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For Teryn Nicole Busch. It took me 21 years to find another girl as sweet as your mom.
About The Author

David D. Busch has written six books devoted exclusively to scanners, including *The Complete Scanner Toolkit*, and *David Busch’s Hands-On Hand Scanner Book*. He’s been writing about scanner technology since 1974, and using them in his own desktop publishing efforts since 1985.

He was the first two-time winner of “Best Book” honors from The Computer Press Association. His 32 other books include the best-sellers *DOS Customized*, *Using DisplayWrite 4*, and *The DR DOS Customizing Toolkit*.

A former contributing editor and monthly columnist for six different computer magazines, Busch’s computer expertise is matched by his experience in photography and publishing. He has worked as a newspaper reporter-photographer, owner of a commercial photography studio, and a photo-posing instructor for a Barbizon-affiliated modeling agency. His articles on photographic techniques have appeared in magazines like *Petersen’s PhotoGraphic* and *The Professional Photographer*.

Vice-president of East Central Ohio Mensa, Busch resides in his native Ohio with his wife and their four children, aged 2 to 22.
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Preface

This new 1992 edition of The Scanner Handbook for Desktop Publishing, Macintosh Edition was written for the million computer users who have discovered that they own only half a desktop publishing system. Personal computers and software like Aldus PageMaker, QuarkXPress, Ventura Publisher, Design Studio, and Ready, Set, Go allow the average person to lay out pages that rival the output of any graphic arts house. Laser printers can generate near-typeset quality output good enough for offset printing or photocopying.

If the Macintosh itself launched the desktop publishing revolution with its what-you-see-is-what-you-get graphics, the scanner is the finishing touch. Without a scanner, you must create artwork for publications yourself and key in all the text. With a $200 hand-held scanner you have whole worlds of art and text at your fingertips.

Mac-based desktop publishing systems let you work with anything you can think of. Scanners give you access to anything you can see. Let this book be your introduction to an exciting technology—one that is changing the way we create documents forever. You'll find everything here you need to know to select and use a scanner for your own work.

That might be all you want. However, I hope this book will provide you with something more. You'll find a bit of history, some interesting background, my own questionable (but award-winning) brand of humor and a few thought-provoking ideas about the role of images in desktop publishing.
For half a millennium, technology has been the enemy of graphic information. Around 1450, Johann Gutenberg popularized the concept of movable type. Until that time, both text and illustrations in books were created by hand, either by a scribe on the page itself or by an artisan who tediously engraved a printing plate. Before Gutenberg found a way to reuse the same characters over and over, text and pictures both required roughly the same amount of effort. Illuminating a manuscript with pictures was a natural thing to do. In fact, a skillfully-drawn sketch might communicate an idea more quickly and clearly than an hour's worth of calligraphy.

Though hand-written and hand-engraved texts seamlessly blended graphic and written information, only a few people had access to the knowledge they conveyed. The printing press with movable type made it possible to mass-produce a much wider variety of books. However, Gutenberg's invention also made it much easier to include text than pictures, which still had to be laboriously carved as woodcuts and, eventually, steel engravings. Soon, a powerful bias in favor of text took hold.

Publications, such as newspapers, which could have benefited enormously from illustrations, were almost solid masses of text, even after the invention of photography in 1839. Daily deadline pressures made it impractical to include anything but artwork that already existed. Consequently, advertisements in the 1860's were better illustrated than newspaper accounts of the Civil War.

It wasn't until the mid-20th Century that technology reached the point where text and graphics could be intermingled freely. In the 1980's color images (humans don't generally see in black-and-white, after all) finally became common in some of our daily newspapers.

Of course, by that time, technology had struck another blow. Computers had become the most efficient way of collecting and distributing information—as long as it was in text form. The
Macintosh was really the first computer system that was able to display graphics in its standard configuration. And even the Mac world had to wait until March, 1987, when the Mac II was introduced, to gain high resolution color graphics. “High resolution” in the computer realm, however, still falls far short of what we would expect in any other medium.

High resolution images require sophisticated technology for managing and storing the information required to display even relatively low quality images. Most Macs still have hard disks with 40 megabytes or less of storage. That’s 20,000 pages of text, or maybe a half-dozen to a dozen 8 x 10-inch black-and-white photographs.

The Technology Gap

We are so accustomed to this gap between text and graphic technology that an entire subindustry—desktop publishing—has evolved—and flourished—without the universal ability to smoothly integrate pictures into those publications. The same people who wouldn’t think of trying to summarize the contents of a spreadsheet without a graph will create a newsletter with no artwork. That makes about as much sense as a business card without your photograph on it. That’s a particular shame when you consider the lengths the folks at Apple went to in order to make text and graphics mixtures a seamless combination with the Macintosh. The Mac’s Clipboard handles text, image information or special formats required by your application software with equal aplomb. Cutting and pasting between applications couldn’t be easier.

Macintosh users will agree that artless newsletters and photo-less business cards are especially dumb ideas, yet they comprise a majority in their respective categories. They both exist for the same reason. Because the war between technology and graphic information has been waged for so long, people assume that adding art to their publications or pictures
to their business cards is expensive or time-consuming. They may also fear that the results will be considered too slick.

These misconceptions are about to change. Scanners are beginning to tip the scales back. Technology is making it possible for us to capture and merge graphic information much more easily.

Cost is no longer much of a barrier. Hand scanners with 300 dpi resolution can be purchased at discount for $180 or less. There are 8- and 24-bit cards for the Mac II for color or gray scale display and appropriate monitors priced at $1000. Laser printers have dropped to the $1000 price point.

The only thing missing is general knowledge of what scanners can do and some tips on how to use them. Scanners are still misunderstood and misused. The intent of this book is to clear up the mystery and provide you with the solid information you need to capture and enhance art, photographs, and text.

How I Know What I Know

You may be wondering why I presume to instruct you in this arcane technology. The rationale is simple: those who can, do; those who can't, learn best from someone who couldn't—but has since caught on. The truth is, I've spent the last dozen years more or less trying to find ways to persuade an endless series of personal computer systems to work properly. In 1977, my first personal computer was furnished with a keyboard that provided two characters for every one pressed. Two-thirds of the generous 48 kilobytes of RAM in this system were separated from the microprocessor in a box called an expansion unit. The connector linking the two was, I suspect, factory-coated with a layer of oxidation designed to protect it from electricity.

In March, 1984, I tackled a new challenge. I took delivery on a 128K Macintosh that was furnished with exactly two appli-
cations: MacWrite and MacPaint. The Mac was so eagerly antici-
ipated that two publishers had approached me about doing
books for this machine even before it was introduced. So, when
the unveiling took place, there I was with money in hand.

Since that time, my big problem has always been that as
soon as I've mastered one aspect of using my Mac, another
one—hard disk drives, laser printers, or scanners—comes
along with different things to learn.

My original training and experience were heavily steeped in
photography. I've operated a commercial photographic studio,
worked as a photojournalist, and written hundreds of articles
for the major professional photo publications. I wrote about
traditional camera techniques for color separating before
scanners gained widespread use in the graphic arts. In fact,
the early million-dollar color scanners were linked to comput-
ers that helped pique my original interest in computers.

My use of desktop scanners dates back almost to the dawn
of desktop publishing—1985—when I was an early user of
Ready, Set, Go. In fact, I produced a souvenir yearbook for my
high school's 20-year reunion with a Mac 512, RSG, a
Thunderscan scanner, and an Imagewriter.

Since then, I've struggled with the same things you may be
attempting right now. I used scanners to provide templates
for publishing office forms long before there were nifty au-
totacing programs to do the same work. I've battled with
murky photographs and lived with scanners like the early
units that could take 30 minutes to produce a low resolution
image. I'll share my experiences with you in this book.

**Who Can Use This Book?**

This book is a complete guide to scanners for
Macintosh desktop publishing, so it might be easy to say,
"Everyone can use this book." However, readers will have
broad ranges of experience and expertise as well as applications as different as their job descriptions.

Therefore, this book will build a solid foundation based on fundamentals that everyone needs to know to understand scanners. Newcomers (to scanning) can learn some fairly sophisticated background which is presented in a non-technical way. More advanced readers can skim these sections or read them at leisure for a more in-depth understanding. I learned a lot in researching this book, and I have been reporting on scanners for 15 years. Everyone should find something new between these covers.

I tried to keep four basic audiences in mind when putting together this material:

- Macintosh users who are interested in purchasing a scanner, but want to know more about what this device can do for them. It may be smart to "try before you buy," but it's even smarter to "learn before you're burned." Reviews in magazines can inform you about what the reviewer did or didn't like about a specific scanner during the relatively short evaluation period. This book will provide you with criteria you can apply to any scanner, as well as tips I picked up during three months to a year or more of using each piece of equipment.

- Scanner owners who have read the documentation that came with their scanner, graphics software, and desktop publishing package and who are ready for more in-depth information. You need information developed by a user—someone who has had to squeeze every bit of performance out of a system and can tell you how to do the same.

- Corporate trainers who want to bring users up to speed quickly on scanner basics. Don't spend hours teaching basics. Point your class toward the specific chapters in this book that deal with the basic information they need.

- Power users looking for a comprehensive reference book of scanner lore. You're like me. You want to pick up some tricks
that will save time, let you do something unusual, or give you an edge over your colleagues.

**Do You Really Need to Know All This Stuff?**

I once attended a seminar at which two people rose from their seats during an intermission following the introductory session and walked purposefully to the speaker's lectern. Both wanted their money back. In an apologetic tone, the first explained that he had misunderstood the scope of the seminar when he signed up. It was clear from the introduction that he already understood quite thoroughly everything that was going to be covered. He felt that his time would be better spent elsewhere and politely asked for a refund.

The second man was abashed when he heard the first's request, but proceeded gamely anyway.

"I didn't understand a word you said," he admitted. "I can see I'm not going to get anything from this seminar until I've done a little homework." He got his money back, as well.

Books aren't like seminars. You don't have to sit through explanations you don't need. Chapter titles and subheads help you skim through familiar material to find information that is of use to you. I've had very few readers complain about extraneous detail as long as there was enough solid, clearly presented information to satisfy them.

In contrast, I have received letters from readers who enjoyed learning things they couldn't find elsewhere. After you finish reading this book, you may feel that you don't need to know everything that appears between these covers to use scanners. I hope you'll find it useful as reference material or background. But don't feel that you must master all the concepts presented right away. Absorb what you're comfortable with, and come back when you need to know more.
What This Book Covers—and Doesn’t

The chapter summary that follows should give you a good idea of what is covered in this book. You’ll find discussions of scanner and imaging technology, comparisons of different types of scanners, and explanations of emerging arenas like optical character recognition. Most of the information applies to any desktop publishing package. However, QuarkXPress, PageMaker, Design Studio/Ready, Set, Go are addressed separately with sections that explain how to use scanned images more efficiently.

Because the leading desktop publishing software is fairly stable, changing only slightly from year to year, the advice in this book should remain current for some time. That’s especially true since PageMaker has just undergone a major overhaul with Release 4.0. Some key new features have been added to QuarkXPress 3.0 in the past few months, too, even though it already had a significant lead in some areas (such as color separation capabilities). At this writing, it remains to be seen whether Design Studio will replace RSG, or will continue to serve as an upgrade for those with more powerful Macs.

Timeliness An Issue

However, the timeliness issue becomes a little stickier when it comes to other software packages and especially hardware. Some of the software I describe in this book has had several revisions just during the last few months, and some exciting new scanner models introduced since I started this book.

I didn’t let the rapid pace of technology deter me. I’ve touched on a broad spectrum of hardware and software products. Before undertaking this book, I had already accumulated quite a bit of experience with the key tools you are likely to use yourself. I was already a QuarkXPress, PageMaker, Ventura Publisher and Ready, Set, Go veteran. I know that’s hard to believe, but I used QuarkXPress because of its advanced features, PageMaker and Ventura Publisher because they
were also available on the IBM PC, and Ready, Set, Go because I began using it first. I also used one of several scanners I own daily. However, when the leading vendors got wind of this project, I was deluged with evaluation samples from most of the industry leaders as well as a few up-and-comers I hadn't heard of. Unlike my colleagues at the monthly magazines, I had the luxury of spending months working with the components I liked best. I got a real in-depth look at the equipment discussed in this book.

Even so, this book is not meant to be a comprehensive review of all the scanners, image manipulation packages, OCR systems, and other tools of use to desktop publishers. For the latest information, I suggest you leaf through your back issues of MacUser or InfoWorld. Those publications are the best at critiquing all the products in a particular category. For a technology as fast-moving as scanners, a set of reviews even six months old may be sadly out-of-date.

A Look At Some Useful Products

Instead, this book will look at a number of useful products, even though everything can't be covered. These will be products that I liked. If the descriptions appeal to you, keep in mind that software and hardware vendors upgrade and improve their offerings all the time. If the version I used has been supplanted by a newer one, it should simply be better. Perhaps some of the shortcomings I note will have been side-stepped.

For example, I loved OmniPage. You should find it just as delightful in whatever version is currently available. The latest Hewlett-Packard and Microtek scanners available to me were the best things to hit scanning since I began using them. So, the ScanJet Ne Plus Ultra or Microtek MFS-900Z Super or whatever is on the market now should be equally competitive.

You won't find everything there is to know about the printing process, either. I had decided that long before I undertook Chapter 13 and grappled with explaining the process of color
separating to an audience that may not have been exposed to the concept before. Entire books have been written about halftoning, image processing, and making color separations. To be honest, the technology war over imaging is far from over in the computer realm.

**Macs Have Head Start**

Luckily, Macintosh owners have a head start over users of most other computer systems, particularly IBM PCs and compatibles. Although color came late to the Mac world, we're way ahead of IBM in terms of sophisticated color displays, color image capture hardware, and color manipulation software. As I write this, there simply isn't an IBM equivalent of Adobe PhotoShop (although PhotoStyler and Image-In Color come close), nor can any IBM desktop publishing software handle color separations as easily and efficiently as QuarkXPress. Again Ventura Publisher 4.0 for Windows has some add-ons that threaten to change this in the near future.

For that reason, I will try to do justice to the topics of halftoning, color separation, and video in this book. Just be forewarned that each of these deserves a lot more coverage than we have room for in this book. I did just that in a followup to this book, titled *The Complete Scanner Toolkit*.

**High End Is Still High**

Also keep in mind that as sophisticated as Mac technology is, high end equipment and high end skills are required to do a truly professional job for ambitious projects. The state of the art is probably too ambitious for 99 percent of the readers of this book. It all depends on where you're coming from. A graphic arts shop with a million-dollar scanner/color electronic pre-press system (CEPS) will look at a $40,000 Macintosh Quadra/slide-scanner/color PostScript printer configuration and be amazed at what can be done for the price. A photographer who may spend a few thousand dollars outfitting a darkroom will be aghast at the expenditure required to do what may seem like similar work.
If you have the tools and experience, you can make pretty good halftones from scanned photographs, do some image processing with a Macintosh, and actually make decent color separations. In fact, there are nationally distributed magazines which use equipment fairly comparable to your own for much of their layout, design and production.

You'll learn about halftones here. I'll also address using color—primarily for simple spot (accent) color, but also for simple three- and four-color work. You can use this introduction as a foundation for building the more comprehensive knowledge you need. The Scanner Toolkit can take you a step or two further. I wish you luck.

Why Three Books On Scanners?

Actually, I've managed to find more than 1200 pages worth of essential scanner information to write about. If you enjoy this book, you will find some additional information in one of my other scanner books. In brief, they are:

David Busch's Hands-On Hand Scanner Book

This book was written for the 800,000 new hand scanner owners expected by 1993. It tells you how to overcome the largely imaginary limitations of hand scanners. You'll learn how to scan in color using a gray scale hand scanner, a simple way to scan color slides, and the advantages of using a hand scanner for OCR. There is even a section on a new phenomenon: portable hand scanning with a laptop computer.

The Complete Scanner Toolkit, Macintosh Edition

This book-disk package focuses on applications for scanners, such as color separating, OCR, and desktop publishing. The included disk includes a demonstration version of Studio/11.0, a monochrome painting/animation program; QuickGIF, a GIF file viewer/converter, PCXtc, a program that lets you view IBM PCX files on a Mac, and GrayView, a sophisticated gray-scale editing program. You'll also learn how to get the
most from your memory and other hardware, and discover what scanner vendors don’t tell you about installing their equipment.

The Complete Scanner Handbook for Desktop Publishing

A description of the contents of this book is provided below:

Chapter Summary

Chapter 1: Scanners and Desktop Publishing
This chapter quickly traces the history of scanners and explains some of the technology that has reduced the cost of these devices from $40,000 to less than $400 in a decade. You’ll learn why scanners will be essential tools in desktop publishing in the future.

Chapter 2: How a Scanner Works
Understanding some of the technology behind scanners can help readers by-pass their limitations and get the most from these devices. This chapter will is an in-depth, clear, non-technical discussion of scanner technology. It provides explanations of bit maps, types of scanners, resolution, and interfaces.

Chapter 3: Selecting a Scanner
This chapter covers the various scanner types in more depth. Do you need a hand-held scanner or a desktop unit? What are the limitations of each? How do you protect your system from obsolescence? The information in this chapter will enable you to select the right scanner for your application, regardless of what new systems are introduced in the future.

Chapter 4: Hardware Considerations
The computer system you have can affect how easy-to-use or functional your scanner will be. This chapter discusses each of the major components of a typical computer configuration and explains how they affect scanner operation. A typical minimal hardware system and deluxe system will be described, along with some ballpark cost estimates.
Chapter 5: Images, Images, Images

You, as a desktop publisher, know the differences between line art and photographs. Are gray scales and dithering foreign terms to you? This chapter will clear up the confusion and provide a solid grounding in these important basics. You'll learn about the major file formats and how they can be interchanged among various software programs.

Chapter 6: Understanding Gray Scales

This chapter explores the expanding world of gray scale imaging. Some scanners today allow capturing only 16 or 64 different values of continuous tone images. In the future, 8-bit images (256 different gray tones) will be standard. Chapter 6 explains the complex topic of gray scales in simple terms and shows how scanners can be used for capturing photographs.

Chapter 7: Image Editing and Manipulation

This chapter describes the various options for manipulating images using graphics software. It explains the various types of file formats and the advantages of each. Emphasis is placed on using images for later incorporation into PageMaker, QuarkXPress, Design Studio or Ready, Set, Go documents.

Chapter 8: Using Images in QuarkXPress, Design Studio and Ready, Set, Go

Most of the information in this book applies equally to publications created with Aldus PageMaker, QuarkXPress, Letraset's Design Studio or Ready, Set, Go. This chapter explores some tips and techniques of particular interest to Quark and Design Studio/Ready, Set, Go users.

Chapter 9: Using Images in PageMaker

Like Chapter 8, this chapter explains how to import, size, and manipulate images with a specific desktop publishing package (in this case, PageMaker). Tips and shortcuts are also provided for both PageMaker 4.0 and 3.02.
Chapter 10: Scanner Tricks and Tips

This chapter discusses some special tricks for getting high quality images from your scanner.

Chapter 11: Using OCR Software and Hardware

This chapter explains the pros and cons of OCR software and hardware options. The two major types of OCR systems are explained, and a comparison of software-only and hardware/software solutions is made. I pass along tips gained from my own sometimes-frustrating efforts to get an efficient OCR system working.

Chapter 12: Printing

Almost all scanning is oriented toward eventual printed output. This chapter discusses hardcopy options, including laser printers and imagesetters and tells you why image quality depends on more than the dots-per-inch resolution of your output device. It answers the question “When are laser printers good enough?” and discusses printing halftones, printing color separations with Quark and PageMaker, and new options, including low cost PostScript interpreters for non-PostScript printers.

Chapter 13: Color Scanning

There are already fully-featured color scanners at the $4000 price level. Several models are priced at $1000 or less. This chapter explores the uses of color scanners—even for those who need output in black-and-white only. The use of spot color with QuarkXPress and PageMaker is discussed in depth.

Chapter 14: Video Capture

Video capture boards provide a special option for scanner users. While not boasting the same resolution as traditional scanners, video digitizers enable you to capture three-dimensional objects quickly. You can even convert images from existing videotapes and use them in your desktop publications.
Chapter 15: Uses for Scanners

Even within desktop publishing there are dozens of applications for scanners that you might not have thought of. New uses are explored in this chapter. For example, did you know you can scan in fonts from printed material and then use the images as a basis for creating your own display and text fonts?

