year	1 year
Serviced by	Vendor	Vendor, dealers	Vendor, dealers	Vendor, dealers
Retail List Price (US. \$)	65,000	6,895	1,145	2,460
COMMENTS	—	—	—	—

Scanner and Character Recognition Device Comparison Columns

VENDOR NAME	Logitech International SA	Microtek Lab. Inc.	Microtek Lab. Inc.	Microtek Lab. Inc.
PRODUCT NAME	Scan Man for Macintosh	MSF-300G	MSF-300Q	MSF-400G
Type	Scanner with software	Scanner with software	Scanner with software	Scanner with software
Applications	CAD/CAM, database services, DTP, facsimile input, presentation graphics	CAD/CAM, commercial printing, database services, DTP, facsimile input, forms processing, presentation graphics	CAD/CAM, commercial printing, database services, DTP, facsimile input, forms processing, presentation graphics	CAD/CAM, commercial printing, database services, DTP, facsimile input, forms processing, presentation graphics
Date Introduced	February 1989	November 1987	August 1988	January 1988
Distribution	Retail	Retail	Retail	Retail
Technology	CCD, LED	CCD	CCD	CCD
Interfaces Available	SCSI 1, SCSI 2	Centronics parallel, RS-232-C, RS-422, SCSI 1, MSF-300GS version has built-in SCSI	Centronics parallel, RS-232-C, RS-422, SCSI 1, MSF-300QS has built-in SCSI	Centronics parallel, RS-232-C, RS-422, SCSI 1, MSF-400GS has built-in SCSI
Scanner Configuration	Handheld	Desktop	Desktop	Desktop
Software Included	Text recognition, graphics	Graphics	Graphics	Graphics
TEXT RECOGNITION FUNCTIONS				
Recognition Speed	82 cps	Not applicable	Not applicable	Not applicable
Recognition Method	Matrix matching, feature extraction	Not applicable	Not applicable	Not applicable
Error Correction Method	Batch	Not applicable	Not applicable	Not applicable
File Formats	ASCII	Not applicable	Not applicable	Not applicable
Text Type Identified	Typeset	Not applicable	Not applicable	Not applicable
No. of Fonts Recognized	Most common - Omni	Not applicable	Not applicable	Not applicable
GRAPHICS FUNCTIONS				
Scanning Speed (sec./pg., 8.5" x 11.0")	Vendor did not specify	9.9	9.9	16.0 at 400 dpi
Graphics Type	Line art	Line art, continuous tone	Line art, continuous tone	Line art, continuous tone
Resolution (H x V, dpi)	100 x 100 - 400 x 400	75 x 75 - 300 x 300	75 x 75 - 300 x 300	75 x 75 - 400 x 400
Halftone Screen Resolution (lpi)	Vendor did not specify	65 - 130	65 - 130	65 - 130
Color Support	Not applicable	Not applicable	Not applicable	Not applicable
Gray Scale Levels	None	256	64	256
Graphics Formats	TIFF, PICT, PCX, MacPaint	TIFF, PICT, PICT II, PCX	TIFF, PICT, PICT II, PCX	TIFF, PICT, PICT II, PCX
MEDIA HANDLING				
Media Type	Vendor did not specify	Paper, 3-D	Paper, 3-D	Paper, 3-D
Media Area (H x V, inches)	Vendor did not specify	Max.: 8.5 x 14.0	Max.: 8.5 x 14.0	Max.: 8.5 x 14.0
Media Thickness (inches)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Feeder System/No. of Sheets	None	Flatbed	Sheetfed	Flatbed
DIMENSIONS (H x W x D, inches)	Vendor did not specify	5.75 x 15.50 x 23.75	5.75 x 15.50 x 23.75	5.75 x 15.50 x 23.75
SERVICE AND PRICING				
Length of Warranty	180 days	180 days	180 days	180 days
Serviced by	Vendor	Vendor, dealers	Vendor	Vendor, dealers
Retail List Price (US, \$)	499	3,495	2,295	3,995
COMMENTS	—	Text recognition functions are software dependent	Text recognition functions are software dependent	Text recognition functions are software dependent

Scanner and Character Recognition Device Comparison Columns

VENDOR NAME	New Image Technology, Inc.	New Image Technology, Inc.	NISCA, Inc.	Packard Bell
PRODUCT NAME	MacScan	MacScan Pro	NISCAN Hand Scanner	Pocket Scanner PB-PS1000
Type	Scanner with software	Scanner with software	Vendor did not specify	Scanner with software
Applications	DTP	DTP	DTP, facsimile input, presentation graphics	DTP
Date Introduced	October 1986	August 1988	August 1988	November 1987
Distribution	Retail	Retail	Retail	Retail
Technology	CCD	CCD	CCD	LED
Interfaces Available	SCSI 1	SCSI 1	Interface card	Custom interface
Scanner Configuration	Desktop	Desktop	Handheld	Handheld
Software Included	Text recognition, graphics	Text recognition, graphics	Graphics	Graphics
TEXT RECOGNITION FUNCTIONS				
Recognition Speed	60 sec./8.5 x 11.0 in pg.	60 sec./8.5 x 11.0 in pg.	Not applicable	Not applicable
Recognition Method	Matrix matching, feature extraction	Matrix matching, feature extraction	Not applicable	Not applicable
Error Correction Method	Interactive, batch	Interactive, batch	Not applicable	Not applicable
File Formats	ASCII	ASCII	Not applicable	Not applicable
Text Type Identified	NLQ, typewritten, typeset	Draft, NLQ, typewritten, typeset	Not applicable	Not applicable
No. of Fonts Recognized	Vendor did not specify	Vendor did not specify	Not applicable	Not applicable
GRAPHICS FUNCTIONS				
Scanning Speed (sec./pg., 8.5" x 11.0")	15.0	15.0	2.0 inches/sec.	1.5
Graphics Type	Line art, continuous tone	Line art, continuous tone	Line art, continuous tone	Line art, continuous tone
Resolution (H x V, dpi)	75 x 75 - 300 x 300	75 x 75 - 300 x 300	100 x 100 - 200 x 200	Min.: 200 x 200
Halftone Screen Resolution (lpi)	Not applicable	Vendor did not specify	25 - 50	Vendor did not specify
Color Support	Not applicable	Not applicable	Not applicable	Not applicable
Gray Scale Levels	None	256	Vendor did not specify	256
Graphics Formats	TIFF, PICT, EPSF, PostScript, MacPaint, SuperPaint, PageMaker	TIFF, PICT, EPSF, PostScript, MacPaint, SuperPaint, PageMaker	TIFF, GEM IMG	TIFF
MEDIA HANDLING				
Media Type	Paper	Paper	Paper	Vendor did not specify
Media Area (H x V, inches)	Vendor did not specify	Vendor did not specify	None	Vendor did not specify
Media Thickness (inches)	Vendor did not specify	Vendor did not specify	None	Vendor did not specify
Feeder System/No. of Sheets	Flatbed, sheetfed/5	Flatbed, sheetfed/5	None	None
DIMENSIONS (H x W x D, inches)	Vendor did not specify	Vendor did not specify	Vendor did not specify	1.13 x 3.50 x 4.88
SERVICE AND PRICING				
Length of Warranty	1 year	1 year	1 year	1 year
Serviced by	Vendor	Vendor	Vendor	Vendor
Retail List Price (US, \$)	999	1,599	299	295
COMMENTS	Sheetfed \$999, flatbed \$1,995	—	Expansion card included	—