A scanner can also be used as an input device for an information storage and retrieval system, as half of a fax system (you can send documents to people who don't even have fax machines) or to recreate forms quickly.

Chapter 16: The Future of Scanners

Twenty years ago, early laser scanners, used in graphics arts applications, cost a million dollars. What can we expect in the next 20 years? This chapter sets the stage for even more useful scanner applications in the future and tells about the technology that will make these innovations possible.

Appendix A: Scanner Capsules

This Appendix provides capsule descriptions of some of the leading scanners on the market today.

Appendix B: Paint and Draw Software

Brief discussions of the most popular image editing software for bit-mapped and object-oriented files.

Appendix C: Continuous Tone Software

Descriptions of some of the latest packages for manipulating gray scale and color images.

Appendix D: Glossary

Definitions of key terms used in this book, as well as other words you're likely to encounter in your desktop publishing ventures.

Appendix E: Manufacturers' Addresses

A listing of vendor addresses for products discussed in this book, as well as other products related to scanners, image editing, printing, and desktop publishing.
Scanners and Desktop Publishing

Truman Capote once dismissed the efforts of a lesser author by observing, "That's not writing—that's typing." Something similar could be said about using Quark, RSG, or PageMaker without images. That's not desktop publishing—that's formatting.

Scanners enable us to capture and manipulate the images we need for desktop publications. Fancy fonts and multicolumn designs alone can't transform text into an effective communications tool. Imaginative layouts simply make publications interesting and information more accessible. Images, on the other hand, provide new information that often can't be conveyed with words alone.

Although we speak in words, humans instinctively rely on images to communicate. Our roadsides are dotted with universally understood picture-symbols. Mathematicians and physicists like Stephen Hawking who work entirely with numbers nevertheless use visually-oriented terms like strings and black holes to describe their discoveries.

The scanner gives a computer eyes, just as RAM serves as its memory and the microprocessor its brain. Like most computer counterparts of the human body, scanners are a triumph of technology's quest to get machines to do things that humans do, but in a completely different manner.
Humans don’t generally do anything the same way computers do. It’s easy to see why computer power must double or triple every few years simply to keep pace with new applications. It takes quite a bit of brute force to coerce a machine to do something the exact opposite way people do, only much faster.

We multiply 11 times 11 by pulling the number out of a table we memorized sometime before sixth grade. Your Macintosh might add 11 to a register 11 times in succession to produce the total. If you ask it what 11 times 11 is a second later, it will perform the operations all over again. It won’t remember what the total was, unless you tell it to file the answer away somewhere. The ironic part is that even with its clumsy way of “thinking,” the Mac can still come up with the answer before you do.

**Humans Use Intuition**

Humans use some unknown intuitive process to learn and play chess; computers examine all possible moves—even stupid ones—to see what might happen. People capture images as a whole through millions of receptors built into their eyes. Computers scan—looking at one tiny piece of the image at a time, dot-by-dot, line-by-line.

Scanners aren’t as new a phenomenon as you might think. Scanning was first proposed in 1850 as a method of transmitting photographs over telegraph lines. In 1863, a Catholic priest named Caselli achieved the first facsimile transmission when an image was sent between Paris and LeHavre, France. It might be said, then, that the telephone was invented 13 years later so we’d have a way to call somebody up and see if our fax arrived okay.

Another scanning system was developed in 1884 as a precursor to television. Then, work by a German physicist in the early part of the 20th Century led to wire photos, introduced to the United States in 1925. The first scanner used to produce color separations for graphic arts applications was developed in 1937.
So why have scanners taken so long to come to the personal computer? In truth, computers can do one thing really, really well—add numbers. To handle visual information, a computer must first translate it into numbers—a lot of numbers. An 8 x 10-inch color photograph, for example, represents a minimum of 173 million 1’s and 0’s—almost 22 megabytes of binary information.

And that's only if the image is scanned at a resolution that humans will find difficult to differentiate from the original photograph; the actual image has a great deal more information available. Integrating images into computer systems has always required compromises, usually involving sacrificing some of the image information.

**Scanners Clumsy, Expensive, Difficult To Use**

Scanners have been clumsy, expensive, and difficult to use because the technology needed to translate images into the computer’s terms has been clumsy, expensive, and difficult to perfect. It has only been in the past several years that Mac users have had access to low cost scanners with sufficient resolution for desktop publishing.

Now a magical revolution has begun. When laser printers like the Apple LaserWriter became available for less than $5000 (and more recently a lot less), they became a practical tool for millions. A similar situation is developing for scanners. You can now purchase for $500 a scanner that will do the job a $5000 device did half a decade ago.

**Why a Scanner?**

Surely, you don’t need a scanner to include images in your desktop publications. Programs like Adobe Illustrator, Canvas 3.0, and Aldus Freehand let you create your own illustrations, and there is the old-fashioned photographic alternative for any publication that is offset printed. That is, you can have a photograph converted to a halftone, which is a type of artwork
that can be easily reproduced by a printing press. Images that consist only of lines (line art) can be photographed, sized, and inserted (stripped in) within your pages of text.

The need for a scanner becomes even more questionable when you realize that halftones and line art mechanicals often cost as little as $5 or $6 apiece. You could include ten images in each issue of a monthly desktop publication for nearly three years for the price of a good scanner. In most cases, the quality of the images would be superior.

Cost Justifying A Scanner

You won’t be able to cost-justify a scanner, then, in purely economic terms. What a scanner does do to justify its purchase is provide unmatched speed and flexibility. If you need to add an image to your publication five minutes before you have to make the printing plate or photocopy master, a desktop scanner is the only option. You may decide that an image must be 10 percent smaller to make room for some last-minute text additions. If the deadline is close, you’ll be glad you’re working with scanned artwork.

A scanner is also essential if the image must be in electronic form for some reason. Perhaps you want to send an image of a drawing quickly to a colleague in another part of the country. A fax machine (which contains a scanner) is one option. You can also scan the artwork and telecommunicate the image by modem to your coworker. Once in electronic form, the image can be sent anywhere in the world and then reconstructed at the same resolution at which you scanned it (which is probably a lot higher than that available from most fax machines, by the way).

The ability to resize, modify, and combine images with your Macintosh on the fly gives you a capability that, for all practical purposes, does not exist with the traditional photostat/pasteup process.

You might need images in electronic form when your laser printer also functions as your printing press. Halftones and
line art mechanicals must go through a final optical photographic step to reach the offset press.

A scanner can also function effectively as a design tool. You can capture artwork, then crop and size it for use in laying out the pages of your publication. That's true whether you are doing the layout on-screen, electronically, or by more traditional paste-up means. That hard copy of a scanned image can give the designer a realistic view of the finished page even before the halftone is pasted into place.

**Areas In Which Scanners Excel**

There are many other areas in which scanners excel. Many people simply need an easy way to merge images into their documents at low cost. Perhaps you’re putting together a report for internal use within your company or preparing a newsletter. For these applications, the output of your scanner and laser printer is easily “good enough,” and may be far better than you really need. For an ad hoc report, internal document, or newsletter with a small budget, it’s unlikely that you would bother having a halftone or negative made. It’s either scanner art or nothing.

A scanner is a bridge between your documents and an enormous library of clip art. Copyright considerations aside for the moment, just about anything you see in hardcopy form can be scanned and used in your own documents. Commercial clip art books are only a starting point.

Some months back I was doing an article for a newsletter about the importance of protecting trademarks. I wanted to include a collage made up of logos of Fortune 500 corporations. A quick trip to the trash can yielded a Burger King french fry container, an AT&T phone bill, an empty Kodak film box, and assorted other items. After five minutes with my scanner, I had a half-dozen logos captured for assembly into a collage. I rotated a few of the images and added a dot-screen and ruling box, and there was my illustration.
I've scanned wonderful illustrations from a 1911 college yearbook that cost me ten cents, and turned insignia on bumperstickers into letterhead logos. The cover of a humor book I wrote last year included four satirical variations on famous images. The original was captured with my scanner, and a paint program did the rest.

Your scanner also can provide access to the lowest cost mass storage alternative of all. As you'll learn in this book, images require a great deal of magnetic storage. I found that out the hard way when I began accumulating a personal clip art library. After filling up an 80 megabyte hard disk in short order, the perfect solution occurred to me. I set aside a file drawer in my office for neat folders of the hardcopy originals. Instead of filling up a $2.50 high density floppy disk with three or four images, I keep the hard copies in a ten cent file folder. When I need one, it can be scanned again in a few seconds. Indeed, it doesn't take much longer to rescan the original than it does to locate a file on a disk, and it's a lot quicker to choose the image you want from a dozen or more hardcopy originals than it is to load each file into a publishing or viewing program.

General Uses for Scanners

There are eight basic applications for scanners that are of particular interest to desktop publishers. Some of them were mentioned in the previous section. Let's look at each of them in turn in a little more detail.

- **Capture line art for publications.** You have a piece of line art such as a logo, decorative alphabet character (to be used, say, as a drop cap), cartoon, or chart. Your publication is under too tight a deadline for traditional photographic techniques. Or, you don't have a budget, don't require the added quality possible, or wish to make some changes in the line art using a paint program. Scanning can provide you with the art you need in a few seconds.
Capture photographs for halftoning in a publication. Desktop publishers go to extraordinary lengths to include photos in their documents. If, as is common in many offices, a newsletter will be reproduced by photocopier, photographs can be taped onto the master copy and reproduced along with the text. Depending on the quality of the copy machine, this can provide barely acceptable to okay photo images.

Even the cheapest scanner will capture a photograph and translate the continuous tones of the image into a halftone-like dither pattern of a higher quality than straight photocopying. Given a little effort, you can produce fairly good to excellent halftone images with a desktop publishing system and a laser printer.

So, when time, budget constraints, or quality considerations aren't paramount, a scanner makes a good tool for capturing photographs for desktop publications.

Capture images for use as drawing templates. Very sophisticated drawing programs are available for computers today. A scanned image can be used as a template for tracing high quality art. Some drawing programs even have an autotrace feature that takes care of this step for you. Adobe's Streamline program is a sophisticated stand-alone package that does nothing more than trace scanned images very, very well. When your scanned image has been traced, you can use it as is or refine the drawing with the various tools available.

Capture low resolution images for screen display or positioning in publications. At times, super high quality isn't needed, because the image won't be used as is in the desktop publication.

For example, even if you plan to have photographs converted to halftones by traditional methods, it's useful to have a screened image available to use as "for position only" (FPO) artwork. It's easier to visualize layout and finished appearance when you have an actual image instead of a gray or black box on the screen or in your proof printouts.
Other applications call for images of a resolution just good enough to help you recognize and classify the image. Perhaps you are developing a computerized multiple listing database for a real estate firm. Certainly, the finished listings and photographs could be printed using desktop publishing techniques. However, in this case, it might make sense to keep the publication in electronic form. Potential homebuyers could look up information and view photographs of the house on the CRT screen. In such cases, superb resolution isn't essential. The homebuyers will examine the properties in person in any case. They will just view the scanned image for an idea of what a given house looks like.

- **Capture text in optical character recognition (OCR) applications.** Desktop publication editors receive text from a variety of sources. Many computer disk formats are incompatible: text may arrive on a high density 3.5-inch disk when the editor has only 800K drives. In many cases, the text may have been created by an IBM PC compatible or another completely different computer system. In a few cases, there are people who still use typewriters. One format is common to all these users—the printed page. OCR software and a good scanner can allow capturing typed or printed text in a form that your desktop publishing software can digest. As we'll see later in this book, OCR systems have gained in accuracy to the point that they are much more practical in applications like these.

- **Grab images of three-dimensional objects.** You need a picture of your CEO for a newsletter but don't have a photograph. Or, you want to include a picture of your company's latest product. Some kinds of scanners make it simple to capture images of three-dimensional objects. Seat your president in front of a video camera, and ten seconds later you can have a photograph suitable for Quark framing.

- **Translate images into a format for facsimile transmission.** Fax machines have scanners of their own built in. Fax
boards that fit in your PC and allow you to receive or send fax images do not include a provision for capture. That's up to you and your scanner. A scanner and a fax board enable you to bypass long lines at the departmental fax machine. You can also keep confidential documents safe from unauthorized eyes if they never leave your office.

- **Capture the outlines of text characters in order to create new fonts.** Do you need a specialized font? A new category of software, such as Altsy's Fontographer, lets you design your own fonts and modify existing fonts. You can even scan a font you like and use the software package to transform it into a format compatible with your desktop publishing program. Currently, it is difficult to protect actual font outlines through copyright.

Adobe Systems made headlines in the computer press as the decade opened when it was able to gain copyright protection for the design and rendering of its ITC Garamond font. It was able to establish to the court's satisfaction that the PostScript font was actually a computer program (which is copyrightable).

Despite this change, most type houses simply copyright their font names. So, scanning and duplicating a font for yourself is perfectly legal, although still rare.

### Legal Questions

Please note: this section is entitled **Legal Questions**, not **Legal Answers**. The widespread availability of scanning has opened a Pandora's Box of considerations for anyone who produces desktop publications. I'll try to provide some common sense guidelines, but I haven't tested any of them personally in court. The odds against being sued because you scanned someone else's artwork are small, unless you are particularly blatant. However, if you have any doubts about the legal ground you're standing on, please consult an attorney. Most computer authors know only what they've seen on "LA Law."
While swiping other people's font designs is legal, there are other things you can do with a scanner that are not. I'm not referring to the first thing we all do when we get a scanner: capture an image of a dollar bill to see how sharp it looks.

By definition, anything you capture with a scanner already exists on paper. Text that is read with OCR software was typed or printed out by someone. Photographs were taken by someone with a camera. Line art was created by an artist, even if that artist's skills are barely beyond the stick figure stage.

Don't Steal Others' Images

If the creator in each case is yourself, the opportunities for problems are reduced. If the image belongs to someone else, you could have problems. As noted, you probably won't be sued unless you appropriate someone else's image quite obviously for profit. Scan in a picture of a hobo to illustrate an article on poor investments, and nothing probably will happen. Capture a few dozen Andrew Wyeth paintings and try to market them as a clip art library, and you will certainly have problems.

Note that creating an image yourself is not a guarantee of protection. For example, just because you drew a picture of Charles Schulz’s Peanuts character Snoopy yourself doesn’t mean you can use that image in your publication. I tangled with the legal department of my publisher over exactly this issue a couple years ago, when I was preparing a book called “Secrets of MacWrite, MacPaint, and MacDraw.” Since time was short, I satisfied their objections by giving Snoopy long ears, whiskers, and a puffy tail (thus turning him into a rabbit.) As much as you like Mickey Mouse, you may not use him in a publication, since the character is protected by copyright even if the actual drawing you scan is not. Logos and trademarks can also provide complications.

One thing to keep in mind is that it is perfectly acceptable to use someone else's image if you get written permission from the owner. In many cases, you'll find that a simple letter will do the job if your deadline is a month or so in the future.
Otherwise, you may want to telephone for a verbal okay and follow up with written confirmation. Some of the images in this book were scanned from artwork I used with permission.

Use a little common sense in seeking permissions. No matter how polite your letter is, it's unlikely that the Walt Disney people or the folks at IBM will allow you to use one of their trademarked characters or logos. You may have more luck with local businesses, artists, and others.

Figure 1.1

This illustration was taken from a book called Spanish Vistas, published in 1893.

Don't neglect the vast amount of public domain artwork available to you. The most recent copyright laws protect works for the author's lifetime, plus 50 years. Copyright on works published before 1978 was extended to a total of 75 years.

So, in 1990, you can be fairly certain that artwork published before 1915 has moved into the public domain. I've purchased in used book stores for a few dollars 80- to 110-year old books that were filled with thousands of dollars' worth of excellent line art. I'm careful to purchase damaged or incomplete books ("reading copies") that are of no value to collectors. You're free
to disassemble these crumbling masterpieces and give new life to the artwork within. Of course, old time artwork in any publication simply screams “Clip Art!” at your readers. At the same time, period illustrations can lend a certain charm and mood if used carefully.

Artwork with a more modern flavor is available from various clip art services and books used by ad agencies, newspaper ad departments, and so forth. Since you pay for the right to use this clip art, you can scan it, modify it, and use it in your publications as you wish. About the only thing you can’t do is scan it and market the art as a commercial clip art collection of your own.

Other Images Can Cause Problems

Other images can cause legal problems for you. Even if you take a photograph yourself, you still may not be allowed to use it if the people pictured are recognizable. A special document called a photo release form should be signed by each person in the picture, giving you permission to use his or her image in your publication. Most photo stores have pads of these releases you can use. Note that a photo release provides some protection, but is never absolutely ironclad. If you do a lot of scanning of such images, you might want to consult with an attorney, who can also draw up a more binding release for you.

My expertise in the law is limited to one “Law of Mass Communications” course in college and several sessions as an attentive plaintiff. Keep in mind that in our society, anyone can sue anyone else for just about anything. The suit may be totally without merit, in which case it may be immediately thrown out by the judge. In other cases, it can cost you a lot of money to find out you are right—or even more money to discover you are wrong.

You should be careful when using scanned images, just as you would avoid plagiarizing someone else’s text or publishing libelous statements about a person. However, these general
guidelines are common sense rules that can help you stay out of trouble:

**When you may not need a release for scanned images:**

- When the image is for your private use and not for publication. A few snapshots you scan and show to your friends probably won't be considered "published."

- When the photo was taken in a public place and will not be used in anything that could be construed as advertising. News photographers take pictures of people in the act of being themselves in public all the time and don't bother with photo releases. If your publication qualifies as news, you probably don't need one either.

- When people are not recognizable. If faces are obscured, out of focus, or so small as to be unidentifiable, you don't need a release. How could someone prove that the photograph was of him or her? Keep in mind that a person who always wears distinctive clothing or has other distinctive features (he or she may be eight feet tall and have large ears) may be identifiable even you can't see his or her face.

- When the person is a public figure. Generally, public figures such as legislators and entertainers are semi-fair game, unless you've broken some law to gain access to them.

- When you are making what is called fair use of an image. You can publish a scanned image to make an editorial or artistic point. I probably could have gotten away with using Snoopy in this book, if I confined him to a discussion of copyrights (as an illustration of fair use, for example). Generally, fair use is confined to news reporters, teachers, scholars, reviewers, critics. Their use of material is judged to not decrease the commercial potential of the original image.

That is, you're more likely to want to go buy a book if a review includes some quotations or an image from the book. That's fair use. Reproducing a significant portion of a photo book or clip art library in your own book is not fair use.
When you do need a photo release:

- When the picture will be used in a way that might be taken as promotional or advertising. You can include a picture of Teddy Kennedy in your newsletter as editorial matter, but you can't appropriate his image for an ad or testimonial. If he signs a release authorizing this use, you're off the hook, as long as the picture is used in the ways indicated by the release. Make especially sure you have a valid photo release before using a scanned picture in advertising.

- When the subject is portrayed in an unflattering or misleading way. You can libel someone with an image. If your picture seems to show Joe Jones stealing a woman's purse—and he wasn't—it may not help you that the photo was taken in a public place. You are particularly open to such charges of graphic libel if your desktop publication doesn't happen to come from a recognized news organization. A photo release can help, if Joe Jones has an open mind.

Libel and slander laws are quite complex. Whether the allegation is true or not and whether the plaintiff can show malicious intent are two factors that can enter into potential lawsuits. Unless you work for a news organization, you're better off avoiding such problems entirely.

Keep in mind that technicalities and other factors I haven't mentioned can complicate these legal issues.

The Real World

One noted rap group bragged that their riffs were all "sampled" from other musicians' records. Led Zeppelin drummer John Bonham may live forever electronically in synthesizers all over the world.

By the same token, the real-world use of scanners is going to result in an increasing number of sampled images finding their way into desktop publications. It's just too tempting to
appropriate images that we find all around us. You need a telephone handset for a graphic. Ah, there's a neat one in today's newspaper in an ad pleading you to phone in a classified advertisement. Wish you had a line drawing map of the United States? If you have a decent library of books available, your search won't take long.

Many readers will in fact use images that are not their own in their publications. If you are one of them, ideally, you should use a painting or drawing software package to modify these samples sufficiently to make them your own. How much modification is required is open to interpretation.

If your publication has limited circulation, say, within your own office, the chances that anyone will bother to object to your use of his or her image are slim. If it makes the New York Times bestseller list, you could have problems. In between, use your own judgement, and don’t tell anyone I urged you to do anything illegal.

**Summary**

Desktop publishing without images is like driving under the influence of alcohol: not a good idea, but there's a lot more of it around than you imagine. In the past, technological barriers kept us from incorporating scanned images, but these barriers have largely been overcome. Cost considerations are evaporating as well; scanners with resolutions of up to 400 dpi can cost only a few hundred dollars.

That's heartening, because scanners are the computer's eyes. There are eight key ways in which desktop publishers can use scanners. Within each of these categories are hundreds of specialized applications.
Eight Key Uses for Scanners

- 1. Capture line art for publications.
- 2. Capture photographs for halftoning in a publication.
- 3. Capture images for use as drawing templates.
- 4. Capture low resolution images for screen display or positioning in publications.
- 5. Capture text in optical character recognition (OCR) applications.
- 6. Grab images of three-dimensional objects.
- 7. Translate images into a format for facsimile transmission.
- 8. Capture the outlines of text characters in order to create new fonts.

From a legal standpoint, you should take extra care to insure that the images you use are either in the public domain or otherwise unprotected by copyright. Even drawings and photographs you create yourself may have their use restricted if you picture copyrighted logos or characters or portray real humans in advertisements or in unflattering situations.

A vast amount of clip art, including most published material more than 75 years old, is available for you to scan. In the real world, however, it’s likely that published material will be sampled and reused regardless of the legal consequences. If you use your judgement wisely, it’s unlikely you’ll get into real trouble.
How A Scanner Works

Too little knowledge can be a dangerous thing. It's true that you don't need to know how a scanner works to use one, any more than you need to understand the concept of electrical resistance to operate a toaster. Yet, if you're the type who extricates a stubborn piece of toast with a fork, you might find a little theory useful. By the same token, learning some of the nuts-and-bolts of scanner operation can help you find your way out of tricky situations—and might even improve the quality of your work.

Best of all, you can avoid getting the wrong piece of equipment for the type of work you want to do. All scanners can capture images. Some are capable of producing only black-and-white, line art images. Others are furnished with software that simulates a continuous gray scale of tones by varying the size of the black dots. Still others can capture true gray scale information. Knowing how scanners work can help you understand these differences—and why they may or may not be important to you.

Or, to provide another example, some black-and-white scanners use a light source of a particular color, such as red, to illuminate the artwork you are capturing. If your subject matter includes the same color, those sections may appear in relatively lighter tones of gray compared with other hues in the art. This discrepancy may cause some problems. However, understanding how the scanner works and why the problem occurred can give you a head start in solving it.
This chapter will provide a thorough grounding in how desktop scanners work. The information will be detailed, but fairly nontechnical. If you're the type who doesn't want to know how things operate, you can safely skip most of the following section if you wish. I'm including it for those who need in-depth knowledge or who are incurably curious. The rest of you can simply seek out such a person when you encounter something you can't handle and ask him or her to read this chapter for you.

The Day Before the Dawn of Scanning

One of the problems in writing computer satire is that the exaggerated, ridiculous things you invent as a way of poking fun at the industry usually end up as serious products a few years later. Back in 1981 I published an 18-part series of pieces dealing with Kitchen Table International, the world's leading fictitious supplier of computer hardware, software, and limpware. During its rise from oblivion to obscurity, KTI introduced a number of really stupid innovations. About 15 of these were later actually brought to market—not by me.

One was the Reverse LPRINT facility. This enabled dot matrix printers to operate in reverse. As paper fed through the printer backwards, a special printhead with built-in sensor would detect the characters on the page and transmit them back to the computer. Of course, the KTI version also removed the printing from the page, producing clean formfeed paper in the process. The announcement turned out to be a mistake caused when a PR executive accidentally ran a demonstration film backwards.

Enter Thunderscan

By 1984 we had Thunderscan, a real-life, independently developed version of my backwards dot matrix printer. The Thunderscan device looked an awful lot like an Imagewriter printer ribbon cartridge and was, in fact, inserted in place of the ribbon. The photograph or other art to be scanned was
inserted in the Imagewriter as if it were a piece of printer paper. Then, the scanner software moved the printhead/scanner across the platen, one line at a time. When the entire sheet had been fed through, a pretty good image was available for storage or manipulation. Of course, feeding books and other thick materials through the printer was out of the question. However, that wasn’t the point. For less than $200 (I paid $179 for mine), you could actually capture all kinds of images easily, quickly, and with decent quality. Improved versions of the Thunderscan device are still on the market today, providing a low-cost entry for many into scanning.

If you understand how dot matrix printers work, you’re that much farther ahead in knowing how scanners operate. Or, you may be more comfortable thinking of a scanner as a reverse television set. In either case, the images are formed (or captured) row-by-row, dot-by-dot.

Figure 2.1

The ThunderScan scanner is used in place of the ribbon cartridge in an Apple ImageWriter or ImageWriter II.
Digitizing Images

Scanning is sometimes called digitizing, because the process changes analog information into a digital form that computers can understand. However, digitizing has a special, more restricted meaning in some fields; in computer aided design and map-making, for example, digitizing is the process of entering coordinates of points on an original image into a computer database. Therefore, I'll use the term scanning in this book almost exclusively.

The idea of digitizing a piece of art is a useful concept, though. In practice, a scanner is nothing more than a device with a sensor that detects the amount of light reflected or transmitted by a given point on the artwork. As you probably know, black objects absorb all the colors of light that strike them equally. White objects reflect those colors equally. The more light an object absorbs, the blacker it appears to our eyes. The more light an object reflects, the whiter it seems to be.

Only Black Holes Really Black

In the real world, practically nothing this side of a black hole absorbs all the light that strikes it. Similarly, even mirrors don't reflect 100 percent of the light they receive. Things that look gray to us are somewhere in between: some of the light is absorbed, and some is reflected. If an object happens to soak up more of one of the three primary colors of light than the others, it will seem to have a hue. Color will be addressed in more detail in Chapter 13.

Scanners, like our eyes, take advantage of the different ways in which objects reflect light. If the light received by the sensor doesn't exceed a predetermined threshold, that picture element is recorded as black. Values higher than the threshold are either assigned a number representing white or, in the case of gray scale scanners (more on them later), a number corresponding to some shade of gray.
Some scanners allow you to adjust the threshold upward or downward. That lets you control whether artifacts like dirt or even the texture of the paper itself will be recorded as image information or ignored. Scanner software designed for gray scale imaging allows you to alter the values assigned to specific light levels, as well, thus adjusting what is called the gray map.

Color scanners work exactly the same way, except that separate lightness/darkness values are recorded for each of the three primary colors.

Once the scanner has captured information about a given picture element of the original art, the sensor moves on to the next until the entire scanning area has been covered. This process is very fast, so the original can be entirely scanned in a few seconds.

Figure
2.2

A typical flatbed scanner
Different Types of Scanners

The mechanics of this process vary, depending on the scanner type. All scanners use a light source, some means of moving the sensor (or a mirror that reflects light to the sensor) over the surface of the artwork (or vice versa), and circuitry to convert the captured information to digital form. A video camera is a special type of image capture device that can be used as a scanner for desktop publishing. Video systems also scan in the sense that they read consecutively and store each line and pixel of an image. However, video systems use a two-dimensional array of many sensors, each of which captures a pixel's worth of information.

Most of the material in this next section applies only to the more traditional type of scanner in which a single set of sensors captures multiple lines or pixels. These scanners fall into four categories: flatbed, sheetfed, overhead, and hand scanner.

With flatbed scanners, like the Apple scanner, Microtek, and HP ScanJet Plus, the original is usually placed face down on a glass surface, much as you would with a photocopier. (Some modern copiers are, in fact, digital units with built-in scan-
How A Scanner Works

Figure 2.4

An overhead scanner

ners.) Light is reflected from a system of mirrors to progressively illuminate each line of the artwork. The scan head is located very near the underside of the glass and is moved by a motorized mechanism simultaneously with the travel of the light source. A lens in the scan head directs the light to a light-sensitive component (usually a photodiode or charge-coupled device) that translates the light level into an electrical current. The more light reflected, the greater the voltage. Figure 2.2 shows a typical flatbed scanner.

Some scanners are sheetfed. The original artwork is fed through the device, passing over the scanning sensor one line at a time. Most fax machines also work on this principle: you feed the original into a slot, where the leading edge is grabbed by a roller. Neither the sensor nor the built-in light source must move. The only moving parts are in the roller mechanism. Figure 2.3 shows a sheetfed scanner.

The overhead scanners offered by Chinon, Mirror Technologies, and a few other companies resemble photographic enlargers or, more closely, “planetary” style microfilm cameras.
With these, the original is placed on a table or bed beneath the sensor head, which is suspended about a foot over the copy. No internal light source is required. Ambient illumination in the room provides the sensor with enough light. A pivoting mechanism inside the sensor head directs the scanner’s "eye" at each line of the original in turn. An overhead scanner is illustrated in Figure 2.4.

**Hand scanners** achieve their low cost by replacing many components with human muscle and by restricting the field of view. With these, the sensor and light source are built into a hand-held device about four inches wide. The original is read as you run the scanner down the artwork. An interface board installed in your computer translates the information into digital form and relays it to the scanning software supplied by the vendor.

Some hand scanners are furnished with software that makes it relatively easy to merge multiple passes of a wider document. A hand scanner is shown in Figure 2.5.

You may encounter references to drum scanners, which are typical of the higher priced, very high resolution color separa-
tion scanners found in the graphic arts industry. With these, the artwork is wrapped around a drum and rotated at very high speeds. Laser light is usually used to illuminate very tiny sections of the original. These scanners can provide highly detailed image files that can be used for sophisticated layout and page composition, electronic retouching, and color separating. High end scanners can also electronically generate halftone dots while exposing films used to make the printing plates.

I won't discuss graphic arts scanners further. I did want to mention the devices that eventually led to the desktop scanners we use today.

That's basically all there is to the mechanics of traditional scanners. They are fairly simple devices and, as such, remarkably reliable. Don't be misled by the resemblance of flatbed scanners, in particular, to photocopiers. You won't need a key operator or a resident field engineer to keep your scanner running. Copiers, after all, have complex paper transport and toning mechanisms in addition to their optical or digital image capture components. (In that respect, they're more akin to laser printers.) My oldest Thunderscan scanner, now more than five years old, works as well as it did when it was new and has never required service.

**Video Scanners**

Video scanners have been available for the Macintosh for quite a while, dating back to products like ComputerEyes and Koala's MacVision. Video capture technology has really taken off in the past several years, however, the Mac II made it possible to insert special video frame grabber boards inside the Mac itself. These make it easy to grab good quality video images in file formats compatible with RSG, QuarkXPress and PageMaker.

Video scanners differ from the other types in several ways. One key difference is that video input often consists of a stream of still images captured as 30 different frames each
second. Another noteworthy difference is that the capture or frame grabbing step is distinctly separate from the imaging process itself. You can, in fact, substitute any of several different video sources or sensors with most systems. Sometimes your video images will come from video cameras, other times from existing videotapes. Let's look at each of the steps in the process.

Video imaging is done with a camera. The camera itself is much like a photographic camera in that a lens is used to focus an image onto a light-sensitive surface. In the past, this surface was one end of a special glass tube, such as the vidicon and plumbicon tubes found in old-style professional television cameras.

More recently, charge-coupled device (CCD) sensor arrays have become predominant. These solid-state components consist of rows and columns of light-sensitive material, which is used to produce an electrical voltage that varies according to the amount of light reaching it.

### Scanning An Electronic Process

As mentioned in the beginning of this chapter, the scanning is electronic. Ideally, there should be one pixel for each pixel on the screen (525 lines by approximately 420 pixels per line)—at least 220,000 mini-sensors. In practice, resolution is somewhat lower than this. Some 21 of the total 525 lines are retrace lines that are not displayed. Resolution is limited by the bandwidth of the carrier signal to about 320 lines by 425 pixels per line.

When the image is painted on a television screen (but not on the Macintosh screen), the pixels on one line are illuminated first, then those on alternate lines to the bottom of the screen. After that, the even numbered lines are drawn. The process is repeated 30 times a second. This odd/even scheme is called **interlacing** and allows a shorter interval between frames than would be possible if an entire screen had to be painted before the next one could be started. The tendency of the phosphors
on the CRT to glow for some time after they have been illuminated (*persistence*) allows the eye to blend the two frames together into a single series of images.

Many non-Macintosh computer systems also use interlaced video. The Mac, however, doesn't use interlacing. The entire screen of 342 or 480 lines is painted each time. Noninterlaced video is more difficult to accomplish and requires speedier hardware, but produces an easier to view, nonflickering image. Video input can be imaged by many different types of scanners. You may have access to a home video camcorder, such as the VHS or 8mm models available from a variety of manufacturers. Professional-quality RGB cameras can also be used for better quality images.

**Still Video Devices**

Video can come from still video capture devices, such as Canon's Xapshot or DynaCam and their more expensive professional still video brethren. You don't necessarily need a video camera at all: the frame grabbing devices discussed in this book will accept input from videotape, too. (Please keep in mind copyright considerations when re-using images from videotape.)

Video capture devices don't know where the signal is coming from. The information can be stored on videotape for later retrieval or directed to the frame grabbing device on your computer. Just as you would guess, a frame grabber freezes one of the video frames and translates it into a form that can be used by your desktop publishing software or image manipulation package.

The Macintosh can't display video signals directly. Some video scanners, like ComputerEyes, include an extra cable you can attach to a video monitor. You can then view the camera image and select the frame you want to grab. Other more expensive products convert the video image to signals that can be viewed on a Mac II monitor.
The converted image can be stored to disk in one of a variety of file format and then manipulated like any image produced in that format.

Summary

This chapter has provided a fairly complete explanation of how scanners work. You learned about how images are captured and a bit of the mechanics involved with the various common types of scanners.

Scanning is sometimes called digitizing, because a scanner converts an image of an original subject into a form that digital computers can store and process. Scanners contain sensors that detect the amount of light reflected or transmitted by a given point, or pixel, in the original. This information is converted to an electrical signal that the computer can handle.

There are basically five types of scanners—flatbed, sheetfed, overhead, hand, and video. Each of these has advantages and disadvantages, which will be explored in the next chapter.
Many factors go into selecting the best scanner for your application. The functions that you need are one key consideration. Another is your budget. You may find that your needs will exceed your grasp. This chapter will provide you with an honest estimate of what you can expect to accomplish, whether you have an unlimited budget or simply unlimited aspirations. Fortunately, there are ways of setting up a highly usable scanner system without spending a fortune.

First, we'll look at the different scanner types described in the last chapter in more detail. Then, in the next chapter, I'll discuss some of the system requirements of scanning, so you'll have a better idea of how your current (or future) computer setup will handle the demands of scanning.

Which Scanner Type is Best?

There are four main types of desktop scanners as well as a fifth option—video image capture devices. Each has strengths and weaknesses you need to be aware of. I'll list the pros and cons of each.

Flatbed Scanners

Most full-page scanners are flatbed types, and with good reason. This configuration provides the best and most flexible combination of features for most users. Such scanners are
lodged firmly in the middle price range, from about $1000 to $2500. More costly units are generally color scanners or those with very high resolution. Typical flatbed scanners are the Apple One Scanner, HP ScanJet, and Microtek series.

The key advantages of flatbed scanners are as follows:

- **They can be used with a wide range of non-transparent artwork.** Anything that is flat and can fit on the glass platen can be scanned. As with photocopiers that have hinged lids, you can place books, large originals, and "thick" copy face down. Images up to 8.5 x 13 inches can be accommodated by the typical flatbed scanner.

- **You can scan some three-dimensional objects.** Keys, watches, human hands, and similar subjects can be captured with a flatbed scanner more easily than with sheetfed models. Don't count too much on this capability, however. Results will vary widely, depending on the scanner and the object being scanned.

- **It is fairly easy to align originals correctly with flatbed scanners, although not as easy as with overhead models.**

- **Flatbed scanners can combine the automation advantages of sheetfed scanners, when equipped with mechanical multiple sheet feeders.**

The disadvantages of flatbed scanners are:

- **They have large footprints.** These scanners take up a large amount of real estate on your desk. For ease of use, you'll want to keep the scanner as close to your computer and keyboard as possible. That way, you can reposition a piece of art or replace an original with a new one without moving from your seat. However, that desk space is likely to be scarce and precious. Because the lid must be free to open, you can't put anything on top of a flatbed scanner, either. You might be able to place the scanner on a shelf next to your desk as long as there is plenty of open space above it.


- **Difficult to Align.** Originals are placed face down, so you may not be able to see if they are aligned perfectly without a preview scan.

- **Reduced flexibility.** Most three-dimensional objects can't be scanned at all.

- **High Cost.** Flatbed scanners cost more than some other types, particularly hand scanners and overhead scanners.

### Sheetfed Scanners

Given the advantages of flatbed scanners, these days you won't find as many sheetfeed-only scanners as you used to (apart from those found in fax machines and specialized OCR devices). The majority of sheetfed scanners today provide double duty in some way. Fax scanners are an example. Some fax units have an interface that allows transferring the image they capture to your Mac, in fact. The advantages of sheetfed scanners are:

- **Compact size.** Documents that are longer than the scanner itself can be fed through, so sheetfed scanners can be built smaller than flatbed models. Basically, these are wide hand scanners, except the paper moves instead of your hand.

- **Automated operation.** Since the paper is already being moved through the scanner, it's relatively simple to build a feeding mechanism to supply one sheet after another. This is particularly useful in OCR applications, in which you may be scanning multiple sheets from a single document.

- **Low cost.** Sheetfed scanners can be much less expensive than the flatbed types since they are simpler to build. Instead of the complex moving light source or light source/mirror combination found in flatbed scanners, sheetfed models just have rollers to move the paper.
The disadvantages of sheetfed scanners are:

- **Difficulty in aligning originals.** You must be careful to feed originals into the scanner correctly. If one roller grabs the paper before the other, the page may feed at an angle. Artwork having straight horizontal or vertical lines will display jaggies. Fodder for OCR software may not be read accurately at all.

  All this assumes that your original is placed at right angles to the edges of the paper. If the original is a photocopy that is skewed slightly, or if it was intentionally placed at an angle, you may be unable to correct this defect at all.

- **Limitations on originals scanned.** To state the obvious, sheetfed scanners can work only with sheets of paper or similar materials. While you have fewer restrictions on the length of the original, there are sharp constraints on the width and thickness. So, you may not be able to scan images from books or from wide sheets unless you photocopy them first. Pasteups and art on boards can also be difficult or impossible to scan with these models.

- **Inconvenience with irregularly shaped and sized originals.** Not only must the sheets you feed one of these scanners be relatively thin, they should be rectangular and sized about 8.5 x 11 inches for best scanning. Very small originals, such as postcards, won't feed unless you tape them to a larger sheet or enclose them in acetate. Odd shapes, particularly items with curved edges, can also cause alignment problems.

- **Possible damage to originals.** In some cases, it may be possible to accidentally damage your original as it is fed through a scanner of this type. The rollers may put marks on the document or fold over one or more edges. This is particularly true when the original is old, fragile or dog-eared. Pasteups must be put between sheets of acetate to keep the edges from catching. As with oversize originals, you can work
around these problems to an extent by making a photocopy, or better yet a Photostat, of the original.

In practice, jams may be few and far between. You may be more familiar with the operation of fax machines than sheet-fed scanners. If you can't recall the last time you had an original jam in your fax machine, you're probably on the right track in estimating the reliability of sheetfed scanners.

If the layout of the pages you'll be scanning changes frequently, the automatic operation of a sheetfed scanner may be of little value to you. You'll find yourself changing the scanning window so often you might as well be using a flatbed scanner. However, if you feed page after page of the same type of document (say typewritten text for OCR, or similar-sized documents which must be captured as graphics in their entirety), a sheetfed scanner can be a productivity booster.

**Overhead Scanners**

These fall into two broad categories. The first includes scanners in which the overhead component is a full-fledged camera. These tend to be very expensive and flexible, with multiple reproduction size ratios, built-in light sources, and other features. Such models are priced in the range of $5000 and up. The same configuration is used for some very reasonably priced scanners. These scanners have a relatively simple scanning device located overhead.

Expensive camera models are beyond the reach of desktop publishers. However, I'm surprised that there aren't more low cost scanners in configurations like that of the Chinon. Such units are very convenient and easy to use.