Scanner and Character Recognition Device Comparison Columns

VENDOR NAME	Sharp Electronics Corp.	Siemens Information System, Inc.	Taxan USA Corp.	Thunderware, Inc.
PRODUCT NAME	JX-450 Professional Color Scanner	HighScan	Crystal Scan Image Scanner 3001	Lighting Scan LS1001
Type	Scanner without software	Scanner with software	Scanner with software	Scanner with software
Applications	CAD/CAM, database services, DTP, presentation graphics, image proc., pkg. design, ad layout, med. imaging	CAD/CAM, commercial printing, database services, DTP, facsimile input, forms processing, presentation graphics	CAD/CAM, commercial printing, DTP, facsimile input	DTP, presentation graphics
Date Introduced	Vendor did not specify	October 1988	June 1987	Vendor did not specify
Distribution	Retail	OEM	Retail	Retail
Technology	CCD	CCD	CCD	CCD
Interfaces Available	GPIO	SCSI 2	RS-422, SCSI 1, bi-directional parallel	SCSI 1
Scanner Configuration	Desktop	Desktop	Desktop	Handheld
Software Included	PixelScan, scanner driver for Macintosh environment only	Vendor did not specify	Graphics	Graphics
TEXT RECOGNITION FUNCTIONS				
Recognition Speed	Not applicable	10 sec./8.5 x 11.0 in. pg.	Vendor did not specify	Not applicable
Recognition Method	Not applicable	Matrix matching	Matrix matching	Not applicable
Error Correction Method	Not applicable	Interactive, batch	Vendor did not specify	Not applicable
File Formats	Not applicable	ASCII, DCA/RFT	ASCII, WordStar, WordPerfect	Not applicable
Text Type Identified	Not applicable	NLC, typewritten, typeset	Typewritten, 6 - 12 point fonts	Not applicable
No. of Fonts Recognized	Not applicable	Vendor did not specify	250	Not applicable
GRAPHICS FUNCTIONS				
Scanning Speed (sec./pg., 8.5" x 11.0")	114.0 in 24-bit color	10.0	9.9	20.0 - 24.0
Graphics Type	Line art, continuous tone	Line art, continuous tone	Line art, continuous tone	Line art, continuous tone
Resolution (H x V, dpi)	30 x — - 300 x —	75 x 75 - 800 x 800	75 x 75 - 300 x 300	100 x 100 - 400 x 400
Halftone Screen Resolution (lpi)	Vendor did not specify	5 - 400	None	10 - 150
Color Support	Yes	Yes	Not applicable	Not applicable
Gray Scale Levels	256	256	None	None
Graphics Formats	TIFF, PSF, PICT, PICT II, PCX, industry standard formats	TIFF, PSF, PICT, PICT II, PCX, RGB Data, CCITT III	TIFF, PCX, Microsoft Paint	TIFF, PICT, ThunderScan, Paint, EPSF
MEDIA HANDLING				
Media Type	Paper, transparency	Paper	Paper	Paper, transparency, tile, wall paper, fabric
Media Area (H x V, inches)	Max.: 11.0 x 17.0	Max.: 8.5 x 11.0	Max.: 8.5 x 14.0	Vendor did not specify
Media Thickness (inches)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Feeder System/No. of Sheets	Flatbed	Flatbed, sheetfed/50	Sheetfed/50	T 06DNone
DIMENSIONS (H x W x D, inches)				
	7.31 x 21.75 x 20.87	Vendor did not specify	Vendor did not specify	Vendor did not specify
SERVICE AND PRICING				
Length of Warranty	90 days	90 days	1 year	90 days
Serviced by	Vendor	Vendor, dealers, 3rd party	3rd party	Vendor
Retail List Price (US, \$)	6,995	4,900	1,695	549
COMMENTS				
	—	—	Text recog. is software dep., IBM price above, Mac \$1,595	—

Scanner and Character Recognition Device Comparison Columns

VENDOR NAME	Xerox Imaging Systems	Xerox Imaging Systems	Xerox Imaging Systems	Xerox Imaging Systems (XIS)
PRODUCT NAME	Discover 7320 20	Discover 7320 30	Kurzweil 5000 5000	Datacopy JetReader
Type	Scanner with software	Scanner with software	Scanner with software	Scanner without software
Applications	Commercial printing, database services, DTP, word processing	Commercial printing, database services, DTP, word processing	Commercial printing, database services, DTP, word processing	Database services, DTP, facsimile input, presentation graphics, image data storage
Date introduced	June 1987	June 1988	October 1988	Vendor did not specify
Distribution	VAR/VAD	VAR/VAD	VAR/VAD	VAR/VAD
Technology	CCD	CCD	CCD	Vendor did not specify
Interfaces Available	RS-232-C, proprietary	RS-232-C, proprietary	RS-232-C, proprietary	Centronics parallel
Scanner Configuration	Desktop	Desktop	Desktop	Desktop
Software included	Text recognition, graphics	Text recognition, graphics	Text recognition, graphics	None
TEXT RECOGNITION FUNCTIONS				
Recognition Speed	30 sec./8.5 x 11.0 in. pg., 60 cps	30 sec./8.5 x 11.0 in. pg., 60 cps	30 sec./8.5 x 11.0 in. pg., 60 cps	Vendor did not specify
Recognition Method	Matrix matching, feature extraction, AI, intelligent char. recog.	Matrix matching, feature extraction, AI, intelligent char. recog.	Matrix matching, feature extraction, AI, intelligent char. recog.	Vendor did not specify
Error Correction Method	Batch	Batch	Batch	Vendor did not specify
File Formats	ASCII, DCA/RFT, user definable	ASCII, DCA/RFT, user definable	ASCII, DCA/RFT, user definable	Vendor did not specify
Text Type Identified	NLQ, typewritten, typeset	NLQ, typewritten, typeset	NLQ, typewritten, typeset	Vendor did not specify
No. of Fonts Recognized	Thousands	Thousands	Thousands	Vendor did not specify
GRAPHICS FUNCTIONS				
Scanning Speed (sec./pg., 8.5" x 11.0")	Vendor did not specify	Vendor did not specify	Vendor did not specify	14.0 for line art
Graphics Type	Line art, continuous tone	Line art, continuous tone	Line art, continuous tone	Line art, continuous tone
Resolution (H x V, dpi)	Max.: 300 x 300	300 x 300	50 x 50 - 600 x 600	150 x 150 - 300 x 300
Halftone Screen Resolution (lpi)	Vendor did not specify	Vendor did not specify	Vendor did not specify	Vendor did not specify
Color Support	Not applicable	Not applicable	Not applicable	Not applicable
Gray Scale Levels	None	Vendor did not specify	64	16
Graphics Formats	TIFF, PCX	TIFF, PCX	TIFF, PCX	Vendor did not specify
MEDIA HANDLING				
Media Type	Paper	Paper	Paper	Paper
Media Area (H x V, inches)	4.0 x 5.0 - 8.5 x 14.0	4.0 x 5.0 - 8.5 x 14.0	4.0 x 5.0 - 8.5 x 14.0	5.8 x 4.1 - 10.1 x 14.3
Media Thickness (inches)	Vendor did not specify	0.050 - 0.150	0.050 - 0.150	Vendor did not specify
Feeder System/No. of Sheets	Sheetfed/10	Flatbed	Flatbed	Sheetfed/10
DIMENSIONS (H x W x D, inches)	16.25 x 10.90 x 3.50	11.83 x 6.13 x 2.50	23.30 x 15.30 x 5.90	3.40 x 16.00 x 10.70
SERVICE AND PRICING				
Length of Warranty	1 year	1 year	1 year	90 days
Serviced by	Dealers	Dealers	Dealers	Vendor
Retail List Price (US, \$)	4,995	6,995	15,950	1,300
COMMENTS	—	—	—	Text recognition functions are software dependent

Grayscale Scanning Gains Support from Hardware and Software Advances

Scanners are offering more grayscale capability at lower cost as new hardware options for printing and new grayscale editing software emerges in the PC environment.

by Robert Mueller

Just a year ago, grayscale scanning was an expensive novelty in the PC world. Prices for 8-bit scanners averaged around \$3,500 and 6-bit scanners averaged only a few hundred dollars less. The majority of grayscale scanners were 4-bit machines, and the consensus was that scanner technology was being stalled by the inability of laser printers to output decent grayscale images, the vast storage requirements of grayscale and the poor availability of grayscale editing software.

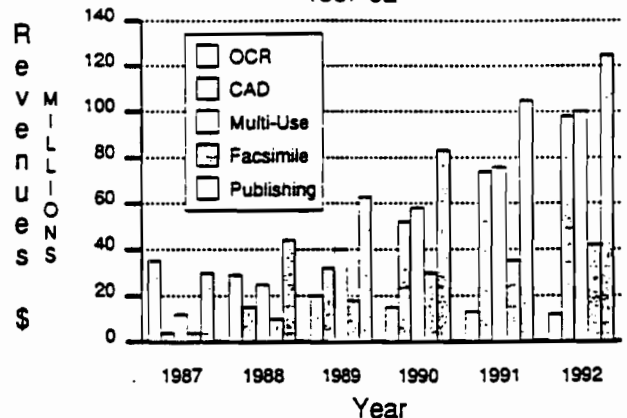
Although not all those problems have been resolved, the past few months have seen a flurry of significant hardware and software developments in grayscale manipulation and printing on the PC, and scanner makers have lowered prices and raised grayscale capabilities in anticipation of a veritable boom in grayscale use.

Grayscale and Perception

Essentially, grayscale scanning means bringing photographs into documents. Photos are continuous-tone images—that is, shading in a photo ranges from white to black over a near-infinite number of intermediate gray tones. The ability of the human eye to distinguish borders between one shade of gray and another, however, is not infinite. Depending on the individual, it ranges between 50 and 100 shades of gray. Somewhere in that range, people lose the ability to perceive the difference between one shade and the next lighter or darker shade. By converting continuous-tone images into enough shades of gray to exceed the perceptual threshold, grayscale scanners collect enough data to recreate the illusion of continuous-tone graphics.

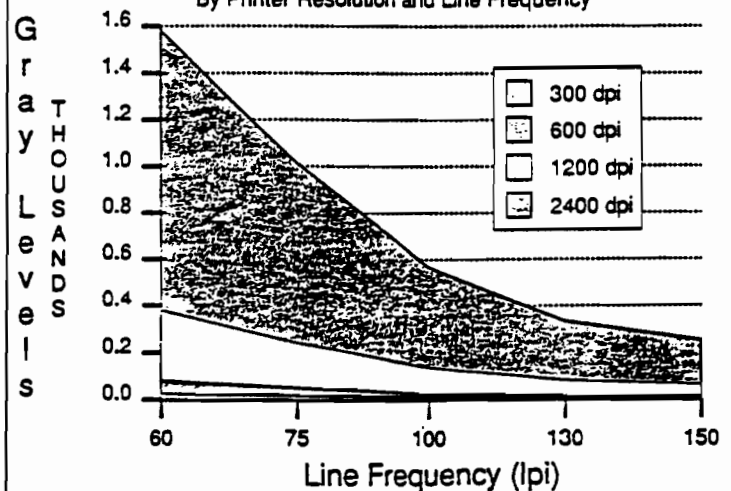
Scanners scan images at various resolutions, specified in dots per inch much like laser printers. Originally (and still, in the case of inexpensive scanners), each scanned dot was converted into a single binary bit of data which could be either on or off, black or white. That worked fine in OCR (optical character recognition) and line art applications, but the black-or-white options didn't allow for reproduction of intermediate tones.

Scanner Revenues by Application
1987-92



Levels of Gray

By Printer Resolution and Line Frequency



Top: Scanner applications are growing most rapidly in desktop publishing and multi-use applications. (Source: Dataquest Information Systems.)
Bottom: Higher printer resolution and coarser halftones yield more printable shades of gray.

Grayscale scanners work by assigning multiple data bits to each dot. The number of gray shades the grayscale scanner can interpret is a geometric function of number of bits assigned to each dot. A 4-bit scanner, for example, can reproduce 2^4 or 16 shades of gray. An 8-bit scanner can reproduce 2^8 or 256.

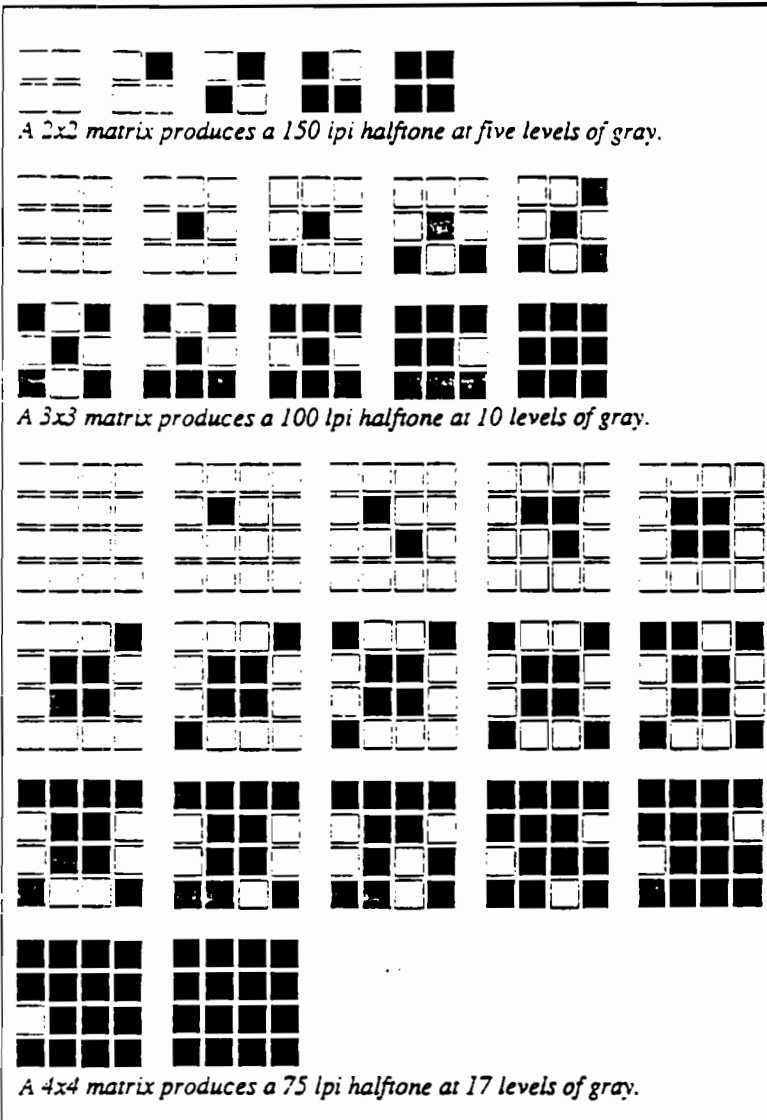
The problem so far has been what happens to that data once it's collected. The first problem is, there's a lot of it. An 8x10 black-and-white photo, scanned at 300 dpi and 256 levels of gray, creates a 7.2MB file. Although some file compression algorithms exist to shrink grayscale storage requirements, grayscale applications are still very storage-intensive. Some storage alternatives to hard disk are beginning to appear, but they're still a long way from common use. "We're solving some of the mass storage problems as costs come down there," observes Gary Kaiser, marketing section manager for Hewlett-Packard's Greeley Hardcopy Operation. "We're seeing optical become a reality, and it's just going to have to evolve along with other technologies."

Not only does all that data have to be stored, it also has to be processed, reminds Al Robins, scanner product manager for Ricoh. "You try loading an 8MB or 12MB image into a 25MHz 386, and even with a 19 millisecond access time drive and 8MB of memory in the system, you're still dealing with a three- or four-minute wait," he says. "If you stick that in Windows, you might as well go to lunch." New data compression chip sets and software algorithms are being explored by everyone involved in grayscale imaging, Robins adds, but so far there are no easy answers.

Printing Grayscale Images

Once stored, the next issue for grayscale images is printing. As with most printing technologies, laser printers and imagesetters make black dots or no dots. Conventional printing technology mimics continuous-tone art by making the dots larger or smaller—larger in darker areas, smaller in lighter ones. The effectiveness of the illusion depends on how close together the halftone dots are placed, in printers' terms, the screen density. A 75 line screen, about what's commonly used in newspapers, means there are 75 halftone dots per inch. Higher density (measured in lines per inch or lpi) yields a better-looking halftone. The black-and-white photos in *PC Publishing* are reproduced at 120 lpi.

With a few very notable exceptions—more on that in a moment—laser printers and imagesetters cannot alter the size of the dots they make. To approximate the halftone effect, therefore, they divide the image into a series of cells consisting of small grids, in turn made up of individual printer pixels. The size of the grid affects both halftone density and the number of gray



Laser printers simulate halftoning by dividing the printed area into matrices comprised of individual printer dots. The darkness or lightness of each matrix is controlled by the number of dots printed. Small matrices produce a finer halftone screen, but prints fewer shades of gray. Larger matrices print more gray levels, but produce a coarser halftone. (Source: Datek Information Services.)

Grayscale Scanners

This chart lists grayscale scanners only; manufacturers may have additional text and image scanners available. Some sheet feeder models have automatic paper feeders available as optional equipment. The maximum levels of gray are shown. The DPI resolution indicated is the highest optical scanning resolution possible. The file formats each scanner supports are listed; some scanners may support additional formats. Manufacturer's suggested retail list price is shown.

Mfr./Model	Levels of Gray	Sheetfed/Flatbed	DPI	File Compression	File Formats Supported	Price	Circle No.
Agfa Compugraphic Corp.							
S600 GS	64	Flatbed	600	Y	.IMG, TIFF, .PCX, EPS	\$6,390	100
S800 GS	64	Flatbed	800	Y	.IMG, TIFF, .PCX, TIFF	\$6,390	101
AT&T Information Systems							
OverView	64	Flatbed	300	Y	.PCX, TIFF	\$2,300	102
Canon U.S.A., Inc.							
IX-12	32	Sheetfed	300	N	.PCX, TIFF, .IMG	\$1,190	103
IX-12F	32	Flatbed	300	N	.PCX, TIFF, .IMG	\$1,740	104
Computer Aided Technology, Inc.							
CAT Image							
Scanner Plus	128	Other	400	N	.PCX, TIFF	\$239	105
Datacopy Corp.							
730GS	64	Flatbed	450	Y	.PCX, TIFF, .IMG, .EPS	\$1,995	106
830	64	Flatbed	300	Y	.PCX, TIFF, .IMG, .EPS	\$3,495	107
840	256	Flatbed	400	Y	.PCX, TIFF, .IMG, .EPS	\$7,495	108
730	16	Flatbed	300	Y	.PCX, TIFF, .IMG, .EPS	\$2,495	109
Jet Reader	16	Sheetfed	300	Y	.PCX, TIFF, .IMG, .EPS	\$1,995	110
Diamond Flower Electric Instruments Co.							
DFI HS 3000							
Handy Scanner	32	Hand Held	400	N	.PCX, TIFF, .MSP, .IMG, .CUT	\$299	111

levels that can be printed. The larger the cell, the coarser the halftone, but the higher the number of gray levels that can be printed. A 6x6 pixel cell, for example, produces a 50 lpi halftone on a 300 dpi printer (300 ÷ 6) at 37 levels of gray (6 X 6 + 1). A 4x4 cell produces a 75 lpi halftone at 17 levels of gray.

As printer resolution goes up, so do the number of lines per inch at a given gray level or the number of gray levels at a given number of lines per inch. On a 600 dpi printer, a 6x6 cell yields a 100 lpi halftone at 37 levels of gray and a 12x12 cell yields a 50 lpi halftone at 145 levels of gray.