**Specific advantages are:**

- **Copy is scanned face up** so you can position copy accurately. The copy bed usually has guides you can use to align the document properly.
Overhead scanners have a very small footprint, scarcely larger than the copy size. Not much desktop space is taken up. My Moniterm Viking G/S monitor is a special gray scale CRT for the Macintosh. It has a flat top that can store a scanner of this type between jobs. (You shouldn’t try this unless you are certain your scanner won’t block any ventilation slots on the monitor.)

Many different types of originals can be handled. Books, artwork pasted up on flats, even small three-dimensional objects can be scanned easily. You can usually move an over-size piece around and scan it in sections. It's even easier to do this with an overhead scanner than with a flatbed scanner, because you can see what portions you have already done.

Flat and 3-D originals can be combined. In some cases, you can place a small three-dimensional object on top of a two-dimensional subject and scan both at once. It’s a quick way to combine two images. Again, I’ve had mixed success scanning 3-D originals, but the technique is worth a try.

Disadvantages are:

Dependence on your ambient light source. The least expensive overhead scanners rely on room illumination. If it’s not strong, or there are shadows which fall on the copy board, your scans may suffer. I simply direct a single desk lamp at the copy board and find that it gives plenty of light.

Limited copy size. Overhead scanners generally don’t have any way to adjust the height and focus of the scanner head. So, you’re limited to a fixed field of view that may not be large enough for some artwork.

Difficulty in holding books flat. The platen cover of flatbed scanners serves to hold books flat during the scan. You may need a special holder to keep books face up and flat on an overhead scanner.
Hand Scanners

Hand scanners may replace mechanical components with the effort of your arms and fingers, but they are no slouches in the one area that shows up in your publication—resolution. Hand scanners are available with 300 to 400 dpi resolution.

Advantages are:

- **Low cost.** Many hand scanners are available for less than $200. This cost may drop further, but I suspect that manufacturers may just add features instead. We’re already seeing hand scanners with $179 price tags bundled with valuable utilities.

- **Zero footprint.** You can unplug a hand scanner and throw it in a drawer when it’s not in use. Or you can leave it atop your monitor or in some other unobtrusive location. Hand scanners have a definite advantage for the user with no space to spare on the desktop.

- **Flexibility in selecting subject matter.** A hand scanner makes it easy to scan small portions of an original without setting up a frame or window using your scanning software. You can look through the scanner’s window to see exactly what is being scanned.

Disadvantages include:

- **Limited width of image.** You may be able to scan only four inches of copy at a time. For some applications, you’ll find that four inches encompass nearly everything you scan anyway. In addition, you can often overlap images a little and merge them later. That’s particularly true with devices like Mouse System’s Page Brush, which “stitches” an image together on-screen, using a reflective pad as a reference point.

- **Susceptibility to human error.** With most hand scanners, you need to scan straight and evenly to get the best results.
Limited OCR functions. At this writing there are only a couple OCR programs with support for hand scanners. These are the less sophisticated packages with higher error rates than those designed for use with other scanner types. If columns of text are wider than the four inches or so your hand scanner can handle, you’re out of luck.

Keep in mind that sophisticated OCR software usually will accept any TIFF file and work with it offline. So, you may be able to scan and then process the text in the file mode of the OCR program. Generally, though, you will find this more trouble than it’s worth. This technique is most useful when you want to capture images with one computer and process them on another one (which may be faster, or occupied, or not connected to a scanner.)

Video Image Capture Devices

I introduced video capture devices briefly in the last chapter. As mentioned, they capture images in an entirely different way from the other scanners covered in this book. However, video devices are an alternative for certain applications, particularly when you want to capture images from three-dimensional objects.

A video scanner is usually packaged as a special board for your computer with a connector for standard video sources, which can include camcorders and VCRs. As you may know, television pictures of this sort consist of frames of images displayed 30 times a second. The CRT paints the pixels for every other line, then goes back and draws the alternate lines (the Macintosh does not use this interlaced technique). Thus, a television picture will consist of two frames, each with half the 525-line vertical resolution of the entire screen. (As I noted in the last chapter, the real resolution of a video system is likely to be much less.)

Video scanners grab one or more of these frames and place them in a memory repository called a frame store. Then the signal is translated into a form that can be viewed on your
monitor or stored to disk. Like the other scanning technologies, video scanners have their pros and cons.

Advantages include:

- **Ability to capture images of three-dimensional subjects.** Need a quick head shot of a new vice president for the company newsletter? Point a video camera at the lucky devil and fire away. How about an image of that new product? Adjust the lighting the way you want, and use your camcorder to capture the image. As with overhead scanners, you can combine three-dimensional and flat artwork by shooting both simultaneously. Have your company president put his or her arm around a life-size cutout of George Bush, grab an image of the pair with the video camera, and no one will be able to tell which of them is more two-dimensional.

- **Flexibility.** The 30-frames-per-second capture rate of the video camera gives you hundreds of views to choose from. Select exactly the image you want.

- **Access to video images.** You're not limited to capturing images "live." Any existing videotape provides fodder for your frame grabber. Imagine how movie reviewers' jobs would change if they could capture a frame from a video at will and publish it along with their comments?

Disadvantages:

- **Relatively low resolution.** Some video scanners can provide images with low resolution only—no better than the 640 x 480 pixels of the Mac II screen (systems may interpolate the pixels actually captured to simulate such resolution, in fact). A conventional scanner can resolve more detail than that in less than a square inch of your original. Still, for small images or those you can't obtain any other way, the results may be good enough. Others do provide sufficient resolution for many applications. For example, the series of Targa boards available from Truevision can capture images with a resolution of 512
x 512 pixels. Another model can grab images at a resolution of 1024 x 1024 pixels.

- **Need for special lighting.** Video scanners aren’t necessarily less sensitive to light than other types, but when you go beyond flat, two-dimensional artwork, lighting takes on new meaning. I’ll avoid a long technical explanation here and just note that when capturing images of three-dimensional objects, the more light you have the greater the depth-of-focus will be. So, unless you use an extra light source, you may find that your vice president’s nose is sharp but the rest of his face is a little blurry. In addition, some knowledge of lighting is needed to avoid objectionable shadows.

  Scanners without the three-dimensional capabilities of video devices don’t face these problems simply because they are more limited in subject matter.

- **Requirement for extra monitor.** Some video capture devices must be connected to another monitor if you want to preview the images before they are captured.

- **Higher cost if you don’t own a camera.** Video capture boards can be quite reasonable in cost—from $200 to $800 for monochrome models. However, you must add to that the cost of a camera. Simple black-and-white video cameras can be purchased for $200 or less. Most of us would rather have a multi-purpose camcorder that can also be used for conventional video applications. Those run $800 and up. At that point you’ll have spent $1600 for a video scanner system that can’t be used for OCR and may have no better than 72 dpi resolution.

**General Criteria**

This section will examine some of the general criteria that apply to all the different scanner types we’ve looked at so far. You can use this information to choose from among specific features that not all scanners share.
Scanner Resolution

A resolution of at least 300 dpi is almost standard among all non-video scanners. The resolution of video scanners isn't normally measured in dots per inch, since that measurement can vary depending on how close the subject is to the camera. Instead, the total number of pixels in the horizontal and vertical directions is used.

Figure 3.1

For all other scanners, you should look for a minimum of 300 dpi and not give too much extra weight to small increments above that. For example, a 400 dpi scanner won't provide an image that is appreciably sharper than one with 300 dpi resolution. The difference is likely to be noted only with fine lines and diagonal strokes in your image. The main effect you will see is that an image scanned at 400 dpi will print about 25 percent larger in each direction than one scanned at 300
dpi. This phenomenon is explained more thoroughly in Chapter 5.

In addition, you’ll find that images with gray tones, such as photographs, usually can’t be scanned at resolutions higher than 150 dpi if you intend to incorporate them in your desktop publications. As you’ll find in Chapter 6, most laser printers can’t create the halftone dots needed to reproduce such detailed images, anyway.

If you have specialized applications that require higher resolutions, you’ll find a bigger jump more useful. Truvel, for example, makes an overhead scanner with up to 900 dpi resolution.

Some scanners, such as the HP ScanJet, can interpolate between scanner dots and go beyond the simple optical resolution of the unit. This can be useful if you need a specific resolution to avoid patterns when printing dithered halftones, or 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, though. To understand this, consider a small portion of image area scanned at 300 dpi, four pixels on a side. The area is represented in Figure 3.1. At an interpolated 600 dpi, shown in Figure 3.2, each of the four pixels will be subdivided into four smaller pixels. Instead of storing the same value found in the original pixel in each of the new sub-pixels, the scanner software will calculate a new value for each. The values found in the surrounding pixels will be used in the algorithm, so an average of the gray (or black) levels will be used.

For many subjects, this will represent an excellent guess. Therefore, as the image is enlarged further, the new, averaged pixels will provide a smoother gradation in the image. If you simply enlarged the original 300 dpi image, the original pixels would soon become visible and therefore objectionable. Yet, interpolation doesn’t provide any additional information, so there are some limits to the amount of enlargement you can do using this technique.

Consider your applications carefully if your main criterion in choosing a scanner is resolution. If you’ll be using images for position only and then making conventional halftones or photomechanical transfers (PMTs), anything higher than your screen resolution is a waste.

Scanner Control Software

Scanners are nearly always furnished with software that allows you to perform scans and control the basic features of the scanner. These programs provide some tools for manipulating the images you capture. You’ll also usually have a choice of file format in which to save the scanned image (see Chapter 5).

You might want to examine the control software available for your scanner. Some programs don’t allow you to vary the scanning parameters as much as you might like. You may, for example, always have to scan at the highest resolution offered
by the scanner. Or you may not be able to scan at a resolution of less than 150 dpi. A few programs have only light/normal/dark brightness controls instead of a continuous full range.

While the scanning hardware determines maximum optical resolution, you don't always need the maximum. The software should let you use other resolutions to keep file sizes down and to fine tune scans for special situations. Some programs provide only three or four common settings. Others, like Microtek's control software, let you select resolutions in 15 dpi increments. Ideal is the scheme used by some programs, which let you adjust resolution in one dpi increments. That way, if you know your final size and output resolution, you can scan at an exact multiple. This reduces problems in converting from scanned pixels to printer pixels.

If you find that you need features not offered by the software that came with your scanner, take a look at some of the third-party software that can drive your scanner. Usually, these are image manipulation programs like Digital Darkroom and Photo Mac. The ability to control the scanner from

Figure 3.3

Scanner Setup

![Scanner Setup](image)

ScanMan Setup box
within the image software lets you avoid having to exit and load a scanner control package every time you need an image.

A valuable feature of scanner control software is the ability to do preview scans. A preview scan is a low resolution image that gives you an idea of what the entire piece of artwork looks like. You can then select a portion of the art for scanning at the final resolution. This capability can save you time and reduce disk storage requirements. Some scanner control software lets you print out samples of the scans. Let's look at some typical scanner controller options, so you can make your own comparisons.

Figure 3.3 shows the setup window for a typical scanner control program, the Logitech ScanMan. The top line shows the SCSI port selected for your scanner, as well as the resolution (set by a switch on the ScanMan itself).

Other scanners don’t control resolution and other scanning parameters through switches. These may be handled by the scanning software itself. That that case, you may be provided...
with sliders which allow you to adjust resolution continuously, while modifying the scale factor of the image. In this way, you can adjust both the sharpness of the image and the relative size over a broad scale.

You may also get a Brightness box which enables you to choose between dark, normal or light images. A flexible continuous range is better if your scanner allows it. Such a control is shown in the Lightning Scan box illustrated in Figure 3.4. You may also be able to adjust brightness and contrast by manipulating the scanned gray scale image, but it's always best to change the information you capture, rather than try to change the information after it has been captured.

The three typical scan modes are provided: line art, halftone, and gray scale. Each of these will be discussed in detail in Chapter 5. If you are halftoning your image during the scan step (which is usually not a good idea; see Chapter 6 for details), you can often choose from one of four or five halftone patterns. A typical dialog box is shown in Figure 3.5.

Control Over Scanning Area

Most packages let you draw a box that defines the area you want to scan. It allows you to scan the entire image, view the page in reduced size, and then box out the exact area for a high
resolution scan or for halftoning, editing, printing, or saving. Such a box is illustrated in Figure 3.6.

One common practice is to scan only a portion of the image to help you zero in on the area of most interest. You then draw a box around the area you want to scan "for real" before the final scan. Other systems make you type in coordinates.

The worst type shows you an image of the scanned area, but doesn't provide a preview scan. You must select the area you want "blind," either with the mouse or by typing coordinates. Then, when you view the scanned image, you can make adjustments and rescan. It's often necessary to scan several times before you are able to zero in on the exact area you want scanned.

Figure 3.6

![Preview scan box.](image)

Some software tells you how much disk space or memory your scan will require and whether you have enough. Packages which hold the entire image in memory are limited to the amount of memory you have available. I have 8 megabytes of RAM in my main computer, yet still find that some control programs won't scan a full 8 x 10-inch photo at 300 dpi. That's
not surprising, since such an image requires 7 megabytes at 256 levels of gray. Other programs store the scanned image temporarily on disk. You still must have the space available, but it’s more common to have 8 megabytes of free disk storage than 8 megabytes of memory.

Brightness, contrast, and threshold are also important parameters to control. It’s valuable to adjust brightness and contrast before rather than after scanning. Keep in mind that with images that are dithered during the scanner process, you can’t change the gray scale later on. The particular dither patterned used (most scanners offer several choices) can also affect apparent resolution, contrast, and brightness. A few packages allow you to control these factors with a sophisticated process called gamma correction.

Most scanner controller software will provide some variation on these combinations of features. Some products are marketed as OEM (original equipment manufacturer) packages
by their vendors. These are purchased by scanner manufacturers and provided with their offerings.

Number of Gray Levels

All scanners can recognize a fairly broad range of gray levels. If this were not true, you would be unable to scan anything that wasn’t perfectly black or white. If the blacks were a little light, or if the image were printed on even slightly colored paper, your scanner would be unable to read it.

The ability of a scanner to distinguish various tones of gray enables you to set the threshold at which it decides whether a given pixel is black or white. So, even with a binary (black-and-white only) scanner, the ability of the sensor to interpret gray information can be important.

With line art, the ability to control the threshold is important. When you set the threshold, you select the point at which light grays in an image go to white and dark grays go to black. This is helpful even if you are scanning a binary, black-and-white image. You can adjust the threshold to screen out noise caused by color, dirt, or even paper texture.

If you are using such a scanner only for optical character recognition (OCR) or line art, adjusting the threshold will let you filter out defects in the paper and capture less-than-perfect text.

Other scanners can do more with grays. Such scanners can pass along a number of different gray levels for each pixel to the scanner software.

As you’ll see later, the more gray levels a scanner can produce, the better. A scanner may be a binary (bilevel) scanner that can produce only black-and-white images. The scanning software will automatically convert the images through a process called dithering. Others will provide 16, 64, or 256 levels of gray.

The original Apple scanner, for example, was a 4-bit scanner. As such, it will provide 16 levels of gray. It can be upgraded
with a modification from Abaton, however, to produce full 8-bit, 256-gray level scans.

However, even if you have a multi-bit scanner, it can be useful to be able to scan with fewer bits per pixel to save disk space and printing time, if the larger number of gray levels isn't required.

For example, you may want to perform a bilevel scan to produce an image used for position only or for optical character recognition (OCR) translation. Some scanner controller software allows you to change the relationship between grays, altering the gray map. Chapter 6 covers this capability in a little more detail.

If you want descriptions of specific scanners, please consult Appendix A.

Summary

Many factors go into selecting the best scanner for your application. Each type of scanner has its own advantages and disadvantages.

- Flatbed scanners can be used with almost any type of artwork that will fit on the glass, including some three-dimensional objects. Aligning originals is easy, and you can gain automation by adding a sheet feeder. However, flatbed units typically have large footprints and cost more than other types. Because originals are placed face down, it is difficult to see what area will be scanned without doing a preview scan.

- Sheetfed scanners boast low cost, compact size, and automated operation. They make it difficult to align and feed odd-size originals and can damage documents with their roller transports.

- Overhead scanners make it easy to position copy accurately, and come in models with relatively small desktop footprints. They also are excellent for scanning three-dimensional origi-
nals and flat artwork simultaneously. They can limit your copy size more than other types and are problematic for holding books flat.

- Hand scanners are very low in cost, with many priced at less than $200. They consume zero desktop space when not in use and provide a great deal of flexibility in selecting subject matter. Yet, they have a limited image width, aren’t generally useful for OCR functions, and are more susceptible to human error than other types.

- Video image capture devices excel at scanning three-dimensional subjects and may be particularly useful for capturing portraits. They do offer lower resolution than other scanners and require special lighting for best results.

This chapter also looked at scanner control software and listed key functions you should look for in selecting such a package.
You'll find that in most cases you can use your scanner with the Macintosh you already have, regardless of the type of scanner you select. Many scanners are furnished with their own interface box that plugs into the Mac's SCSI port, so you don't need a card in the computer itself. Others, particularly high end video frame grabbers, do require a slot. That may be a concern if you have a Mac SE, SE/30 with a single expansion slot, or a compact version of the Mac II, such as the Mac IIx, with just three NuBus expansion slots.

A color card and gray scale or color monitor are optional; the software will provide a dithered black-and-white image for viewing if you have only a standard monochrome monitor.

As with any computer setup, the hardware must-haves and nice-to-haves for a scanner-equipped system are two different things. Many scanning functions, image manipulation features, and desktop publishing chores can be made much easier when you have more than the minimal equipment configuration. This chapter will explain how each of the basic components and peripherals of a computer system can the affect use of a scanner. I'll show you both basic, bare-bones systems as well as a high end, do-everything setup. You'll learn why and how each component or peripheral is important, and where you can cut corners, safely, if you have to.
Cost Justification

Scanners themselves are low enough in cost that a broad spectrum of users has access to them. Some computer users work with desktop scanners extensively in their businesses. Others think of a scanner as a nice toy that delivers new capabilities. These two different mind sets call for two different approaches to selecting a computer with which to use the scanner.

If you plan to use a scanner in your work, configuring a Mac to run the scanner won't be much of a problem. When you compare the long-term cost of having your artwork all photographed at the printer (or the intangible cost of not using art at all), the price of even a lavish desktop computer system is quite modest. The same holds true if you plan to use the scanner for a lot of optical character recognition. The clerical labor that will be saved by not keying documents manually can provide a fairly short payback on a powerful scanning setup.

If, on the other hand, you plan more casual or intermittent use of your scanner, you simply can't justify paying $1000 for extra memory or an equal amount for a larger hard disk.

Minimal System

Happily, an efficient scanner setup can be put together with about the same equipment you need for your desktop publishing. Here's a list of the major components you'll need:

- Any Macintosh computer.
- 512K of memory.
- A 20 megabyte hard disk.
- A hand scanner.

You can probably put together a new system with these specifications for something in the neighborhood of $2000. It
might be possible to use a scanner with a less complete system, but you would face serious limitations. Using a floppy-disk-only system would require an awful lot of disk swapping. Most sophisticated applications simply won’t run on a 128K Macintosh, and such an early system would in any case severely constrain the size of the image you could capture.

Let’s look at each of these major components to see what problems you might run into while putting together a minimal scanner system.

**Computer/CPU**

Any Mac should work. The chief constraints imposed by the computer itself are the speed with which it operates and the availability of a slot to accept a special scanner interface board (if required).

Speed actually has more of an impact on the desktop publishing software you want to use than on scanner operation itself. Even the slowest Mac can be used to run most scanner software. The exceptions are optical character recognition packages. OCR takes a lot of time even on fast computers, and an OCR program may run intolerably slowly on a Mac Plus or Mac Classic equipped with a Motorola 68000 microprocessor.

However, in general, if your Mac is fast enough for your desktop publishing software, it will be fast enough for your scanner.

**Memory**

Our minimal system can probably get by with 512K of memory. Computers with 512K or less of RAM are fairly scarce today. Even when memory prices skyrocketed a while back, there was little reason not to have at least 1 megabyte. Now, all Macintoshes are sold with that much or more.

Additional memory beyond that is essential only if you have some specific applications that call for it. Some packages demand memory simply to run. Others will use extra memory
if you have it but will otherwise store the information they work with on your hard disk. Other programs for scanner applications work better or faster with additional memory.

However, if you’re putting together a minimal system, 512K to 1 megabyte should be enough.