By almost any standard, a 50 lpi halftone is unacceptable and 37 levels of gray falls well below the perceptual limits described above. Yet, says Jim McNaul, vice president-strategic marketing for Xerox Imaging Systems (née Datacopy and Kurzweil), that's about the best you can do on a 300 dpi printer.

Higher Resolution, Higher Cost

The obvious alternative is to go to a higher-resolution output device, such as a Linotronic or Compugraphic imagesetter. Printers of this sort do yield good-quality halftones at acceptable screen density and gray level, but there's a penalty. The imagesetters are expensive, and even service bureau output isn't cheap. It takes time to output a grayscale image, and when the bureaus see them coming, many turn off the per-page meter and turn on the per-hour meter. At the end of the day, it's probably cheaper to go down the street to a stat house or a printer and get a conventional halftone made for five or six bucks, and the quality will likely be better. "Most of the service bureaus will run their grayscale images at night, and maybe give you some kind of discount," says McNaul. "Still, I have to say that it's still most cost-effective if you have the time to go and do a photographic halftone."

Of course, that runs counter to one of the chief reasons users buy into desktop publishing—control over their documents. "There's no question if I were an in-house producer of documentation and I wanted to get the best, sharpest look on my photograph and if I wanted to spend the least amount of money, I'd just take my continuous tone photo over to my printer and halftone it," says John Kozlowski, director of marketing communications for Microtek Lab.

Scanning and Document Control

"But I think the people who buy scanners—and, an even bigger picture, the people who buy into desktop publishing—do so primarily because they want control over the production of their whole documents. For those people, money is not the biggest issue. I think most people can be happy with what comes out of a Linotronic machine. If they're the kind of people who have

more interest in maintaining control over the whole publication, grayscale definitely supports that."

DEST Corp.'s Larry Orr, vice president-marketing, agrees that control is a major motivator in grayscale use, and notes that laser printer vs. imagesetter use is rarely an either/or issue. "Grayscale scanning lets you use the same input and page composition for prepress and higher-quality output. When you see statistics on output between laser printers and Linotronics and so forth, the vast majority are laser printers. What that doesn't really reflect is that sometimes you want to do a number of different jobs on the same scanner, and you don't want to buy a separate scanner for the cases where you want to take your output to a service bureau."

Typically, Orr continues, users of high-resolution service bureau output proof their pages on laser printers. Even if their laser printers can't produce decent halftones, the ability to use the same grayscale scanner for both proofing and final output makes sense.

Halftones from 300 dpi Printers

Within the last few months, several laser printer enhancements have come on the market that vastly improve halftone output, and most scanner makers agree they are the first of many similar products that will be marketed this year. Microtek is selling a \$2,995 product called the GLZ, which bolts onto the bottom of Canon-based printers (most significantly, Hewlett-Packard LaserJets) and controls dot size to create true halftones. The GLZ produces 150 lpi halftones with 64 shades of gray, 75 lpi halftones at 128 shades of gray.

Intel offers a product called Visual Edge that works with LaserJet IIs to produce screens as fine as 70 lpi at 64 levels of gray. The Intel product is a controller card that resides in a PC slot, and goes for \$695 (although most LaserJet users will have to add memory to use the product—see *PC Publishing*, January, p. 9).

Although the products work on slightly different principles—the Microtek product controls dot size; the Intel product increases horizontal printer resolution and clumps pixels together—both products in effect produce dots of different sizes to create a true halftone effect. Both products send grayscale data through the add-on controller, type via conventional routes—which lets users integrate type and halftones in desktop publishing programs which can handle grayscale information.

"From a scanner vendor's standpoint, I think products such as these are very strategic," says Kozlowski. "This really completes the cycle, and it gives people a valid reason for buying these high-end grayscale scanners because now they can really use them to their full capability."

Grayscale Scanners

Mfr./Model	Levels of Gray	Sheetfed/Flatbed	DPI	File Compression	File Formats Supported	Price	Circle No.
Hewlett-Packard							
HP9190A (ScanJet)	16	Flatbed	300	Y	.PCX, TIFF, .MSP, .IMG	\$2,090	112
HP9195A (ScanJet Plus)	256	Flatbed	300	Y	.PCX, TIFF, .MSP, .IMG, .EPS	\$2,190	113
Intelligent Optics Corp.							
Model 200	256	Flatbed	300	Y	.PCX, TIFF	\$3,395	114
Kurzweil Computer Products, Inc.							
K5000	64	Flatbed	600	Y	Varies	\$15,950	115
Laser Connection							
IS-300	32	Sheetfed	300	Y	TIFF, .EPS	\$1,295	116
Logitech International							
ScanMan PC	32	Hand Held	400	Y	.PCX, TIFF	\$339	117
ScanMan PS/2	32	Hand Held	400	Y	.PCX, TIFF	\$399	118
Microtek Lab., Inc.							
MSF-400G	256	Flatbed	400	Y	.PCX, TIFF, Others	\$3,995	119
MSF-300G	256	Flatbed	300	Y	.PCX, TIFF, Others	\$3,495	120
MSF-300Q	64	Flatbed	300	Y	.PCX, TIFF, Others	\$2,295	121
Pentax Technologies Corp.							
SB-A4301	16	Flatbed	300	Y	.PCX, TIFF, .IMG	\$2,195	122
Ricoh Corp.							
RS 312	64	Flatbed	300	Y	Varies	*\$2,000	123
Shape, Inc.							
Shape Scan SS 300 Plus	16	Flatbed	300	Y	.PCX	\$795	124
Taxan U.S.A. Corp.							
Crystal Scan Model 300I	64	Sheetfed	300	Y	.PCX, TIFF, .MSP, .IMG	\$1,695	125

*In \$2,000 range

Scanners and OCR

Strictly speaking, OCR (optical character recognition) isn't a grayscale issue. But it's very much a scanner issue, and scanner makers point to recent technical developments in OCR as yet another addition to the growing arsenal of scanner applications.

OCR software for scanners has been around a long time, but much of what's been available has been only marginally accurate and most users of the low-end products have been unhappy with the results. What's got scanner makers excited now is the availability of a new group of products that bring the capabilities of OCR systems once priced well in the five-figure range down to PC levels. Among the most-cited products in this area are Caere's OmniPage and Calera's TrueScan, both \$2,495 products that use sophisticated software/hardware combinations to yield high accuracy rates (see *PC Publishing*, December, p. 10).

"This new technology, with its ability to read multicolumn and typeset text, opens up OCR to a whole new set of users," says Hewlett-Packard's Gary Kaiser. "There's still a ways to go in OCR technology, but this is a big step because it opens up a whole new set of documents that can be used to input information."

"People have always asked, 'Can I take a book or a magazine, lay it down on my scanner, and bring it into my PC?' The answer in the past has almost always been 'no' for desktop scanners because the software hasn't been sophisticated enough," says Microtek's John Kozlowski. The new generation of OCR products does give users that flexibility, he adds, and "It's going to be a boon to scanner vendors. Combine it with grayscale image capturing and editing and printing, and it just makes the scanner all that much more functional."

"I think it's going to open a market area we've barely penetrated," agrees Xerox's Jim McNaull. "You don't need a high grayscale scanner right now to use OCR, but it's entirely possible that in the future, these software algorithms will begin to use grayscale information to improve their accuracy."

Before, they bought them more or less like the guy who buys a Ferrari to drive around town. He's got all that power and speed, but he never gets a chance to use it."

Xerox's McNaull agrees that products such as Intel's will help promote grayscale scanner use. "This is another reason why it's important for people who are buying scanners to make sure they get at least a 6-bit scanner. You have to have that amount of grayscale information to make use of these products."

Despite its high cost relative to conventional halftoning, and ignoring for a moment the control issue, imagesetter output could make good economic sense in combination with electronic darkroom software. Conventional photo editing is a costly affair; outlines, drop-outs, air brushing and so forth require skilled labor and take time. Even if the final halftone is cheap to make, the processes leading up to it aren't. If the editing could be done in the computer, the extra cost of imagesetter output would be small in comparison.

Apple Macintosh users have been able to do

darkroom work on their computers for some time now, with products such as Image Studio and Digital Darkroom. Similar products are just beginning to emerge on the PC side.

The grand-daddy of grayscale editing software on the PC is probably Aldus' SnapShot. The product gives considerable control over grayscale images, but so far works effectively only with images collected on a video camera or stored on videotape, and won't work with scanners.

Two newer products, both only months old (at least in this country) are Picture Publisher, from a New Hampshire company called Astral Development, and Picasso, a product marketed by Monitem and originally developed by an outfit called PIXIE Intelligent Computer Systems in Charlottenlund, Denmark. Interestingly, Microtek's GLZ product is manufactured by the company, but was also developed by PIXIE, and Microtek markets Picture Publisher under an OEM deal with Astral.

"You're going to see a lot of grayscale editing capability on the PC side this year," says Xerox's McNaull. "It's not as easy to do and display as it is in the Mac world. The Mac is just a graphics-oriented machine. But by the end of '89, I think you're going to see a lot of grayscale editing software."

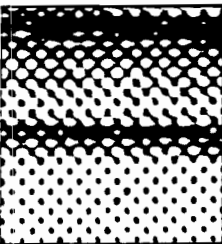
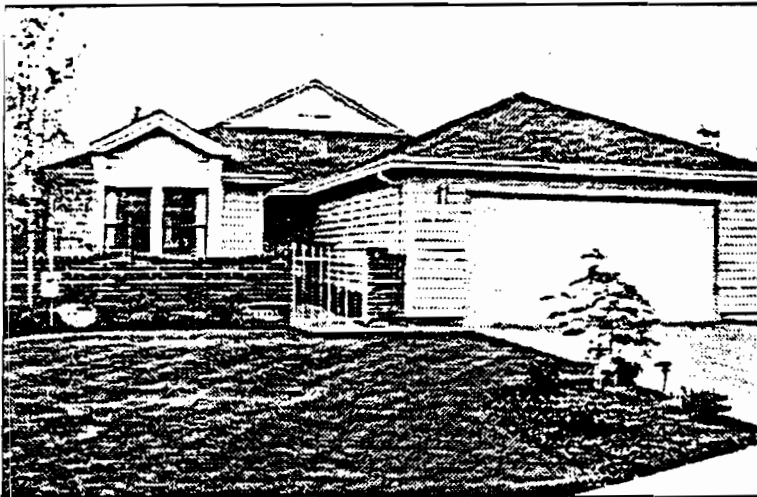
More Graphics Packages Going Grayscale

McNaull sees more of the binary image-editing packages moving into grayscale this year as well, much as Z-Soft's Publisher's Paintbrush and IBM's Image Edit already have done. "We're also building more grayscale processing capability into our scanners," he adds. "Our 730GS, for example, does the normal brightness and contrast control, but it also allows you to run some different gamma curves and do some convolution processing for edge enhancement.

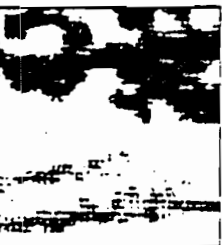
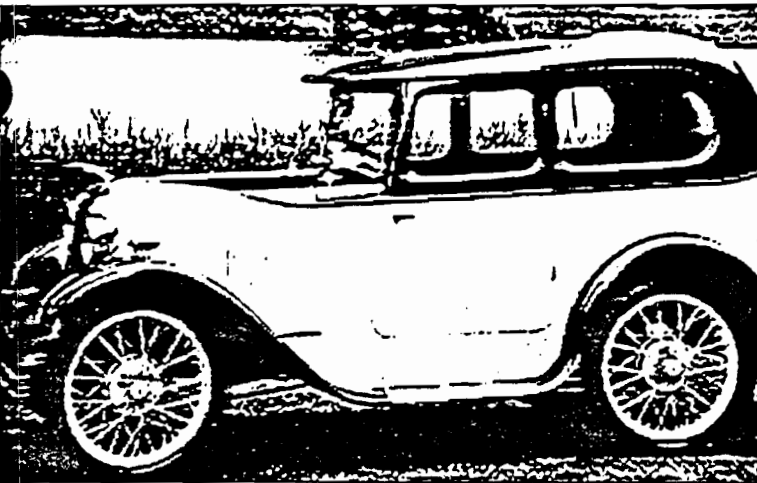
"The other trend is towards building more processing capability into the scanner software. Our Macintosh software has a tremendous amount of processing capability in it. We'll port that over to the PC as we see a higher population of 386 machines showing up."

DEST's Orr sees a similar trend, and adds, "What the market needs is a fairly easy-to-use and reasonably complete and cost-effective package, as opposed to something with a lot of exotic features." Such products have become available on the Mac side first because there's still the perception that the Mac is the machine of choice among graphic artists. "I think now that interest is at a turning point on the PC side. It won't be long before you see products like Image Studio on the PC side."

"The exciting thing that's happened just in the last few months is the ability to complete the cycle with grayscale in, grayscale editing and grayscale output on the laser printer," says



Intel's Visual Edge system produced halftone effects on 300 dpi printers by clustering printer dots together to produce halftone dots of different sizes. The photo above was printed at 70 lpi, 64 levels of gray on an HP LaserJet II with Visual Edge. The 500 percent enlarged view on the left illustrates the dot pattern produced by the product.



The Microtek GLZ bolts onto the bottom of Canon-based laser printers and works by controlling printer dot size to create true halftones. The photo above was printed at 150 lpi and 64 levels of gray on an HP LaserJet II using the GLZ. The 500 percent enlarged view on the left shows dot patterns.



Left: Enlarged view (500 percent) of Linotronic 100 (1270 dpi) output at 150 lpi and 256 levels of gray. Note that the higher-resolution device produces a much finer halftone pattern without loss of gray information.

Microtek's Kozlowski. "Each component makes the other two that much more valuable. When you put them all together as a system, they're geometrically more valuable."

Perhaps in anticipation of greater grayscale use, prices for multibit scanners are dropping dramatically. The 4-bit scanners that were the grayscale standard a year ago are gradually being replaced, at least on resellers shelves, by 6- and 8-bit scanners, and the issue now is which will become the industry standard.

6-Bit or 8-Bit Standard?

Hewlett-Packard, by most accounts the industry leader in terms of market share, leapfrogged the 6-bit machines last month when it announced an 8-bit, the ScanJet Plus, priced at \$2,190 with interface board. That's roughly \$1,300 less than the average for 8-bit scanners a year ago, and HP's Kaiser argues that at prices like that, 8-bit grayscale will become the standard. "The human eye can only detect a certain number of levels of gray. Eight bits covers those numbers. There's no reason to go any higher than that, and if you go lower, you're just trading that capability off," he says.

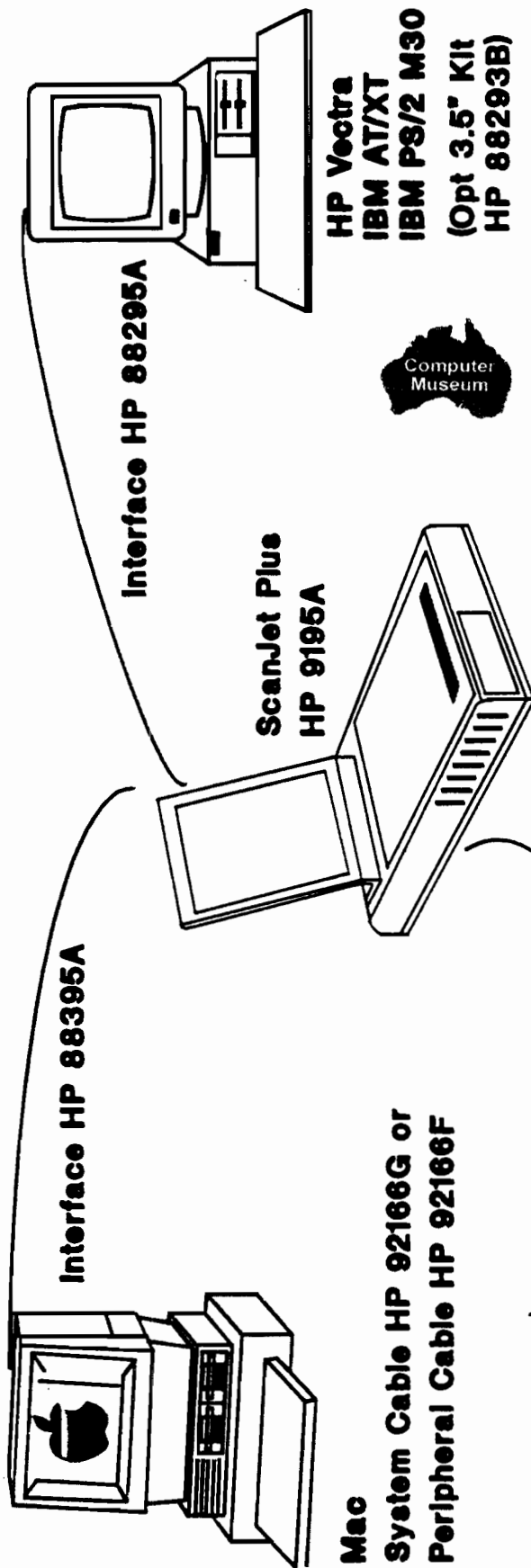
Ricoh has introduced its first grayscale scanner with 6-bit capability, and Xerox is also behind a 6-bit standard. "A lot of people are going to 256 levels of gray, but in desktop publishing applications, that's essentially overkill," comments Ricoh's Robins. Xerox's McNaul uses the same word, overkill, to describe 8-bit machines linked to 300 dpi output devices, still the standard. "If you're going to an imagesetter and scaling up in resolution using PostScript or a software package, eight bits will buy you something. It helps in the scaling process and you can display more levels of gray in your halftones.

"But when you move to six bits from four or eight bits from six, you pay a penalty in your system," McNaul continues. "You're moving more data around. Your files become larger for storage. Your files for manipulation are larger. So it kind of forces you into at least a fast 286 machine or, better, a 386. And you'd better have a big disk."