**Disk Storage**

I know it is possible to set up a desktop publishing system on a Macintosh that doesn’t have a hard disk. I actually did it back in 1985 with a Fat Mac equipped with only two 400K diskette drives. Using that system wasn’t fun. (Actually, it was a lot of fun, but tedious, now that I know what a joy hard disks can be.)

Fortunately, anyone using a Macintosh and scanning for desktop publishing today will almost certainly already have a hard disk drive. The question, then, is how large a drive is necessary to add scanning functions to the system?

As we’ve seen, scanned files can be very large. Image files of artwork even at fairly low resolutions can amount to 100,000 to 300,000 bytes or more. If you’re doing OCR work with smaller type sizes, you may want to scan at the highest resolutions to provide a sharper image for the OCR software to work with. Your files can then easily be larger than a megabyte.

We’re putting together a minimal system here, so the luxury of storing many scanned files on the hard disk is beyond our reach. We’ll have available only enough disk space to store the files we are working with right now and the scanner software itself.

Therefore, you should probably allot a minimum of 5 to 7 megabytes of hard disk storage beyond that taken up by your desktop publishing software, operating system, publication files, etc. That will allow you to load the scanner software and anywhere from five to 20 or more images at one time. If your
publications aren't long or don't have many images, or you're willing to retrieve them from diskettes, that can be enough.

It is probably possible to configure a desktop publishing system with scanner using only a 20 megabyte hard disk drive. But again, that would just be for a minimal system.

Surprisingly, it may be your floppy disks that provide the biggest bottleneck. With a basic system, you are probably relying on floppy disks, rather than tape or some other medium, to back up your files. An older, single-sided 400K floppy disk can be too small to store a single large file in some cases. Given a small hard disk that can't store many images and a floppy disk that can't store even one, what do you do?

Solutions All Cumbersome

None of the solutions to this problem are less than cumbersome. Many software programs that work with scanner images already use file compression schemes to make the file as small as possible. Thus, third-party archiving programs like Raymond Lau's Stuffit won't crunch the files much smaller.

An exception is Kodak's Colorsqueeze software, which was developed specifically to reduce the size of image files on the Macintosh. This utility was written especially for color scanned images, which are typically three times as large as a gray-scale image. The first release of Colorsqueeze wasn't intended for gray scale images. Three different compression ratios are available, providing more than 14:1 reduction of images. At maximum compression, a good image with no detectable loss of detail results. Kodak's motivation for producing Colorsqueeze was to reduce the size of Macintosh image files transmitted over long distance telephone lines by its SV9600-series still video transceivers. There is no reason not to apply this software to image storage chores to produce smaller files.

An alternative is to use a special hard disk backup utility to copy a large file to multiple 400K floppy disks. Of course, you
then end up with dozens of diskettes storing just a few scanned files.

Another solution is possible, if you have several computers available. You can use a serial cable and null modem to link your scanner system computer with a second computer that has more capacious disk drives and use a program like LapLink to exchange files. This may be an unlikely scenario for a system constrained by a minimal configuration, however.

Even if you are putting together a low budget scanning system, you should seriously consider adding a high density disk drive to streamline backups and image file storage. You might be able to get by with an 800K or even a 400K drive, but a 1.44 megabyte drive or even the new 2.8M drives from a company such as Konnect will make life a lot easier.

**Graphics**

Our low budget scanning system won't allow for anything other than the standard screen built into compact Macs. The Mac II, even with the monochrome screen and video card supplied with low end systems, is beyond our reach.

**Operating System**

Many scanner programs call for at least System 6.0 software, so that's what you should use. The memory requirements of System 7.0 put that operating system out of the picture for our low end scanning setup.

**Optimal System**

If you read the columnists in the leading computer magazines you might think that they all use $12,000 state-of-the-art 40 megahertz Macintosh IIfx or Quadra systems with 24-bit color cards and $3000 monitors and assume that all their readers should, too. Their advice and that which follows may, therefore, seem a little out of touch with reality.
Actually, computer industry writers do need to develop expertise with the latest equipment. No one wants to read the opinions of a trailing-edge journalist. However, the personal systems of those writers are generally a hodge-podge of components on 30- or 90-day loan from manufacturers combined with equipment owned by the journalist or the publication. We do understand that not everyone can spend $12,000 on a personal computer, just as we also know that many people are willing to spend a little more on their system if they can justify the benefits they’ll realize from the added expenditure.

The optimal system I’m about to describe will not be a sky’s-the-limit fantasy. Upgrading to a 68040 system—when they are available—with a gigabyte of optical disk storage won’t buy you anything that will improve scanning operations—anything that you can’t duplicate for a lot less money, I should say.

What follows is a realistic configuration of components, carefully selected for someone who does a significant amount of desktop publishing on a fairly regular basis.

Summary of components.

- A Macintosh IIci, IIfx, or Quadra with at least one free slot.
- 8 megabytes of memory.
- A 24-bit color card and monitor.
- One 120 megabyte hard disk drive.
- A 60 megabyte tape backup or other replaceable media system.
- A gray scale or color scanner.

Granted, a system like this doesn’t come cheap. However, it is far from beyond the reach of most of the readers of this book.

I can guarantee that with a system like this, you can do any scanning/desktop publishing you care to—efficiently and
quickly. Now, let's examine each of these components to see where all that money went.

**Computer/CPU.**

The Macintosh IIci will give you a fast Mac system with enough slots for a broad range of video cards and other specialized peripherals. The Mac IIfx or Quadra are an even better bets if you can afford them, offering both a 40 megahertz 68030 or 68040 CPUs and 68882 floating-point processor. The latter chip can really speed up number-intensive image processing applications. You also get a 32K superfast memory cache on the motherboard, and other speed enhancements.

**Figure 4.1**

Bernoulli Box II twin 90 megabyte removable disk drive
Operating Systems
System 6.05 is required for some software, but many readers will be upgrading to System 7.0 by the time this book is published.

Memory
With a Macintosh and Multifinder, or System 7, the more memory you have, the more programs you can run at the same time. Your minimum ought to be 4 megabytes. Some software actually requires that much just for itself. Other packages can use more memory if you have it, which can help speed up many functions when working with large image files. I started out with 4 megabytes when beginning this book, then added another 4 megabytes for less than $160 a few months later. RAM prices are dropping at this writing, so you may be able to upgrade your system for even less. With 4 to 8 megabytes of memory you can run the most memory hungry OCR programs or even several packages at once without resorting to slower virtual memory techniques.

Monitor and graphics
The basic 640 x 480 resolution and gray scale capabilities of 8-bit color cards are almost the minimum required for working with scanned images. The 8-bit color card provides 256 on-screen gray shades or colors. A 24-bit color card is even better, providing a life-like 16.7 million colors in its palette.

Disk Storage
I won't repeat here how scanned images can eat up hard disk space. It's very likely that all the hard disk storage you'll ever have will never be enough. The best solution is probably to have a decent amount of hard disk space, say, 160 megabytes on line at all times. Then, you can have some sort of removable media that can be plugged in and out to provide the open-ended storage capacity you really need.
The 160 megabytes figure was arrived at by looking at the current prices and configurations of popular add-on hard drives.

I prefer the Bernoulli box approach, since the removable media can be treated as another hard disk—with an infinite amount of storage. By configuring a 160 megabyte drive as two 80 megabyte volumes, each can be backed up to a single 90 megabyte Bernoulli cartridge. You can keep another 90 megabyte cartridge on-line to make additional images available. In effect, you have more than 250 megabytes of on-line storage and can replace 90 megabytes of that with any other 90 megabytes in a few seconds. As a bonus, Bernoulli provides utility software similar to the Apple File Exchange program that lets you interchange their cartridges with IBM PC compatible systems if you need to.

Back Up

If you don't go the Bernoulli route, some sort of tape backup is essential. It's possible to back up all the data on 160 megabytes of hard disk storage incrementally using high density diskettes. It's also possible to restore all those files if you have a head crash or some other problem. But personally, I'd hate to sit there and copy 100 or more diskettes back to a pair of hard drives. Tape backup systems cost less than $300 today. Our optimum configuration should include one.

Environmental Considerations

In general, a scanner doesn't require an environment much different from that required by a computer system. You'll want a clean, dry work area for the scanner, just as you would for your computer. Some general guidelines follow:

- Install the scanner on a level surface. This will make it easier to position objects properly.
- Make sure the scanner is located on a surface that is free of frequent or constant vibration. The alignment of any type of precision equipment can be disturbed by a lot of vibration. Moreover, your scans could conceivably be affected by significant jiggles. Thus, you wouldn’t want to place your scanner on top of or next to anything with a fan or motor, such as a photocopier, printer, or even a computer system unit.

- Don’t expose your scanner to direct sunlight. Sudden bursts of high intensity illumination or long-term exposure to high light levels can damage the unit. At the very least, direct sunlight could “leak,” reducing the quality of a particular scan.

- Use the scanner only in normal office temperature and humidity ranges. Very cold temperatures can reduce the efficiency of the lubrication used in moving parts and encourage condensation of moisture if warmer air or objects come in contact with the scanner. High temperatures can cause those lubricants to vaporize (and deposit themselves on surfaces where they are not appreciated). Heat can also reduce the useful life of components. Dry air probably won’t harm your scanner, but excessively high humidity levels can cause problems.

  Most scanner manufacturers recommend using your scanner at temperatures from about 40 to 90 degrees Fahrenheit (5 to 35 degrees Celsius) and relative humidities of 5 to 35 percent on the low end to 85 or 95 percent on the high end if the temperature is high enough that condensation isn’t likely.

**Summary**

Most scanners can be used with just about any computer system. However, you may find that you can work a lot more productively with your scanner if you have more than a minimal system.

Businesses can find it relatively simple to justify a fully-configured computer for scanner use; the time saved by extra memory, additional hard disk storage, etc., will pay back the
investment in a relatively short time. Casual users may find the expenditures more difficult to swing.

A minimal system will consist of any Macintosh with 512K to 1 megabytes of memory, with a 20 megabyte hard disk, System 6.0 or later software, and a scanner, such as a low-cost hand scanner. Such a system can cost as little as $2000.

A more fully-featured configuration will include a Mac IIci or IIfx or Quadra, 4 to 8 megabytes of memory, a 24-bit color card and monitor. Also included should be a 160 megabyte SCSI hard disk drive, and a backup system with replaceable media. You should be able to assemble a workstation like this for less than $12000 (and up, for the IIfx and Quadra). A good gray scale scanner will cost $1500-$2500 more.
Once you've scanned an image, your work has only begun. In many cases, you'll want to touch up or manipulate the image using a paint or drawing program. Or, you may want to run the image through an optical character recognition (OCR) software package to convert the bitmap to a stream of characters. Certainly, if you're involved with desktop publishing, the probable final destination for your images will be a page layout package like PageMaker, QuarkXPress, Design Studio, or Ready, Set, Go.

To understand your options in all these situations, you'll need to learn about the different types of images: line art, continuous tone images, and halftones. This chapter will serve as an introduction to all three types. Continuous tone images (those with a gray scale) and the process of converting them to halftones will be discussed in more detail in Chapter 6. Then we'll go on to explore some of the software available to manipulate all three types of images in Chapter 7. These three chapters cover the most important concepts you'll need to understand to work with images and your scanner.

But first, I'd like to address one problem we have when working with images: the differences between the images we scan and those we see and work with.
WYSINWYG

In the Introduction to this book, I talked about technology as the enemy of imaging. We've also seen that it can be very, very difficult for computers to do simple things that humans do, unless they do them in different ways that are more natural to machines.

How computers handle images is an excellent example of this. Many of the problems we encounter in using scanned images in desktop programs stem from the fact that what you see is not what you get (WYSINWYG). Most computer systems, even the Macintosh, use one technique to show us an image on the screen and an entirely different technology to print it out. There are excellent reasons for this, none of them sufficient to justify the contortions we have to go through to accommodate the shortcomings of the computer.

Early Computer Displays

A quick example will show you what I mean. Before the Macintosh, most personal computers used displays that were entirely character-based. A read-only memory (ROM) chip stored a set of characters that the computer could display. This character ROM contained a tiny bit map of each letter or symbol, based on a fixed screen cell that might be as skimpy as 8 x 8 pixels. There was no way to change the appearance of the characters without replacing the ROM chip itself, either with a hardware modification or by fooling the operating system into looking to another location for its character information.

In fact, I can still remember the thrill of upgrading my original TRS-80 to provide the optional ability to display lowercase characters.

Printers of the time didn’t necessarily use the same bit map for each character that the computer used. All they were interested in receiving was the set of ASCII codes that repre-
sented your text, along with some control codes that provided the printer with other instructions. Each printer had its own set of characters, often with funny names like expanded, condensed, and elite. What you saw on your screen definitely was not what you got on the printed page.

The first Macintosh was a brilliant early attempt to overcome the problems inherent in this approach. Those of us who were pioneering users of the system were amazed by the almost-WYSIWYG approach of this ground-breaking Apple.

Everything Is Graphics

The Macintosh, in short, treats everything you see on the screen as graphics. Text characters for the most common sizes are built from bit maps stored in the System file, or calculated from those maps for other sizes. Because the 68000-series microprocessors are so fast (compared to the Intel 8088 chips used in PCs in 1984), the Mac is able to perform these calculations and redraw the screen fast enough to make this all-graphics approach work.

The original Macintosh had a 74 dpi screen coupled with a 72 dpi Imagewriter printer, so what you saw was, more or less, what you got.

However, today printer resolution has gotten much better and screen resolution has lagged behind. So, WYSIWYG is no longer the case for Macintosh users. Some special solutions, such as the Adobe Type Manager, have had to be cobbled together to provide Macs with even a semblance of screen/printer correspondence.

Why Not 300 dpi Monitors?

You may have a 300 dpi printer and a scanner capable of the same resolution, so you might think it would make sense to have a CRT screen with the same 8.5 x 11 or 11 x 8.5-inch size as a typical business document and a resolution to match.

That's a foolish hope. You're more likely to have a standard Mac 9-inch monitor that can display only a fraction of your
page at one time. Moreover, the pixel layout of your screen won't even be an even multiple of that of the matrix of dots used in your printer. There's no way to reproduce a 72 dpi image at exactly 300 dpi, since 300 can't be divided evenly by 72. You couldn't for example, show every other pixel, to represent the image at one-quarter the original resolution without wasting some of the capabilities of your CRT. This makes it difficult to show on the screen what you scanned or what you will get on the page. For that reason, the Macintosh has a special enhanced printing mode that uses a resolution equivalent to 288 dpi (which is a multiple of 72). The printed image is smaller than it would be at 300 dpi, but more closely resembles the original.

Of course, the same software schemes are not used to draw images on CRT and paper. For PageMaker, RSG, and QuarkXPress, you need separate font files for your printer and screen. That's true even if you happen to be using scalable PostScript printer fonts. That wastes a lot of disk space and still doesn't show you exactly what you are going to get.

**Problems with PostScript**

The greatest disparity is suffered by those with PostScript printers. PostScript is an interpreter that uses commands to tell the printer how to draw an image. PostScript is wonderful for fonts, because it does not require the computer to store a separate printer font file for each size type you want to use. (PostScript will be discussed in more detail in Chapter 12.) However, PostScript sometimes reduces the image quality somewhat when reproducing bit-mapped graphics.

Since you can't display PostScript images on your monitor, PostScript graphics files (called Encapsulated PostScript) can optionally contain an approximate representation of the image in a format you can display. Depending on the software you use, you may see this low resolution image (what-you-see-
is-something-like-what-you-get) or in the worst case, a nice box that shows where the image will go.

Steve Jobs's NeXT computer uses Display PostScript to present on the screen the same images that its printer version of PostScript sends to your output device. Of course, Display PostScript is very slow and demands an advanced computer like the NeXT.

Eventually, Mac users will probably demand nothing less than improvements in the capabilities of the monitor to match those of the 300 dpi printers already in use. Of course, that would require a vertical full-page display with 2550 x 3300 resolution or a half-page monitor that could resolve 1275 x 1950 pixels. Given that the highest resolution monitors in common use today can reproduce just 768 x 1024 to 1024 x 1280 pixels, we're still out of the ballpark. With today's technology, monitors that could resolve the same amount of detail that printers can output would be prohibitively expensive.

Do we need true WYSIWYG? Perhaps not, as long as we understand the source of the problems and learn how to accommodate the disparity between scanned and screened images and those we output on our printers.

Keep this discussion in mind as we survey the different types of images scanner users work with. You'll see that the differences in display and scanner/printer resolution can cause complications and needless translation each time we move from one to the other.

**Types of Artwork**

This section will explain the differences between line art, continuous tone images, gray scale images, and outline-oriented artwork. Most scanners can handle both line art and continuous tone images, but our output devices will provide only binary, black-and-white images. You'll learn a little about how this problem is handled.
Line Art

Line art is any piece of artwork that consists only of black and white areas. We usually think of line art only in terms of illustrations that don't use special techniques, such as dithering, to simulate a continuous scale of gray tones. So, a pen-and-ink sketch of a landscape is line art. A portrait drawn in pencil is also line art. Architectural plans, mechanical drawings, and electrical schematics are another sort of line art. A sample line art illustration is shown in Figure 5.1. The key is that a line of only one density is used to outline the art (the color of the line can be black or dark blue or any other color).

Because a single density is used to draw line art, scanners can capture such images as single-bit, binary images. If the art happens to be drawn in several colors, it can still be captured by a black-and-white (monochrome) scanner. All the
different colors will be represented as black, as long as they are all similar in density and one of the colors is not the color used by the scanner's light source.

Suppose you have an architectural drawing in which walls are represented in black, windows in dark blue, and doorways in dark green. A monochrome scanner will see all these three colors as similar shades of dark gray and capture them as black. As you can see, line art doesn't have to consist of all black lines. (Capturing different colors as separate images will be discussed in Chapter 13.)

Nor is the appearance of the image limited to black-and-white. Line art can include patterns or fills, such as the cross-hatching and other effects found in MacPaint and similar programs to differentiate between adjacent areas. Fills, for example, are often used on bar charts. Because the regular patterns alternate black and white lines, our eyes blur the two to provide a grayish image. Line art may contain only lines of the same density, but still appear to have gray.

Higher Resolutions Help Line Art

With line art, the higher the scanning resolution, the sharper the image will appear to be. That's because many more pixels are available to represent the edges of the lines.

Of course, the higher the scanning resolution, the larger the image will appear on the finished page. That's something that often surprises beginners, who may scan an image at 150 dpi, print it out, then scan it again at 300 dpi. They expect the second image to be the same size, only sharper.

What really happens, of course, is that four times as many pixels are used to capture an image at the higher resolution (300 x 300 per square inch, or 90,000 pixels, compared to 150 x 150 per square inch, or 22,500 pixels). So, each square inch of the original image is printed at, say, 300 dpi in either case. So, four times as many of them will be required to print the higher resolution picture, and it comes out four times as large.
Fortunately, your desktop publishing software compensates for this and reproduces each image at the same size.

**Continuous Tone Images**

Another kind of image is called continuous tone, because it appears to have a continuous scale of shades from pure white to black, with all the grays in between. A black-and-white photograph is a typical continuous tone image. Color images can also have continuous tones, with the added component of
For now, it's simpler just to consider the gray tones or gray scale of monochrome continuous tone images.

Even though continuous tone images may have smooth gradations through all the different shades of gray, it is convenient to think of such images in terms of individual steps or gray levels. Photographers do this all the time when they use one of the various Zone systems of exposure. When we use photographs and other continuous tone images for desktop publishing, we'll need to think of gray levels too. Gray scales are discussed more thoroughly in the next chapter.

Halftone Images

Halftones are a technique that allows printing presses and laser printers to reproduce continuous tone images. Halftones convert the various gray values to black dots of various sizes. The eye merges these black dots with the surrounding white area to produce the perception of a gray tone. Macs without color/gray scale capability always show gray tones in this way, using built-in dithering routines.

While you'll want to learn more about converting images to halftones, you also need to consider them as original input for scanning. At times, you may discover that an image that has already been halftoned must be recaptured for a publication. Generally, you'll obtain poor results in capturing such images. Scanning halftones as the continuous tone images they may appear to be works only until you try to apply your own halftone effect to the image. The extra set of dots usually results in an objectionable effect called moire.

Scanning an existing halftone as line art may be your only choice, and even that won't reproduce the original halftone well.

Scanning Different Types of Line Art

We always scan line art as the series of pixels that make up a bit map. However, we're not limited to working with the
finished art in that form. In Chapter 7, I’ll explain about image manipulation software in some detail. Prior to that, you should learn about the differences between vector and raster graphics, and the advantages and disadvantages of each. The next section will explain bit maps and outlines. The information will help you understand gray scales and some of the other topics that come up in the chapters that follow.

**Vector Graphics vs Raster Graphics**

Scanner images are commonly referred to as raster graphics. Raster images are the most common type of images your computer works with. MacPaint files are the simplest kind of raster images you may be familiar with, but, all the text and graphics displayed on your monitor are shown in raster form. Dot matrix and laser printers use maps of the individual bits that make up an image to generate hard copies.

Another sort of image that computers can work with is called vector graphics. Vectors are simply the individual lines that make up the image itself. Humans are generally more accustomed to working with the straight lines and curves that compose vector graphics than with the dots used in raster graphics. Many of us were first introduced to vector graphics by the popular Etch-A-Sketch drawing toy. On the Macintosh, the program MacDraw was the first outline-oriented software that was widely distributed.

Scanner users should understand both types. Each has advantages and weaknesses. Knowing about raster graphics will help you understand how a scanner captures an image. Learning about vector graphics will put you on the road to understanding some types of optical character recognition, as well as common computer-aided design/ manufacturing (CAD/CAM) applications.
Raster Graphics

We'll look at raster graphics first. A raster image area is divided up into a series of parallel lines, usually laid out horizontally. Each line is in turn divided into individual dots called picture elements or pixels. In the most basic form of raster graphics, each pixel is either black or white. The eye merges this array of black and white pixels into a recognizable image.

Computers work well with raster images of this sort, since the black/white, on/off state of individual pixels can be conveniently represented by the 1's and 0's that computers use. Only a single binary digit, or bit, is required for each pixel. For that reason, a raster image is often called a bit map. The series of bits can be used to reconstruct a map, or representation, of the image.

This explanation is probably a bit too basic for most readers who have been working with bits and bytes for years (or months, anyway). Yet, it's still useful to look a little closer at this topic in order to gain a greater understanding of how gray scale scanners and imaging work.
Imagine a very small television screen, one with only 16 lines of vertical resolution (compared to the actual 525 lines used in the United States). Each of those lines contains 16 pixels. We could represent an image in this 16 x 16 matrix using 1's and 0's. Each 0 would represent a pixel that is white and each 1 would represent a pixel that is black. A picture of the letter A might look like Figure 5.3.

Computers have no problem storing 1's and 0's. Typically, they handle such strings of numbers in eight-digit chunks. So, each 16-pixel line would be divided into two groups of eight digits. Eight binary digits (abbreviated bit) are called a byte.

If this is more bits and bytes terminology than you are comfortable with, take heart. We're almost finished for now. In the example in Figure 5.2, the top line of our screen would be 00000011 and 11000000 in binary, or 3 and 192 in decimal. A string of 32 8-bit numbers (two per line) could represent all 256 different pixels on our 16 x 16 screen. That's all there is to a bit map. More complex and larger graphics simply require bigger bit maps.

Drawbacks

Bit mapped graphics have several drawbacks. First, a bit map can require a great deal of storage, even for a very simple image. In this example, 32 numbers are required to represent a figure that consists of two vertical lines, one horizontal line, and two diagonal lines. That's because one bit has to be used to represent every pixel on the screen, whether that pixel is used to make the image or not. An image of a single dot in the center of the screen still requires 256 individual bits to reconstruct.

This comparison ignores the data compression techniques that are usually used, however. For example, a string of 12 zeros, such as the one found on the bottom line of the example, needn't be represented by a byte-and-a-half of information. A much shorter code that means "12 zeros" can be used instead.
However, most bit maps are larger than 16 x 16 pixels. Your Mac II or Mac Portable screen may have 640 x 480 pixels. That represents more than 38,000 bytes of information for a black-and-white (binary) image.

Unfortunately, we humans don’t generally create the images we work with row-by-row or dot-by-dot. Our artwork is much more object-oriented. To sketch a simple house, we’ll first draw four straight lines to produce a square or rectangle, and then top that off with slanted lines to represent the roof. A skilled painter may then use brush strokes or dabs to produce the texture and detail that make the house look real. But even the most abstract artist doesn’t start at the upper left-hand corner of a canvas and paint a point at a time.

**Vector Graphics**

Line-based, object-oriented graphics are often called vector graphics after the mathematical concept of a quantity that can be represented by a magnitude and direction. The lines we draw with all have a magnitude (length) as well as a direction.

**Figure 5.4**

Vector art is often used in CAD/CAM applications.
In the computer world, vector graphics are most easily seen at work in plotters, which draw images much the way people do, combining lines into shapes. There are a number of advantages to working with images in this way.

First, it's fairly easy to treat each of the individual components in a drawing distinctly. The four lines you use to draw a square can be grouped together as one object, even if you happen to draw a second object, such as a circle, that overlaps it. Figure 5.4 shows what vector art might look like.

In addition, the amount of storage space required for vector graphics is related directly to the complexity of the image. A drawing that consists of a single straight line can be stored as the start and end coordinates. On the downside, very complex images can take as much storage or more than bit mapped images, and are definitely more complicated for computers to draw. High end computer-aided-design (CAD) systems are prized for their ability to redraw complex vector graphics quickly.

**Scanners Capture Only Bit Maps**

Scanners are capable of capturing only bit maps of images. The scanning process itself is strictly a pixel-by-pixel, line-by-line process. This is true whether the device is a single sensor or line of sensors that scans one line at a time, or one that captures an entire image with a two-dimensional sensor array (like the charge-coupled devices found in video cameras).

Fortunately, bit maps can be changed to outline-oriented format through a process called raster-to-vector conversion. This is a software technique in which the edges of objects are inferred by the program because of the relatively rapid change in density that occurs at the edges. Computers are able to interpret a continuous border of relatively even density as the outline of an object.

High end dedicated publishing systems may have raster-to-vector conversion built in, often with a dedicated add-on board that speeds the process. Those of us who work with desktop
publishing systems usually rely on drawing programs that let you manually trace the outlines of bit mapped graphics. Most such programs also have an autotrace function. There are even stand-alone raster-vector packages, like Adobe Streamline.

**Gray Scales and Scanning**

As we’ll see, many scanners capture the relative lightness/darkness of a pixel. Instead of recording just an on/off (a 1 or 0) value for each pixel, these scanners determine how light or dark that pixel is. Of course, darkness/lightness is a continuous, or analog, phenomenon. Computers divide the gray spectrum into a scale of values called a gray scale. If you use several hundred individual levels, the differences between them are so small that the image is for all intents and purposes a continuous gray scale.

By using an entire byte to represent the grayness of a pixel, we can represent all the values from 00000000 to 11111111 in binary (0 to 255 in decimal). That gives us a 256-level gray scale. Scanners used for desktop publishing generally don’t exceed that depth. It simply isn’t necessary to divide the gray scale into more than 256 gradations. In fact, we can frequently get by with quite a few less.

As you might guess, the more detailed the gray scale, the more processing power and data storage are required. For example, with 256 gray levels, our display requires almost a third of a megabyte to represent a full-screen gray scale black-and-white image.

You’ll frequently see gray scale capabilities of scanners represented by the number of bits needed to store information about a single pixel. A binary (one-bit) scanner can capture only black/white information about a pixel. Dots that are 0 to 20 percent black are assigned a white value. Anything from 21 to 100 percent black is stored as black. The software often won’t refer to these percentages directly.
Instead, the threshold will reference only the relative brightness of the image that will be produced. You may be able to move the threshold up and down under software control.

Two-bit scanners can produce four different levels of gray—not enough to represent a continuous-tone picture very well other than as a “posterized” effect. You also will see references to 4-bit (16 gray levels) and 6-bit (64 gray levels). The original HP ScanJet, Apple Scanner, and many similar models were 4-bit devices. It was possible to capture some very good images of photographs using such machines, although a lot depended on the contrast and brightness of the original.

File Types

The image manipulation programs, scanner control programs, and desktop publishing packages that you use are all separate applications programs each of which uses a limited set of file types. The Macintosh world has been fortunate in that we have escaped the vast proliferation of file types found in the IBM PC compatible environment.

In Praise of QuickDraw

There is a simple reason for this. Macintosh software generally uses the Mac's built-in QuickDraw (later on, Color QuickDraw or 32-Bit QuickDraw) routines to write to the screen and similar techniques (or PostScript) to output those images on a printer.

It's hard to over-estimate the importance of the Mac's QuickDraw routines. These are special program subroutines built into each Mac's ROM or loaded by the operating system when you start the computer. (32-Bit QuickDraw consists of a new General control panel device (cdev), a Monitors control panel device for 24/32-bit video cards, and a special INIT (extension under System 7) file.) Application programs call these subroutines whenever something is written to the
screen. QuickDraw instructions are translated to commands your printer can understand at print time.

A few early applications programs by-passed QuickDraw and sent information directly to the Mac's video memory. As a result, you may get some strange images when these programs (which assume you are using a non-Color Mac) are run on other than a black/white, binary image Macintosh.

Today, well-behaved software uses only the routines built into the original QuickDraw, Color QuickDraw or 32-Bit QuickDraw. All can handle a variety of screen sizes, ranging from the 640 x 480 pixels found on the Mac II and Mac Portable to the 512 x 342 pixels on the compact Macs.

These are just different sized windows on a larger virtual screen. With a compact Mac, your desktop is simply smaller, so you can't make an application window as large as you can with a larger screen.

That's not the case in the IBM world, which has no equivalent to QuickDraw. A given application may be asked to display the same screenful of information in the same size at resolutions ranging for 320 x 200 pixels to 800 x 600. Not all software can handle every screen resolution, since special drivers have to be written for each. That leads to a variety of file formats and the resulting incompatibilities between them.

The Macintosh world doesn't have quite the same problem. Many applications do have their own unique file formats, but they can also use one of the common Macintosh formats such as MacPaint, PICT1 or PICT2.

In addition to the formats created for MacPaint and MacDraw, there are special file formats like TIFF (Tagged Image File Format) developed to handle gray scale information. Encapsulated PostScript was created to provide a way to embed (encapsulate) PostScript images within other files (such as your desktop publishing documents). With a few exceptions, those are the key file formats used by the Macintosh. Many Mac applications can import files from other
systems, such as IBM PCs, so you may need to know something about those formats as well.

For this discussion, I'll assume that you already know what a file is. We'll concentrate on the different kinds of graphics files that are available. But, in case you've forgotten, here is a definition:

file (fil) -n. 1. the smallest quantity of information that can accidentally be erased by a computer user. 2. a small tool with cutting ridges or teeth which can be used to make an expansion board fit better in a tight slot. -v. 1. to store something you don't mean to find again. From the Old English fylan: befoul. See also defile.

Graphics files are often stored in the Tagged Image File Format (TIFF) standard or in Encapsulated PostScript (EPS). Generally, these file types break down into two different categories: bit mapped or raster files (such as TIFF) and outline or vector files (like EPS).

Each file type is handled by software that is specifically designed for that format. In common parlance, paint programs are those that work with bit mapped files and which can manipulate these files pixel-by-pixel. Draw programs, in contrast, use vector graphics to define images as lines and shapes (called objects). Paint programs usually can't handle vector-type files (without conversion), and draw programs can't work with pixel-based images as such (a bit map can be used as a template for tracing in a layer “above” the raster image).

Most image manipulation packages (particularly draw packages) can save files in more than one format and thus convert between them. There are also programs with specific conversion features.

Your desktop publishing package may also have some flexibility built in. QuarkXPress, for example, can load formats
called RIFF, TIFF, PICT, PICT2, and EPS as well as black-and-white and color bitmap images. PageMaker allows you to load both bit mapped and outline-oriented file types, including RIFF and TIFF images, and Encapsulated PostScript files.

You need to become familiar with the various graphics file formats so you'll know which are compatible with your image software and desktop publishing program. In some cases, the image manipulation package can load one file format and save in another, so you'll be able to convert from one type to another, if necessary.

The next few pages discuss several of the most common file formats. The issue is complicated by the fact that it is becoming more common to exchange graphic files between unlike computer systems, particularly between Macintosh and IBM types. So, it's not enough to learn about the various Mac graphic file formats. You should also have at least a nodding acquaintance with some of the types used by IBM systems. A more complete listing is shown in the table that follows.

**PICT/PICT2**

These formats are so-called because files consist of a QuickDraw PICTure that can recreate the image. They can be used to form both monochrome and color raster images, as well as object-oriented graphics. A PICT file can even contain a combination of both types.

The PICT2 format is a recent variation that can be used to store color or gray scale information. Such files contain commands used with Color QuickDraw and, therefore, are compatible only with applications run on Macs properly configured for color or gray scale display.

PICT files are produced by MacDraw and other programs.

**MacPaint**

MacPaint format is used by the original MacPaint program, MacPaint II from Claris, and as a main or alternate format by
other paint-type programs. The Mac also captures screen images (with Command-Shift-3) using MacPaint format.

This format is limited to 72 dpi resolution, and therefore is not suitable for high-resolution image capture or manipulation.

MacPaint is the format developed for use with the program that started all the fuss over personal computer imaging. MacPaint was introduced with the Mac more than five years ago and, until recently, was provided free with every system. Bill Atkinson, author of MacPaint, virtually created the paint type drawing program single-handedly. Every program for bit map image editing released since then draws heavily on MacPaint.

There are also a great many MacPaint files out there, both as clip art and as scanned images that you might want to incorporate in your desktop publication. Many IBM PC programs, including Ventura Publisher, also allow importing of MacPaint files.

One of my earlier books on the Macintosh was illustrated almost entirely with MacPaint pictures. Even though the operating systems and disk formats of IBM and Mac computers are different, you can exchange files that are saved in many standard formats. I used to do this by linking the two computers with a null modem cable and telecommunicating between them. More recently, I've purchased a Rapport disk controller, which is a tiny device that can be plugged between the Mac and an external 3.5-inch disk drive. That drive can then read and write both 800K Mac format diskettes and 720K IBM disks. The Apple File Exchange program converts the files both ways.

**TIFF**

TIFF is an abbreviation for Tagged Image Format File, a specification that was developed in 1986. TIFF files, which generally have the file extension .TIF in the IBM world and
sometimes also provided with that indication in Mac environments, are the most common of the standard file formats. In the Mac world, they are usually produced by a scanner. If a software program is able to load a format other than its own specialized file type, that other format is probably TIFF. Keep in mind that there are various types of TIFF files, including compressed TIFF, uncompressed TIFF, and TIFF PackBits. Not all software supports all the TIFF types.

The TIFF format can store both binary (one-bit) files and files with 16, 64, or 256 different tones. Only the binary type can generally be compressed, so TIFF files can hog quite a bit of hard disk space.

A TIFF file is so called because each file includes collections of information, called tags, which describe the file type. A tag can provide information on resolution, number of bits used per pixel, and many other descriptors. The basic data needed to handle a file is included in a standardized set of tags that can be interpreted by any application.

**Applications Create Own Tags**

However, applications can create their own tags with information that the application wants to store with the file. A simple example of this would be a longer descriptive name or caption that is displayed when the file is loaded. These special tags are ignored by applications that don’t understand how to read them, which means that you can exchange TIFF files between older versions of an application and newer, enhanced versions of the same software. Totally different programs can also read many TIFF files created by other applications.

Problems arise when new types of tags include important information that must be understood by the application to reconstruct the image. For that reason, you’ll sometimes find TIFF files that can’t be read by other software easily.

Four standardized TIFF formats used by many applications are classified as B (black-and-white or binary information only), G (gray scale), P (palette—a number of different colors),
and R (red, green, blue (RGB) color). These classes can be compressed or uncompressed.

Color TIFF files are displayed in color on a Mac with color monitor and video card. They are shown as gray scale images.

Figure 5.5

An Encapsulated PostScript file.
on black-and-white gray scale monitors. Other black-and-white monitors show TIFF images in dithered form.

If your application gives you a choice, you should use uncompressed TIFF format when you know you'll be importing files into another program, particularly a desktop publishing package. More disk space will be required, but you'll avoid having to reload the file into the program that created or captured it, and then saving it again in the compatible format.

**RIFF**

RIFF is an abbreviation for Raster Image File Format. It was introduced with LetraSet ImageStudio and can be read by PageMaker 4.0, QuarkXpress, Design Studio and Ready, Set, Go (since the two latter products are also both from Letraset). RIFF files can store gray scale information or line art with up to 256 different tones.

**Encapsulated PostScript**

The first four file types are, of course, bit map formats. Encapsulated PostScript (EPS), used for storing outline images, is the most common of the vector file types. EPS files can be printed by PostScript printers and imported by most desktop publishing packages, including Quark, RSG, and PageMaker.

PostScript is a page description language (PDL) developed by Adobe Systems and licensed or emulated by other manufacturers. Because PostScript uses outlines for fonts and graphics, many of the benefits of vector graphics discussed earlier in this chapter apply. That is, PostScript allows great flexibility in sizing images, since a description of how to draw the image rather than a bit map is used. You don't necessarily save any disk space, however, since the PostScript language descriptions of an image can themselves be very long.

That also means that higher resolution output devices can take full advantage of their high resolution capabilities. A 300 dpi bit map printed on a 1270 dpi Linotronic imagesetter won't
look any sharper. The Lino will simply use four of its smaller dots to simulate each of the larger 300 dpi pixels. However, with a PostScript file, the image can be printed at full resolution.

EPS files are simple ASCII files containing the program statements necessary to build your image in the printer's memory. Figure 5.5 shows an Encapsulated PostScript file that draws a simple square. A low resolution image header, which can be used by the applications program to display a rough approximation of the PostScript image, is appended.

EPS files are much like ordinary PostScript files, except that two lines like the following are required:

```
%!PS-Adobe-2.0 EPSF-1.2
%%BoundingBox: 27 428 387 765
```

The first line tells the interpreter that it is working with an EPS file. The second line defines the coordinates of the EPS image (since, unlike a conventional PostScript file, the EPS file isn't defining an entire page). If you'll visualize a graph with X and Y axes, in this example, the lower left corner of the box is located at X=27, Y=428, while the upper right-hand corner is at X=387, Y=765.

You can see the zeros which outline the image. Each zero represents a pixel that will be displayed with no density (black). Each F represents a pixel that will be shown with maximum density (white). If you have any programming experience, you may correctly guess that the F represents the hexadecimal digit equivalent of the decimal value 15. (Hex numbers progress from 0 to F: 0 1 2 3 4 5 6 7 8 9 A B C D E F.) So, up to 16 different gray levels can be represented in an EPS bit map header.

If your software doesn't support this function, a gray square or a box with a large X will be substituted on-screen instead.
You'll have to print out the page to see what the image looks like.

Note that EPS files created by Macintosh applications with an image representation store that image as QuickDraw instructions. IBM-compatible applications use a bit map instead. Therefore, EPS files exchanged between IBM and Mac computers won't be displayable in the other environment.

Other Formats

There are some additional file formats used in the MS-DOS world that are supported by some Macintosh software or by interchange utilities like the Apple File Exchange. These include

CGM

The Computer Graphics Metafile format is a common vector-oriented file type, available in slightly different variations for a number of different applications programs. These include Arts & Letters, Lotus Freelance, Harvard Graphics, and Micrografx Designer.

DXF

Data Exchange Format is used with AutoCAD. You'll find that some Mac CAD software will accept files from this program.

HPGL

The Hewlett-Packard Graphics Language was developed for plotters, the original vector-oriented computer output devices. There are file translation facilities to convert these files to Macintosh applications.

Summary

In many cases, obtaining a scanned image is only the first step in a long process. You'll usually want to touch up the image using a paint or drawing program. This chapter has
explained the various types of images and file types that you will be working with.

One of the primary reasons that there are so many different file types is that computer graphics displays aren’t standardized. The problems caused by WYSINWYG (what you see is not what you get) displays were explained to help illustrate this point. Users of PostScript printers, for example, find that their screen displays are very different from what is output in hardcopy form. In some cases, nothing but a large X is shown on the screen in place of an Encapsulated PostScript (EPS) graphic.

In this chapter, you learned about line art, continuous tone images, and halftones. Line art consists of only black and white areas, with no gray tones. Gray can be simulated, however, through the use of patterned fills or a process called dithering. With line art, the higher the scanning resolution, the sharper the image will appear to be.