Whatever the standard of the future, most scanner makers agree that the 4-bit desktop scanner, if not dead, isn't looking at all well. McNaul says they'll still be available, but the price differential between 4-bit and 6-bit machines is shrinking and savings on a 4-bit scanner aren't very great. HP's Kaiser notes that most people "won't be satisfied if they go with a 4-bit scanner. The only application I can see that would not require more levels of gray is OCR. What we've seen is that people who by scanners just for OCR is that a few months down the road, they see they can do different things with images and they realize it was a mistake to not go with a scanner with fuller capabilities." ─

ORDERING INFORMATION

ScanJet Plus - Complete Connectivity



Accessories

- HP 88195A - Automatic Document Feeder
- HP 88402A - TrueScan Model S

HP ScanJet Plus Ordering Information

Product	Product Number	U.S. List Price
ScanJet Plus Desktop Scanner	HP 9195A	\$ 1595
Automatic Document Feeder	HP 88195A	595
TrueScan OCR package for the PC	HP 88402A	2745

Interface Kits*	Product Number	U.S. List Price
IBM XT/AT, HP Vectra, and Compatibles	HP 88295A	\$595
IBM PS/2 Model 30 3.5" Software Kit (order with HP 88295A)	HP 88293B	68
IBM PS/2 Model 50, 60, 70, 80	HP 88495A	595
Macintosh Plus, SE, II	HP 88395A	595

*Kits include interface board or converter, interface cable, software, cable terminator and manuals.

Additional Cabling for Macintosh	Product Number	U.S. List Price
SCSI System Cable	HP 92166F	60
or		
SCSI Peripheral Cable	HP 92166G	60

ScanJet Plus Sales Tools and Literature



Literature included here:

"HP ScanJet Plus Desktop Scanner" ^{Prod Brief} ~~Data Sheet - 5959-2446~~ 5952-2976

"HP ScanJet Plus Software Guide" - 5959-2441

"HP ScanJet Plus Setup Guide" (IBM PC) - ~~5959-2442~~ 5952-2981

~~"HP ScanJet Plus Setup Guide" (Vectra) - 5959-2450~~

"HP ScanJet Plus Setup Guide" (IBM PS/2) - ~~5959-2444~~ 5952-2982

"HP ScanJet Plus Setup Guide" (MAC) - ~~5959-2443~~ 5952-2983

"HP ScanJet Plus Application Note" - 250-003

Calera TrueScan Data Sheet - 5959-7868

AccuScan Prod. Brief 5952-2977

Sales Guide 5952-2975

Sales Kit 5952-2974

OCR Primer 5952-2980

HP ScanJet Plus HP 9195A Image/OCR Desktop Scanner

Technical Data

**Desktop scanner for
graphics and text**

Features

- Captures high quality images
- Easy to use
- Automated entry of text
- Macintosh™ compatibility
- IBM™ compatibility

The Hewlett-Packard ScanJet Plus scanner advances the standards of excellence by providing easy capture of high quality images and automated entry of text at a breakthrough price. The ScanJet Plus scanner provides an easy way to include photos, text, line art, and graphics from a variety of sources.

Captures High Quality Images

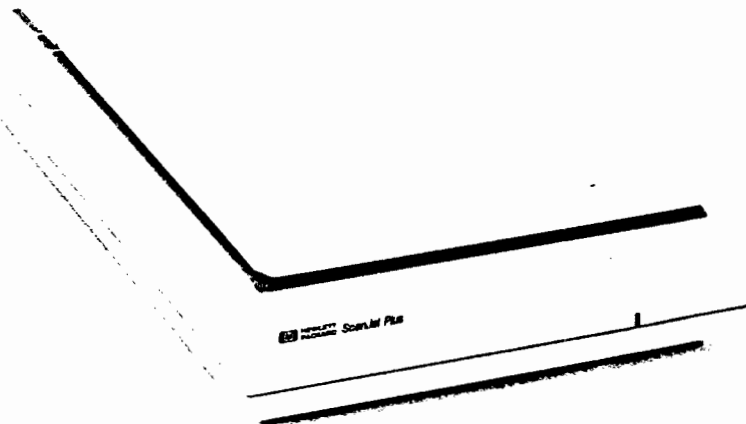
The ScanJet Plus 8-bit grayscale high resolution scanner reads 256 levels of gray and has a wide range of contrast/intensity controls in grayscale, dithered, and line art modes.

Easy to Use

Intuitive operation for PC systems allows interactive scaling and launchable OCR. The Macintosh desk accessory solution includes Live Preview/Zoom features and DeskPaint for image editing. Both solutions provide on-line HELP.

Automated Entry of Text

Optical character recognition (OCR) software and the HP ScanJet Plus scanner allow typed text to be entered into the computer without retyping, saving valuable time. OCR solutions are available from various software vendors providing the ability to read a wide range of text including typeset text.



Product Certifications

9195A: UL 478: Electronic Data Processing Equipment (EMRT) Fifth Ed.; UL 114: Office Appliances and Business Equipment (QAOT); CSA C22.2 #220: Data Processing Equipment; FCC: Class B Part 15 for computing equipment

9195AB: IEC 380 and 435; VDE: FTX 1046/84 (VDE Level B).

Questions concerning regulatory agency compliance should be directed to the local Hewlett-Packard Sales and Service Office.

Interface and Cable Requirements

System	Interface Kit*
HP Vectra, IBM PC-XT/AT, and compatibles	HP88295A
IBM PS/2 (30)	HP88295A and HP 88293B
IBM PS/2 (50, 60, 70, 80) Mac Plus/SE/II	HP 88495A HP 88395A

Ordering Information**Standard Unit**

HP 9195A
HP ScanJet Plus desktop scanner 100/115V
HP 9195AB
HP ScanJet Plus desktop scanner 220/240V

Accessories

HP 88195A	20-sheet Automatic Document Feeder
HP 88400A	ReadRight™ OCR software
HP 88401A	ReadRight™ OCR international software (not available in USA)

*Interface kits include interface board, interface cable, software, and manuals. SCSI cable not included for Macintosh.

**HP ScanJet
Plus Scanner
High Resolution
Images**

Application Note



**Grayscale
Scanning**

Appendix A



Scanning Process

The Scanning Process



The scanning lamp illuminates a horizontal strip of a document placed on the scanner bed.



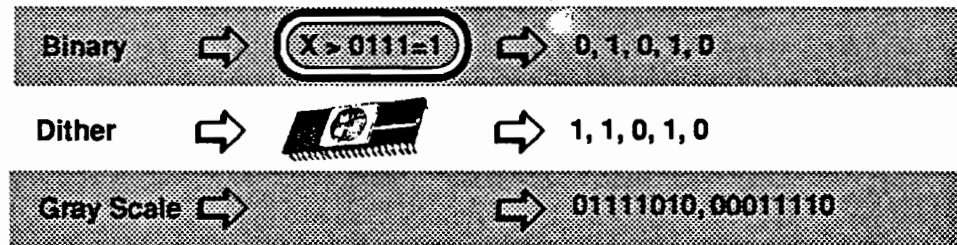
Mirrors reflect the light to the Charge Coupled Device (CCD). The CCD converts the reflected light into a series of analog voltages.



01110111
10101010
00010001
11101110
01000100

The Digital Data is sent to an electronic switch.

The analog voltages are converted to 8-bits per pixel digital data by the Analog to Digital Converter (ADC).



The switch selects one of three circuit paths to transform the data into one of three output data types.



The output data is sent to the host. This process is repeated for each scan line as the scanning lamp and CCD move down the scanner bed.

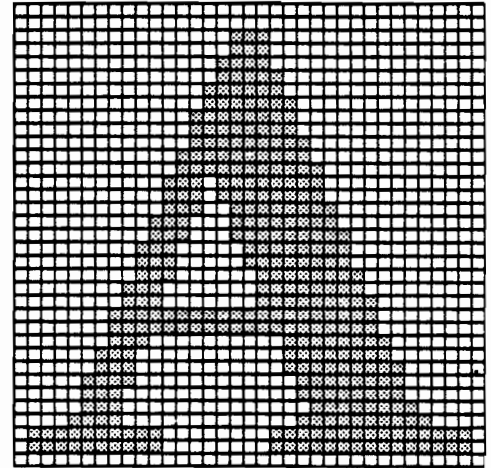
Appendix B

Matrix Matching and Feature Extraction

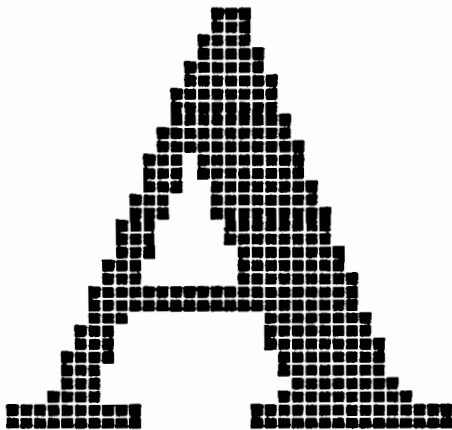
OCR -- MATRIX MATCHING



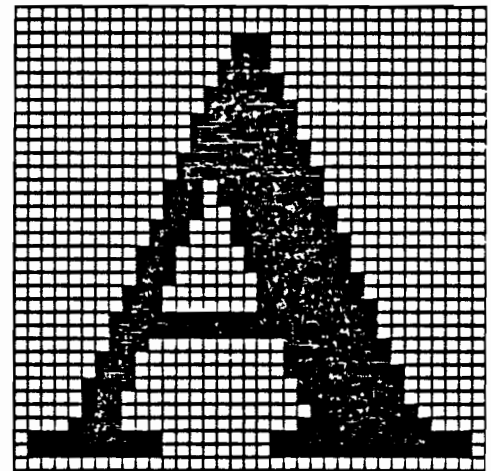
Letter "A" as it is printed on paper.