Continuous tone images appear to have a continuous scale of shades from pure white to black, with all the grays in between. Black-and-white photos are typical continuous tone images.

Halftone images provide a way to reproduce continuous tones with printing systems that are capable of handling only black. The various shades of gray are converted to dots of various sizes. The eye merges these black dots with the surrounding white areas to produce a gray image.

We also looked at the various types of line art. Bit mapped, or raster, graphics consist of a series of pixels arranged in row and column format to reproduce an image. Vector, or outline, graphics store an image as shapes and objects. Raster graphics files require more disk space, but don’t become larger as the complexity of the image increases. Vector graphics allow scaling and sizing an image without losing quality, since only the mathematical representation of the object is stored. Scanners
produce only raster images, which must be converted to vector format before you can manipulate them with a draw program.

Gray scales were also introduced in this chapter. You learned that a single bit can be used to represent two levels of gray (actually black or white), while using eight bits (a full byte) allows storing 256 different gray levels.

The chapter concluded with an explanation of the most common file types, such as TIFF, MacPaint, RIFF, and EPS. In the next chapter, we'll learn more about gray scales and halftoning.
Understanding Gray Scales

After you've been using a scanner for a while, there are certain things you come to know, even if you don't understand them very well. Gray scales, for example, are a key tool that desktop publishers must work with on a regular basis, often without a really good grasp of what they are doing. Your scanner may let you adjust brightness and contrast, or manipulate something called a gray map. Often, just by trying different settings you can improve the quality of your scan. Other times, you may waste a lot of time with this trial and error approach.

This chapter may serve to clear up a lot of the confusion. We've addressed gray scales before, chiefly in the context of how many levels of gray your scanner can capture. Now, let's look at how your publishing software works with those gray levels in converting them to a form your printer can handle.

Why Printers Can't Print Gray

As we've seen, it's not particularly difficult for a scanner to capture a continuous tone image with enough different gray tones to make it almost indistinguishable from the original. Scanned at 300 dpi and 256 gray levels (or even 100 dpi and 64 gray levels), a photograph looks very much like a photograph on a Mac equipped with a color or gray scale screen.
If it had both black and white toner available, a sufficiently sophisticated printer could mix the two to produce all the individual gray shades. Alas, no such printer exists for desktop publishing. (There are high priced printers that use a process called thermal sublimation to transfer varying amounts of black dye to a receiver sheet. These digital printers can produce 256 different levels of gray at about 200 dpi.) Your printer, even though it can print at 300 dpi, has only two choices: it can print a pixel as black or leave it white.

**LaserWriter IIIf and IIg No Exception**

That's true even for Apple's vaunted PhotoGrade technology, introduced in October, 1991 in its LaserWriter IIIf and LaserWriter IIg printers. While Apple claims 65 different levels of gray, the printers actually use dithering, like any other printer. They just have the capability of varying the size of their laser dots to simulate gray.

The standard black-and-white screen of a compact Mac works in a similar manner, although at a lower resolution. Images can be displayed at a 72 dpi resolution, but still only in black or white. The same dithering techniques described below, which are used to print grays on an Imagewriter or other printer produce grays on the screen of your Mac.

**Binary Not Limited to Macs**

Binary images aren't limited to the compact Macintoshes, of course. Conventional printing presses face exactly the same constraint. A printing press can lay down nothing more than black ink (ignoring multicolor printing and a process called duotone for the moment). Yet, we see—or think we see—gray tones in the photographs that appear on the pages of our newspapers every day. You may even have an understanding of how this is done, through a process called halftoning.

Imagine if you will the gray spectrum—a continuous band that is white at one end and black at the other, with all the gradations of gray in between. A tone that is one-quarter of the distance along that gray scale will consist of 25 percent
black and 75 percent white. If we were mixing paint, that might be exactly how we’d do it: one quart of black to three quarts of white to produce a gallon of 25 percent gray paint.

Since printing presses and laser printers don’t have black and white paint/ink/toner (nor CRTs gray phosphors), gray is simulated in another way. The subject is divided into dots or pixels, which themselves consist of the proper mixture of black and white space. For printing systems, this is done by varying the size of the dot itself. A very large black dot, which fills its allotted space, is seen as black. A so-called 50 percent dot, which covers half the area, will be seen as 50 percent gray as the human eye blurs the black space and the white space together. If you look at a newspaper halftone with a magnifier, you’ll see that large and small black dots do make up the gray tones you perceive in the printed picture.

Figure 6.1

Printer cell measuring 2 x 2 pixels

Dithering

The equivalent process for computer images is called dithering. One type of dithering can produce an image that looks much like a conventional halftone. Let’s look at that first.
Since we can print (or display) only black pixels, we must use them as building blocks to construct the various sized dots needed for a computer-generated halftone. The fewer pixels used to make up one of these super-dots, the fewer the different tones of gray available.

In the discussion that follows, I'll talk about dithering as it applies to printers. The super-dots used as examples will be printer cells. However, you can also build super-sized screen cells to produce gray images on the screen of a compact Mac. Keep that in mind as we learn about printer halftoning; the same concepts apply to screen display.

Look At Super-Cell

Consider a super-dot or cell that measures two pixels on a side. An example is shown in Figure 6.1. You could leave that cell empty (white) or fill all four pixels (black). The cell could also contain one, two, or three dark pixels in between. That adds up to five different tones, and four different gray levels, plus white. That's not very good, since that allows only a very restricted gray scale. Fine gradations of tone are instead lumped into one of the five categories, producing a poster-like effect (called posterization). This is most easily seen in areas which change gradually from a light shade to a much darker one. Instead of a smooth progression, the transition will be seen as wide bands of one of the available gray tones.

In addition, something else has happened. We can no longer represent an image using an array measuring 300 x 300 dpi. The smallest picture element we can use, given this scenario, is one that measures two pixels by two pixels. In the original scan, each of the four pixels in a given cell may have a similar gray value, or they may all be quite different. In either case, the software must average the gray values for the four pixels and represent all four by a single dot.

If Four Pixels Close, Not Much Lost

If the four pixels were already close in tone, we haven't lost much detail. The eye would have blurred the similar grays
together anyway. However, over the entire area of the scanned image, we are more or less throwing away three quarters of the information that could be used. Effectively our resolution has dropped to 150 x 150 cells or lines per inch.

Luckily, 150 dpi resolution may be more than we need. In conventional terms, the resolution of a halftone screen is referred to by only one dimension: the number of lines per inch (the second number is redundant, since it is usually the same). A 150-line screen is actually finer than the 120- to 133-line screens commonly used in high quality publishing. Newspapers use 65- to 85-line screens. So, we still have a little leeway to increase our gray scale by making the cell size a little bigger.

Figure
6.2

Printer cell measuring 4 x 4 pixels

A Little Inaccuracy Saves Tons of Explanation
A cell measuring four pixels on a side, as shown in Figure 6.2, would have a total of 16 available pixels and 16 different tones of gray, plus white. That's a resolution of 75 lpi with a 300 dpi printer—almost enough gray tones to reproduce pho-
tographic prints properly. A cell measuring 8 x 8 pixels allows 64 shades of gray, plus white, which is satisfactory. However, at this point, these huge cells have reduced the resolution of our printer to only 37 lpi. That's a lot coarser than you'll ever find in conventional publications.

One solution, of course, is to start with a laser printer that has much tinier pixels than our 300 x 300 model. These smaller pixels can be used to build the 30 to 60 or so different size cells we need for a good gray scale at a decent number of lines per inch. Unfortunately, resolutions of about 2000 dots per inch or greater are needed for this. That corresponds roughly with the output of high-priced Linotronic imagesetters.

**A Solution?**

There are no easy solutions. You can see that it doesn't make sense to scan images for halftoning at the highest resolution of your scanner. The resulting files are quite large and contain information that will be thrown away.

Scanning at 75 dpi, on the other hand, produces images that can be halftoned at the same resolution, to produce images with 16 levels of gray. Only if your printer has a resolution higher than 300 dpi can you scan at higher resolutions (without wasting information) and/or print images with more than 16 gray tones. You may scan at higher ratings if you wish (for example, your scanner may not have a setting lower than 150 dpi), but the extra image data can't be used.

As a rule of thumb, you must double the resolution of the printer each time you want to upgrade gray levels from 4-bit to 6-bit to 8-bit (16, 64 and 256 shades). Table 6.1 shows the printer requirements for 75- and 150-lpi halftone screens:
Table 6.1

<table>
<thead>
<tr>
<th>Gray levels</th>
<th>16</th>
<th>64</th>
<th>256</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 lpi</td>
<td>300</td>
<td>600</td>
<td>1270</td>
</tr>
<tr>
<td>150 lpi</td>
<td>600</td>
<td>1270</td>
<td>2540</td>
</tr>
</tbody>
</table>

An interesting phenomenon occurs when you start to examine trade-offs. That is, a 600 dpi printer lets you select either a 150 lpi screen with only 16 levels of gray or a coarser 75 lpi screen with 64 levels of gray. When you compare the two outputs, you'll often find them very similar. The lesson is simple: with continuous tone images like photographs, the number of gray tones is just as important an element in resolution as the number of pixels per inch. A 75 lpi halftone with 64 gray levels can look sharper than a 300 dpi piece of line art.

When you do have choices like this, let the original print be your guide. A high contrast print (one with only a few different levels of gray) may benefit from a finer screen if it has many small details. Conversely, a low contrast print that has fewer small elements can look better with a longer gray scale that reproduces its full range of tones.

Actually, if you don't have a lot of experience working with photographs you'll have to experiment a bit. In the real world you'll also encounter low contrast prints that reproduce better by increasing the contrast of the final image. In these cases, much of the gray scale is not needed and actually serves to muddy the image.

Why So Many Grays?

At this point, it might be appropriate to consider exactly why it's important to have a long gray scale. You already know that images with only a few different levels of gray look poster-like
and unrealistic. As I noted, this is particularly true of subjects that have large expanses of tone that change gradually from one shade to the next. Pictures with sky, water, or walls typically require more gray tones to represent accurately. If not enough grays are available, the image will be divided into objectionable bands.

But do we really need as many as 256 different gray tones? In truth, studies have shown that the human eye can differentiate only about 30 to 60 different gray levels. A highly detailed subject with no large gradated areas can sometimes be represented by as few as 16 gray levels.

**Even 64 Tones More Than We Need**

Therefore, a 6-bit (64-tone) scanner produces as many gray levels are we are usually able to tell apart. Why do we need more?

The answer comes when you consider the nature of most images. Those 60 or so gray levels we can discern aren’t always spread evenly along the entire gray spectrum.

Think of a picture taken of a group of campers around a campfire. Since the light from the fire is striking them directly in the face, there aren’t many shadows on the campers’ faces. All the gray tones that make up the features of the people around the fire are compressed into one end of the gray spectrum—the lighter end. If we distributed our 64 gray tones equally, we might have only 16 to represent all the nuances of the human face illuminated by the campfire.

Yet, there’s more to this scene than faces. Behind the campers are trees, rocks, and perhaps a few animals who have emerged from the shadows to see what is going on. These are illuminated by the softer light that bounces off the surrounding surfaces. If your eyes become accustomed to the reduced illumination, you’ll find that there is a wealth of detail in these shadow images. Certainly, there is a lot more information than can be represented by, say, 16 gray tones.
A typical histogram will contain one line for each of the gray levels in an image. That is, a picture scanned with 16 levels of gray will have just 16 lines in the histogram. This example shows 256 different lines. The height of each line is determined by the number of pixels present at each of the gray levels.

This campfire scene would be a nightmare to reproduce faithfully under any circumstances. If you are a photographer, you are probably already wincing at this high contrast lighting situation. However, you may also be ahead of me on understanding the answer.

What 8-bit gray scales give you is extra information, which you can then distribute as you wish to adjust the reproduction of an image. With 256 different gray levels, even though they are evenly distributed along the gray spectrum, you still have 64 different highlight tones and 64 different shadow tones from which to choose.

Sophisticated image manipulation software allows you to adjust the gray map used to portray an image. If you want, you can bunch the gray levels you want to use at one end of
Examples of various histograms, representing the same image manipulated in different ways. For example, with the high contrast image in the upper left the 256 tones of the original have been reduced to about 30. In the low contrast example, the tones are compressed in a smaller area of the spectrum. In the darkened histogram, the tones have been moved toward the dark end of the scale. The reverse is true of the brightened histogram. Histograms can tell you at a glance how the tones of your image are distributed.
the scale or the other to provide added detail in the shadows or highlights. Or, you can neglect the middle tones in favor of the ends.

**Working with Gray Maps and Histograms**

Sophisticated image editing software that can handle gray scales usually provides several graphical tools that let you visualize the number and distribution of gray tones in your image. One of these is the gray map, which is a two-dimensional graph showing the relationship between the grays in your original image and the way they are represented by the transformations you've performed in the current editing session.

The other common tool is a histogram, which you might think of as a bar chart that displays the distribution of particular gray tones in another way. I'll explain each of these tools in a little detail in this chapter. Let's start with the histogram, since it is primarily used for information purposes and not to directly manipulate the image.

A typical histogram is shown in Figure 6.3., on the previous page. The bottom of the chart represents a gray scale, the gray spectrum from black to white. Arranged along this continuum are vertical bars, each of which depicts the number of pixels found in your image at a given gray level. A glance at the histogram can show you whether the gray values are bunched at one end of the spectrum, evenly distributed, or arranged in groups.

With an image of normal contrast and typical subject matter, the bars of the histogram will form a curve of some sort. When you use your editing or scanner software to produce a slightly more or less contrasty image, you'll see something happen to the distribution of the histogram. With a lower contrast image, the basic shape of the histogram will remain recognizable, but will be gradually compressed together to cover a smaller area of the gray spectrum. An example is shown in Figure 6.4. The
squished shape of the histogram is caused by all the grays in
the original image being represented by the gray tones in a
smaller range of the scale.

Instead of the darkest tones reaching into the black end of
the spectrum and the whitest tones extending to the lightest
end, the blackest areas are now represented by a light gray,
and the whites by a somewhat lighter gray. The overall con­
trast of the image is reduced.

Going in the other direction, increasing the contrast of an
image produces a histogram like the one shown in Figure 6.4.
In this case, the tonal range is spread over a much larger area.
When you stretch the gray scale in both directions like this,
the darkest tones become darker (that may not be possible)
and the lightest tones become lighter (ditto). In fact, shades
that might have been gray before can change to black or white
as they are moved toward either end of the scale.

The effect of increasing contrast may be to move some tones
off either end of the scale altogether, while spreading the
remaining grays over a smaller number of locations on the
spectrum. That's exactly the case in the example shown above. The number of possible grays is smaller and the image appears harsher.

What does brightness control do to our histogram? As you add or reduce brightness, the proportional distribution of grays shown in the histogram doesn't change; it is neither stretched nor compressed. However, the whole lot of them is moved toward one end of the scale.

Figure 6.6

A high contrast gray map.

So, as you darken the image, grays gradually move to the black end (and off the scale), while the reverse is true when you brighten the image. The contrast within the image is changed only to the extent that some of the grays can no longer be represented when they are moved off the scale. Figure 6.4 also shows histograms of images that have been brightened and darkened, respectively.

Gray maps show you some of this same information in a different way. However, where a histogram shows you the relative gray values as they are, the gray map shows you what they will be in the final image when that particular gray map
Gray maps are particularly useful, because they can be edited to alter the distribution of gray tones. You can even take a smooth, gradual gray scale and make it rise or fall sharply or even take on a posterized, discontinuous aspect.

An unedited gray map is shown in Figure 6.5. In this example, the origin of the graph, in the lower left-hand corner, represents black, while the upper right-hand corner represents pure white. One axis of the graph represents the progression from black to white of the pixels in your original image. The other axis provides a look at how they are displayed on the screen. QuarkXpress has an excellent gray map available from the Other Contrast... choice under the Style menu. Input and Output axes are clearly shown. PageMaker has something similar in its Image Control dialog box (which is found under Options in PageMaker 3.02 and under Elements in PageMaker 4.0). Ready, Set, Go also allows you to control gray values.

An unaltered gray map is shown by a straight line at a 45 degree angle connecting the two corners. Since the screen and

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**Figure 6.7**

[Diagram of Picture Contrast Specifications]

A posterized gray map.
image gray tones are the same, a line bisecting the two axes indicates that the gray map currently is taking a neutral, middle road. As the shortest route between the pair, the 45 degree angle means that the gray tones of the image are reproduced exactly as they appear in the original, with no deviations.

How gray maps work will become more clear when you examine the effects of changing this default map, which is also called a ramp curve, because it looks like the ramp you might use to launch a boat into the water.

**Changing The Curve**

Changing the shape of the curve tells the image editing software that you want to alter the grays used to represent a given tone at that point. For example, the middle tones of an image are represented by the middle part of the ramp curve. Figure 6.6 shows a high contrast gray map with a very steep curve. Drawing a line from the upper left corner to the lower right (the exact opposite of the default map) will reverse the gray values in an image, producing a negative.

Your gray map curve can be tailored to meet the needs of your particular image, or even twisted wildly for special effects. For example, an oscillating up-and-down curve (which reverses only some of the values as the curve dips below the neutral 45 degree line) will cause some strange, poster-like images, producing the half-negative/half-positive effect photographers call solarization. Manipulating the gray map in this manner takes experience. You'll need to play with a large number of images to see what happens with each change of the curve.

Perhaps now you see the true value of having 256 different gray tones. They give you the freedom to throw away those gray levels that have been captured but have no detail in them; you can keep only the 64 that you are most interested in. It's not usually possible to go through the entire gray spectrum and select only the tones that are found in a certain image.
However, it is practical to see where groups of useful tones are clustered, say at the highlight, middle tone, or shadow ends of the scale, and concentrate your selections there.

Sophisticated image editing software, like Digital Darkroom and Image Studio, lets you twist the gray map to concentrate those available tones in the portions of the spectrum where they'll do you the most good.

You can also perform equalization on the image, which distributes gray tones evenly throughout the original. Gray levels are allocated to match the contrast level of a chosen area of your original image. If your editing software provides a histogram, you can use it to see if gray tones are bunched up enough that your image would benefit from equalization. Figure 6.7 shows some examples of typical gray map manipulations, in this case, a posterized effect. Notice how the gray levels are concentrated in several bands, rather than spread out evenly in a curve shape.

It's beyond the scope of this book to teach you everything you need to know about manipulating gray scales. Experimenting with images and gaining some experience is the best way to learn if you work with continuous tone images regularly.

**Gray Scale Displays**

Let's digress for just a moment to a related topic: display of gray scale images on a CRT screen. In the discussion of capturing and printing continuous tone images, I've almost ignored an important consideration: How do you evaluate gray scale information visually?

On a compact Mac with a black-and-white screen or on a Mac II equipped with only a monochrome video card and Apple high resolution monochrome monitor, you won't see gray scale images at all, except through dithering techniques. Such computers present strictly binary images. You can still work with gray scale (or even color images), but it can be very
difficult to evaluate them. You may even have to print out a copy of the document or file to see how it will look in finished form.

The Apple Macintosh Portrait display, Two-Page Monochrome monitor, similar units supplied by third party vendors, and their associated video cards provide gray scale display. These analog systems allow you to choose from 1-, 2-, or 4-bit pixel depth. That translates into black-and-white, four gray levels, and 16 gray levels, respectively.

Such monitors also have higher resolution (77 to 80 dpi) and larger screens (640 x 870 for the portrait monitor; 1152 x 870 for the two-page system) for bigger windows into your application. For many uses such gray scale display is adequate.

More levels of gray come at a price: you will probably need to purchase or upgrade to an 8-bit color video card and color monitor. Gray scales are just another color palette in this instance, so you’ll end up with pricey color equipment even if you have no other need for color display. That’s why many who want only gray scale display stick with the lower-cost 4-bit cards and monitors.

High end gray-scale and color display is discussed in more detail in Chapter 12.

Another Angle on Halftone Screens

So far, I’ve talked about halftone screens only at the most elementary level. You’ve learned that images can be divided into cells and the individual pixels available on your printer used to build various sized halftone dots. The maximum size of the dots determines the resolution or screen ruling of the halftone.

Tricks that are used to improve the quality of a halftone image include varying the dot shapes, so that you have square, round, or elliptical dots. The resolution of a 300 dpi printer generally isn’t sufficient to allow much variation in dot shape.
Another modification that can improve image quality is changing the angle of the lines in which the halftone dots are aligned. Since most images have vertical and horizontal lines, it can be disturbing to the eye to have the halftone screen line up exactly in that orientation. In practice, turning the screen at a 45 degree angle will produce the best looking image. Figure 6.8 shows a typical halftone screen set at 45 degrees.