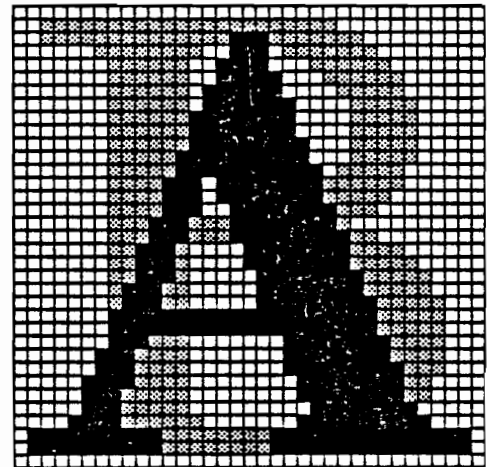
Template for the letter "A".



Scanned image of the character to be recognized.

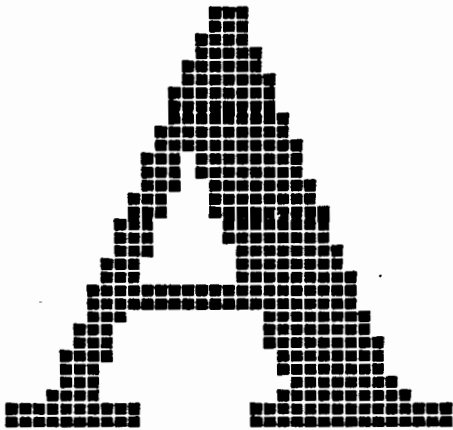


Comparison of the scanned image and the "A" template -- character recognized as "A".

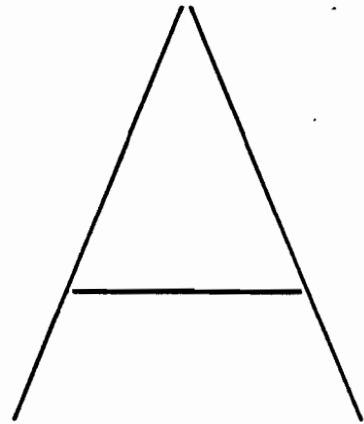


Comparison of the scanned image and the "B" template -- character not identified.

OCR -- FEATURE EXTRACTION

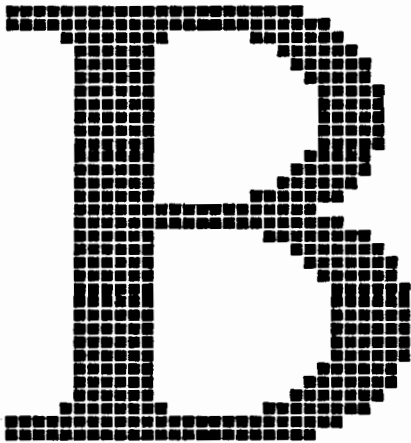


Scanned image of the character to be recognized.

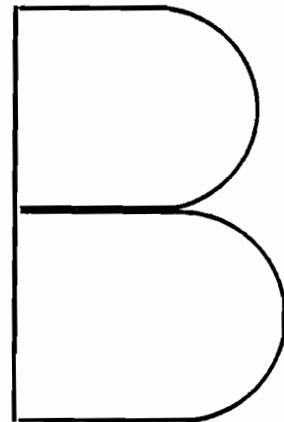


Primitive features extracted from the scanned image:

- * Positive sloping stroke on left.
- * Negative sloping stroke on right.
- * Horizontal crossbar.



Scanned image of the character to be recognized.



Primitive features extracted from the scanned image:

- * 1 curve at the top, open to the left.
- * 1 curve at the bottom, open to the left.
- * 1 vertical stroke on the left.

Appendix C

Customer Profiles

**Data collected from customer response cards
through September, 1989**

Target Customer

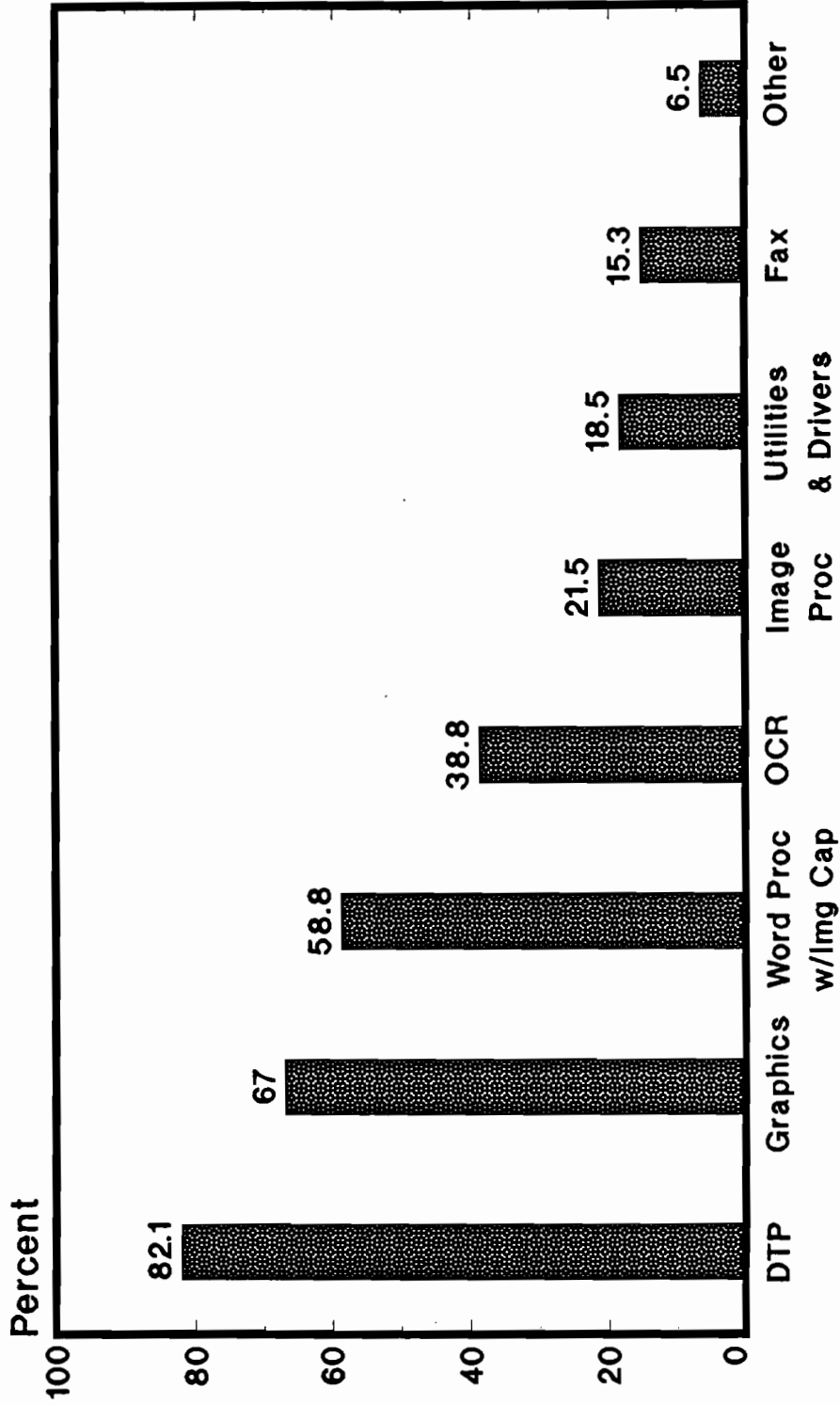
ScanJet Plus

Nov. 1988 - Sept. 1989

- 82% use DTP
- 39% use OCR
- 67% use additional graphics packages
- 59% use Word Processing software with imaging capabilities
- 15% use fax
- 42% consider themselves sophisticated users
- 69% buy ScanJet Plus as add-ons
- 68% connect ScanJet Plus with LaserJets
- 85% scan less than 15 pages per day
(47% scan less than 4 pages per day)

Source: ScanJet Plus Response Cards

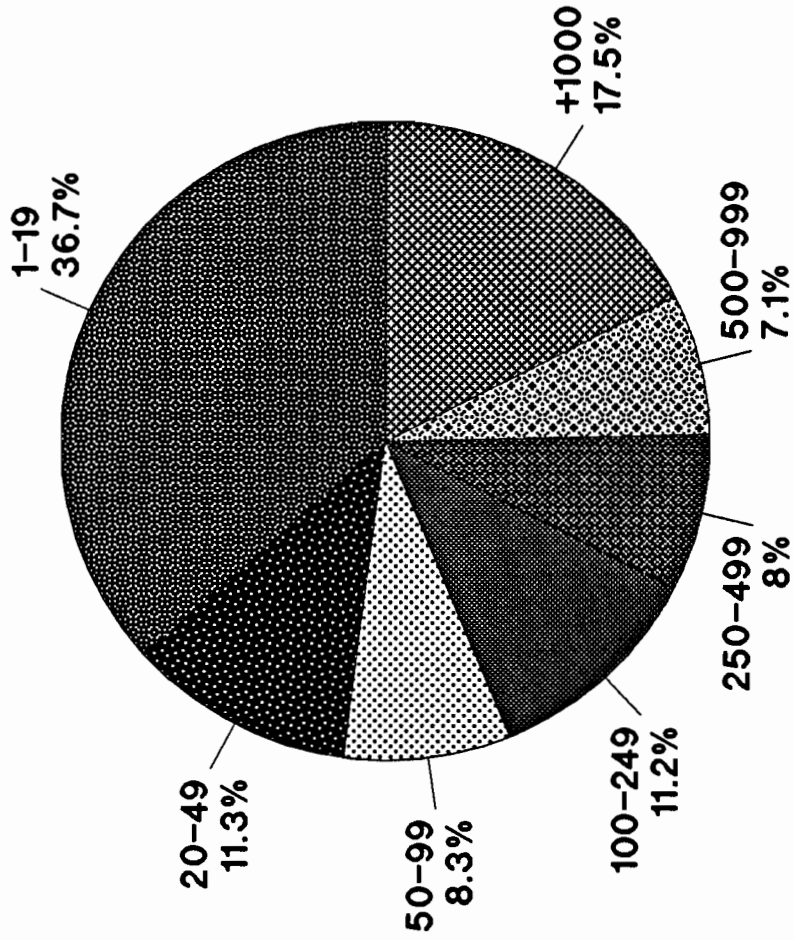
Applications Current Usage of ScanJet Plus Customers



Through September, 1989

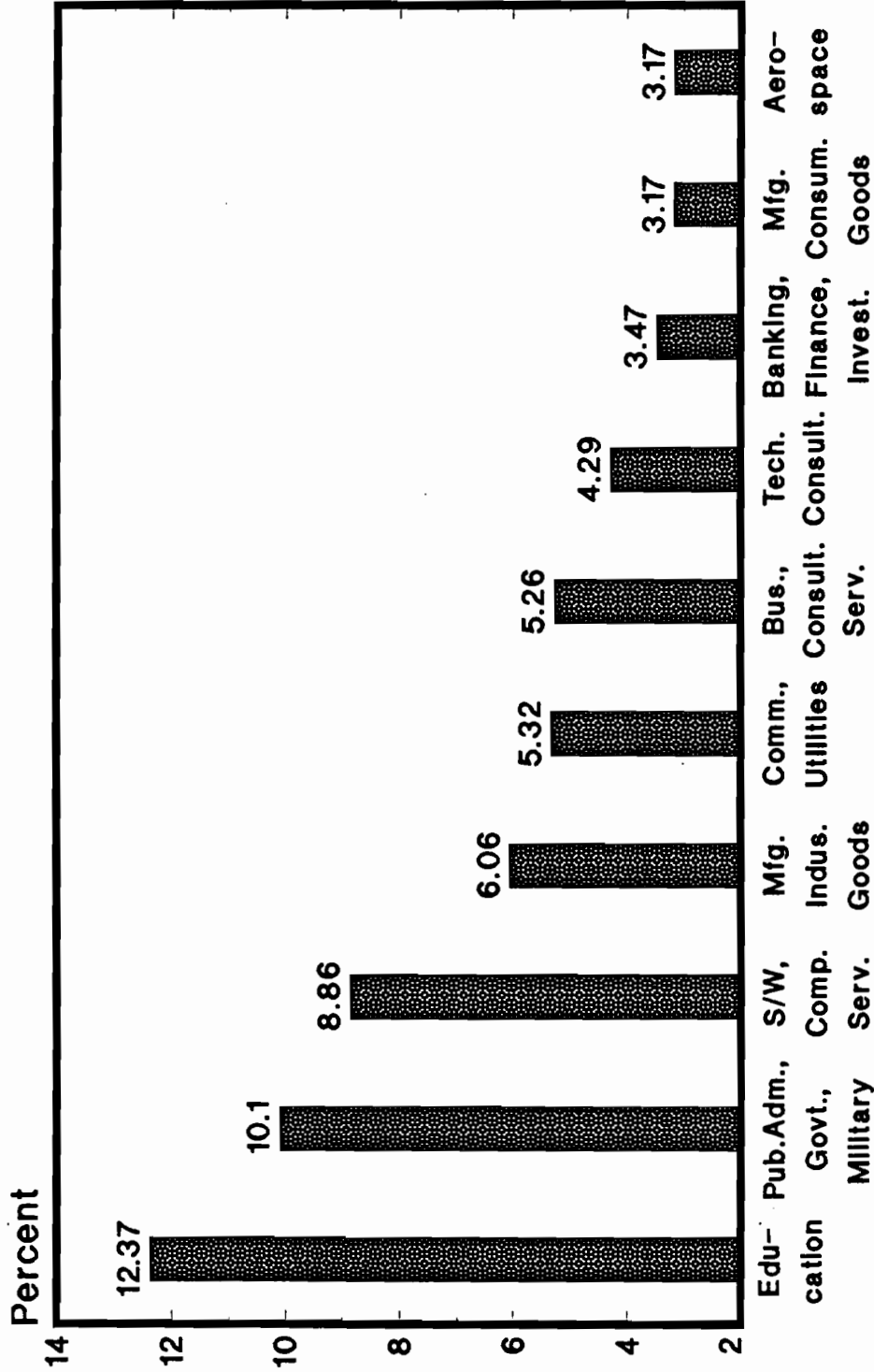
* Respondents can be using more than one type of application.

Size of Company ScanJet Plus Customers



Through September, 1989
Source: ScanJet Plus Response Cards

Top Ranking Industries ScanJet Plus Customers



Through September, 1989

* Note: Remainder of Industries less than 3% each.



Glossary of Scanning Terms

Charged Coupled Device (CCD) - A single row of up to 4,000 tightly packed photoelectric cells that serves as the scanner's "eyes". The CCD produces an electrical voltage proportional to the amount of light striking it. This voltage is converted to digital grayscale values and transmitted to the computer.

Continuous Tone Image - An image, such as a photograph, that has an unbroken, nearly infinite range of gray levels between black and white.

Contrast - An image's balance of of gray tones. A scanner with good contrast provides an even distribution of highlights, dark shadows, and midrange tones. High contrast images have white highlights, black shadows, and few mid-level grays. Low contrast images look washed out because they have too many intermediate grays. When you change the contrast, every gray in the image is affected.

Dithering - A digital technique for simulating grayscale by turning various combinations of pixels on (black) and off (white). The more pixels (dots) turned on in a specific area, the darker the simulated gray. In other words, dithering varies the *number* of dots within a given image (vs. halftoning, which alters the *size* of the dots in an image). Laser printers use dithering to simulate grayscale.

Dots Per Inch (DPI) - A generic term that describes the resolution of printers, monitors, and scanners. A dot (or pixel) is the smallest element depicted by a scanner or monitor.

Flatbed - A scanner in which the original is placed on a glass surface and the light source moves across it.

Grayscale - Another way of saying "gray". Grayscale images (such as photographs) contain true grays, rather than dithered black and white patterns, because each pixel is a shade of gray. The number of grays a scanner (or monitor) can represent depends on the number of bits of digital data that describe each pixel. A 4-bit scanner can capture 16 grays; an 8-bit scanner can record 256 grays.

Halftoning - The method used by newspapers and magazines to simulate grayscale. Halftoning varies the *size* of evenly spaced dots to represent different shades of gray, while dithering, the method used by printers and scanners to simulate gray, varies the *number* of dots in a given area.

Line Art - Drawings, text and other images that are black and white only, with no gray tones. Examples are logos, cartoons, and schematic drawings.

OCR - Optical Character Recognition. OCR is the conversion of printed words (text) into computer readable form such as ASCII.

Pixel - Picture element, the smallest area a scanner can record or a monitor can display. Also referred to as a dot.

Preview Scan - A rapid, low-resolution scan that shows the entire image on-screen; useful for selecting the area for the final scan and optimizing scanning settings.

Resolution - The maximum number of pixels that a scanner can fit into an inch. The higher the resolution, the more fine details you can see in an image. Resolution is usually expressed as dots per inch (dpi).

Scan - The process of digitizing, or converting a real-world image, such as a photograph or text, into bits of data on a computer.

Sheetfed - A scanner with a fixed light source that feeds the original through a pair of rollers.

TIFF - Tag image file format, a versatile method for storing bit-mapped images in various resolutions and numbers of grays. TIFF was created specifically for the storage of grayscale data and is considered to be the standard format for saving scanned images.