When we reach the discussion of color scanning in Chapter 13, you'll see that varying screen angles is a way to print several colors in the same area without placing the dots on top of each other.

As you've seen, working with gray scales can be very complex. For example, you may find some image editing software provides something called gamma correction. This is a way to change the algorithm used to convert color information to binary black and white information. The curve is made non-linear, because the human eye has difficulty perceiving differences in very dark tones, but can tell differences in very light tones much more easily. Gamma correction increases the contrast in some parts of the spectrum.

Figure 6.8

Halftone dots set at 45 degree angle
Types of Halftone and Dithering Patterns

One thing you'll need to consider in converting continuous tone images to halftones is the halftone or dithering pattern used by your software. As you've already learned, if you use a fine halftone screen, you will have fewer printer pixels available to print each dot, and therefore, fewer gray tones will be able to be printed. Conversely, with a coarser halftone screen, more printer pixels can be used with greater variety, to produce a longer gray scale.

Halftone and dithering patterns determine the size and shape of the printer cells used to represent a continuous tone image. Most image editing software and scanner control programs let you select from among a number of halftone patterns. While you'll need to build some experience to know exactly which screen type will provide the best rendition of each new image you encounter, the guidelines that follow can help. Examples of some of the most common are shown in Figure 6.9.

**Horizontal Line** With this pattern, the image is broken up into horizontal lines; it is, therefore, good for subjects which contain a lot of horizontal lines. You may be able to preserve some details with a horizontal pattern. Strong vertical lines will be disrupted and lose apparent resolution.

**Vertical Line** This is obviously the reverse of the horizontal line screen. It may be a good choice for images with strong vertical components, such as buildings, trees, and some people. Faces seem to reproduce well using vertical line screens.

**Bayer** This is a regular, criss-cross type pattern that is good for both horizontal and vertical lines and may therefore be chosen for subjects that have both. The pattern preserves detail while providing somewhat lower contrast than some halftone patterns. You can adjust the contrast setting of your scanner to beef up the blacks and whites when using the Bayer
pattern. It may not reproduce well, but it looks very good on the CRT screen.

**Spiral** In some ways, this is the opposite of the Bayer pattern. The image is not as crisp but includes more shades of gray. Results will look better printed on your laser printer than displayed on the screen. As you might guess from the longer gray scale, the spiral halftone pattern is somewhat coarser than others. For that reason, it is also known as *coarse faying*.

**Fine Fatting** This is a compromise form of the spiral pattern, using smaller dots that provide a sharper looking

**Figure 6.9**

These are some of the most common dither patterns used for electronic halftoning. In the top row are examples of Coarse Fatting and Bayer patterns (left to right). The bottom left example is a Spiral pattern, while the bottom right shows a Vertical line screen.
image. You lose some gray shades but get adequate tonal reproduction with more detail. You might choose this pattern for images that have important small details but don’t require many subtle shades of gray.

In addition to these, several other dithering schemes, provided by image editing software packages are particularly well-suited for certain applications. Some image manipulation programs, for example, have an error diffusion or scatterprint pattern that is particularly good for faces. They produce a random pattern that doesn’t obscure an individual's features.

As I’ve mentioned before, the best place to do your halftoning is within specialized software packages. If you apply the halftone at the scanner, you may run into problems later. First, you won’t be able to size the image easily; the dots will simply grow larger or smaller. Nor will you be able to adjust the contrast or brightness of your image later.

Some scanners that don’t store standard gray scale files, as such, do let you save a “raw” file containing the captured gray scale information that the scanner software uses to apply the halftone. You may be able to reload that file into the scanner software and re-halftone an image later. While this capability isn’t as desirable as that of producing standard gray-scale TIFF files, it’s better than nothing. Scanners that won’t let you store gray scale information are almost useless for this work for that reason.

Other Solutions

Another option you have for outputting high quality gray scale images is to use an outside service bureau. These organizations offer typesetting services to businesses and desktop publishers, using various output devices that have higher resolutions than your 300 dpi printer. The higher the resolution, the more you will generally pay per page. However, even 600 dpi devices will offer better type and higher quality
halftones than you are likely to get from a standard laser printer.

Many factors should be considered when selecting a service bureau. Do they offer 600 or 1000 dpi output on plain paper? Or, can you select 1270 to 2540 dpi pages printed on special phototypesetting paper? Does the service bureau charge by the page, by the hour, or both? Hourly charges can mount up quickly when you are printing halftones and complex graphics at high resolutions.

Another thing to ask about is turnaround time. Frequently, you’ll prepare desktop publications at the last minute. After all, the news in newsletter comes from the timeliness of the information. Your service bureau should be able to provide 48-hour service routinely and 24-hour or quicker turnaround at a premium if you must have it. Does your service bureau have a computer bulletin board or some other way of accepting your files by modem? You can save a trip to the typesetting shop if telecommunications are an option. Some publishers use typesetting houses located on the other side of the country. Files are transmitted over phone lines and finished copy delivered by courier the next day.

When you examine your bureau’s price list, look for volume discounts. When I had this book typeset, I was able to pay about $1 per page for the finished output. My service bureau charges upwards of $5 to $7 a page for shorter runs. The volume discount added up to a significant saving.

All you need to do to use a service bureau is print your publications to a file. I’ll provide step-by-step instructions for leading desktop publishing programs in Chapter 12.

Summary

This chapter has been a discussion of some of the complicated considerations involved in scanning, manipulating, and printing gray scale images. You learned why printers can’t
print gray: they are capable of laying down only solid toner or ink (usually black) in a fixed dot size.

Dithering, a technique for reproducing separate shades of gray, was explained. By combining an array of printer pixels into a larger cell, we lower the effective resolution of the printer, but allow dots to be produced in various sizes. For example, a cell measuring four pixels on a side would allow reproducing 16 different levels of gray, plus white, at a resolution of only 75 lpi.

Actually, the human eye can differentiate only between about 60 different gray levels, so the 256 tones many scanners can produce may seem superfluous. In truth, the excess gray tones can be distributed so that they coincide with the values that have the most detail in an image.

Gray maps and histograms were also explained in this chapter. A histogram is a bar chart that displays the distribution of gray tones in an image. Each bar represents the number of pixels found in the image at a given level of gray. The histogram can show you whether the gray values are bunched up at one end of the gray scale, evenly distributed, or arranged in groups.

Gray maps show the relative value of the gray tones in an image, compared with the way they will be reproduced on the screen or by your printer. You can edit the map to alter the distribution of gray tones.

As gray scale images become more important in scanning and desktop publishing, gray scale displays gain a place as a key tool for viewing those images.

Halftone screens were explained in some detail in this chapter. The angle of the screen is important for reproducing a pleasing image. A 45 degree angle is usually the best for monochrome images. There are several types of halftone and dithering patterns. Horizontal line, vertical line, Bayer, Spiral, and Fine Fatting were provided as examples.
Image Capture, Editing, and Manipulation Software

The software you use to capture an image and the editing software you use after an image is scanned can be as important to you as the scanner itself and the desktop publishing system that will be the ultimate destination for the image. There are few images that aren't modified during the scanning step and then touched up by editing software before they are dropped into a publication.

The number of options you have for manipulating the images you capture is amazing. Scanner control software usually provides primitive image editing tools and allows you to apply a halftone pattern. Ventura Publisher, PageMaker, Quark, Design Studio, and Ready, Set, Go all allow you to crop and size line art. You can even change the proportions of the image to stretch it or shrink it in one direction or another.

However, none of the four leading desktop publishing packages provides the flexibility you need to do everything you want with an image. That calls for more specialized capabilities, which are found in what I'll call image editing software.

Image Editing Software

If you work with a scanner, you will need to choose an image editing program you are comfortable with and learn to use it well. You don't need to be an artist to use any of these programs
effectively, but you should become familiar with the features and capabilities they offer.

Image editing software breaks down into three broad categories, two of which we’ve already looked at briefly. Paint programs and draw software are joined by a third type, gray scale editors. The bit map oriented paint programs are typified by software like UltraPaint and MacPaint. Programs based on vector graphics include Aldus Freehand and Adobe Illustrator. Some, like Canvas, let you work with both.

Gray scale and color editors, which have some special capabilities for manipulating and then dithering continuous tone images like photographs include PhotoShop, ColorStudio, PhotoMac, Letraset Image Studio, and Digital Darkroom. Note that many bit map programs can edit gray scale and color images pixel-by-pixel. They do not, however, include all the tools offered by the more specialized image editing packages.

This chapter will discuss some of the requirements of image editing, so you can decide which types of packages you’ll need. I’ll also explain some of the common features found in the leading programs. Capsule descriptions of paint and draw programs are included in Appendix B, while continuous tone software is discussed in Appendix C.

How to Tell What You Need

Since scanners produce bit-mapped files, everyone who works with a scanner needs a good bit map editor/paint program. At times you’ll scan images that need only a bit of work to make them perfect for your needs. You may want to remove an offending smudge in the background next to the image. Or, a small piece may require modification. As I noted, some scanner controller packages have some pixel-editing capabilities built in.

Paint programs let you use a palette of tools to make these changes to the bit map image. You can add or remove lines or
curves. Areas can be filled with patterns. A fat bits option enables you to zoom in and edit bits pixel-by-pixel.

Paint programs are generally easy to use. However, the images you work with can be no more detailed than the resolution of your screen. Scaling up or down to a size that is not a multiple of your original size will cause you to gain or lose pixels.

If you are able to scan a line art image at the maximum resolution of your scanner, you'll often end up reducing the image to fit it in your publication. That enhances the apparent resolution. The larger images are also easier to work with using your paint software. Admittedly, line art scanned at high resolutions takes up a lot of disk space. Some paint packages have difficulty handling such large images, while others can use whatever expanded memory you may have to store such files in a workspace buffer.
The vector-based drawing programs like Adobe Illustrator 88 can't manipulate bit mapped scanned images directly. Instead, you can load a bit map image into the graphics editor and trace the outlines of the image. Many have an autotrace function that will do this for you.

The advantage is that once you've converted a bit map to vector format, it can be sized and scaled at will without losing resolution. The draw package will use either some form of PICT, Encapsulated PostScript (EPS), or a proprietary format. If a special outline format is used, you must load the draw application to print files. Most packages do allow conversion to EPS for efficient output on a PostScript compatible printer and for importing into RSG, PageMaker, and QuarkXPress.

You need a gray scale editor if you work extensively with photographs and other continuous tone images. These editors let you touch up minor defects in photos, change the contrast and brightness of the whole image or a section of it, and perform extensive gray map editing. A gray scale editor, in effect, provides you with a computer darkroom that can perform many of the functions of a traditional photographic darkroom—and then some.

The next section will explore the capabilities of the most popular raster image editing programs. Then, I'll discuss vector-based software and gray scale imaging products.

**Bit-Map/ Pixel/ Raster/ Paint Software**

I used that somewhat cumbersome heading for this section because this type of software is often referred to in all four ways. A few years ago, pixel-oriented programs like MacPaint allowed you to work only with binary images. That made sense, since few Macs could handle gray scale or color images. Today your choices include packages that can handle at least some gray scale images.
These programs have many features in common. Most of them use a tool metaphor to work with images on the screen. That is, you’ll use virtual pencils, pens, brushes, erasers, scissors, and other real-world tools to perform most functions. Random dots, for example, are often applied with a tool that looks like a spray can, while you may fill shapes with patterns using a tool that resembles a bucket of paint.

The analogies are useful, because the tools act much as their actual counterparts do. For example, if you pour paint into a shape that has even a tiny gap in its outline, the pattern will leak out of the shape and fill surrounding areas until constrained by another line. However, the power of the computer allows you to create entirely fanciful tools, too. For example, some programs have a color eraser that removes only the shade selected. Computers also allow you to undo complex actions that you’d never be able to reverse if you were working with paper and paint.

Tools also lend themselves to icon-based interfaces. If you want to sketch a free-hand line, simply move the mouse cursor to the icon shaped like a brush or pen. To draw a square, click on the square shape in your software toolbox.

Features to Look For

This section will describe some of the key capabilities of paint programs. Once you understand how they are used, you will be better equipped to select the best package for you.

- **Variable drawing area.** Your scanned images will be of different sizes. Most paint programs let you size the working area. A larger workspace allows you to see more of the image, but reduces the amount of screen available for tools, menus, etc.

- **Color/pattern set.** Paint programs allow you to fill areas with colors, gray tones, or patterns. The number of palettes available can be important if you are adding color to scanned line art. Paint programs capable of handling gray scale images
should have a full complement of gray tones, as well. You should be able to customize patterns to suit your own needs. Some packages let you pick up patterns and shades from one area of an image and apply them to another.

**Toolbox.** Paint programs generally use a tool analogy for their various functions. A typical toolbox is shown in Figure 7.2 Your software should provide some combination of the following features:

- **Scissors** — This tool allows you to cut or remove sections of an image.
- **Airbrush** — This can be used to add a random pattern to an area of an image.
- **Text** — While not analogous to a specific tool, this feature is used to add captions, call-outs and other text to your images.
- **Brush shapes** — These round, square and odd-shaped brush types can be very useful.
- **Drawing widths** — As you add lines to scanned art, you’ll want to change the width of the brush or pencil used.
- **Intelligent selection tools** — All paint programs include both a marquee and lasso selection tool. Some go way beyond this to include selection tools you can customize to selectively grab components. A polygon selector makes it easier to specify regularly shaped areas that are not the squares or rectangles formed by the marquee. A smart lasso can rope only pixels of a certain color or range of tones. That way, you can remove a cloud from the middle of a group of clouds that have slightly different shadings.
- **Gradations or fills** — This facility allows you to create tones which gradually change from one color to another in
user-selected combinations. Gradations can run vertically, horizontally, diagonally, and in one or more circular directions (to provide realistic shading on a sphere, for example).

**Color eraser** — This allows you to erase only a specific tone. Given a gray scale image, for example, you may want to remove a background tone surrounding your main subject. The subject may be relatively dark against a lighter background. Two or three applications of the color eraser, each with a different light tone, can remove the background smoothly at the edges of the subject without erasing the subject itself.

**Smudge, Blur, Smooth** — These tools allow you to integrate one image with another by smoothing the sharp edges between them. In some packages, the smooth tool is used to soften jaggies produced when you enlarge an image scanned at a lower resolution.

**Eraser** — This lets you replace one color with another. Some packages have a threshold command, which lets you replace more than one color, depending on level selected. For example, if you have two or three dark red colors on the screen, you may want to replace them with similar colors and intensity levels in the blue range.

- **File types supported.** The number and kinds of file types supported by a paint package can be important. Some support TIFF, and their own proprietary format. Only a few let you work only with their own special format.

- **Rulers and mouse position indicators.** These let you size and scale your images more easily, while letting you know the exact coordinates of the mouse.

- **Zoom options.** This feature lets you zoom in to work with a small section of an image, then zoom out to look at a larger portion or the whole image. A minimum of two zoom-in ratios (400 percent and 800 percent are common) is required, although some packages provide 1600 percent and larger zooms. The ability to zoom out to 75, 50, or 25 percent of the image
size is important, so you can view an entire image on the screen at once.

- **Undo.** Nobody’s perfect. Most packages store a copy of the last image you worked with so you can undo your most recent action and restore the image. That way, if you make a mistake, you don't have to start over. Some software will let you progressively undo a series of steps. Others will undo only the most recent action. It’s common to undo everything you did since you last selected a tool or moved the screen window to a different section of the image. If you have a paint program like that, remember to reselect the current tool at intervals when you are happy with the way the image editing is going.

The latest version of Claris MacPaint is shown in Figure 7.3. A discussion of some of the leading paint programs and the strengths and weaknesses that each displays can be found in Appendix B.
Gray Scale/Color Editors

Until recently, most users had never even heard of gray scale editors. That was easy enough to explain: there weren't any to speak of.

Gray scale editors generally provide similar features. Some have added a few extra capabilities that make them more suitable for certain kinds of tasks.

The next section will discuss the basic features common to most gray scale editing programs. A typical program, Digital Darkroom, is shown in Figure 7.4.

Gray Scale Features

- **Scanning.** Most gray scale editors allow you to control the scanner from within the program. That way you can scan and edit an image without switching back and forth between applications. The key options for scanner control software were discussed in Chapter 3.

- **File Import/Export.** All gray scale editors can load or save files in TIFF. They may add additional file types, such as Encapsulated PostScript. If you need to work with additional file types, check a gray scale editor before you buy to see if it is compatible.

- **Viewing Options.** Gray scale editors may let you choose between displaying 16 and 64 different shades of gray. A few can show 256 shades with compatible monitors, although some of these may be represented by colors rather than neutral tones.

  Other viewing options control the zoom size of the image. The same range found in paint programs—25 to 1600 percent—is desirable.

- **Gray Scale Control.** These options allow you to judge and manipulate the relationships of the gray tones in an image. Typical features are:
- **Histogram**: Shows number and distribution of gray tones.

- **Gray Map**: Displays a representation of the gray tones in the image; that is, are they shown as-is, or modified in some way so they'll print lighter or darker than in the original image. You can modify the gray map to make these changes.

- **Brightness and Contrast**: Control the relative lightness/darkness and number of gray shades in an image. These are often slider controls you can move to adjust the values in one direction or another.

**Digital Darkroom**

- **Invert**: Reverses the values of blacks and whites, producing a negative image.

- **Image Editing Options**: These are functions that let you make changes on whole sections of an image. You can copy a portion to another part of the image (to increase the popula-
tion of a crowd shot, for example). Sections you’ve copied from another image or another part of the image can be kept in a buffer (or Clipboard) and pasted down later. The image can also be transformed by rotating, slanting, reversing, mirroring, or scaling it.

An important feature found in many gray scale editors is paste control. This is a tool that allows you to control how much of the underlying image is covered up when you paste another image on top of it. Using it, you can blend images smoothly into one another.

- **Image Processing.** The power of the computer can be used to manipulate an image or a portion of it in useful ways. Algorithms have been developed to allow changing pixels according to sets of rules that produce special effects. For example, areas in which density changes sharply from one value to another can be selectively increased in contrast. This, in effect, provides edge enhancement or a sharpening effect. The reverse can be done to blur an image. The number of gray tones can be reduced, producing a posterizing effect that can be interesting in some images. (A circus clown, for example, would be interesting posterized; a serious head-and-shoulders portrait would not).

Image processing features are often called filters, since an entire image is passed through the module that does the modification, with some pixels held back or changed, much like a filter screens out unwanted particulate matter. In fact, one common filter is the despeckle option, which can eliminate unwanted spots.

- **Halftoning.** Gray scale editors provide several halftone patterns and other dithering options so your edited image can be printed or imported into your desktop publishing program. Halftoning is discussed in detail in Chapter 6.

- **Painting Tools.** Gray scale editors are simply a sophisticated form of paint program, so most will have a full complement of paint tools, including brushes and gray scale palettes.
Some Specialized Conversion Software

Before I go on with a discussion of vector-based editing programs, let's digress for just a moment to mention two specialized categories of software. Both functions can be handled by other editing programs, but these particular packages were designed to do just one thing and do it well.

Figure 7.5

Autotracing an image. Adobe Streamline allows you to choose whether the traced image will have a header for use with Macintosh or IBM PC EPS software. You can use Streamline to produce PostScript images suitable for either environment.

Autotracing and file conversion can be two key functions for many scanner users. In the first case, you can put the computer to work converting bit-mapped images to vector-format graphics that can be manipulated with a variety of draw
programs. Dedicated file conversion programs change either bit map or vector graphics from one format to another. Some can handle both types, and a few can even perform raster-to-vector and vector-to-raster conversions. I'll address the separate but related functions in the following sections.

Adobe Streamline provides a wealth of options. You can select Outline tracing, Centerline, or a combination. You can also choose how closely the program will follow the outline of an image, and specify the number of curved or straight segments.

**Autotrace**

Adobe's Streamline is the first of a class of software that should gain importance as scanners become more popular. These packages accept bit-mapped images, such as TIFF files, produced by scanners and automatically trace around the edges of those images. The result is a vectorized, outline-oriented version of the bit-mapped image, which can be imported
into and modified by a draw program such as Adobe Illustrator.

Autotrace systems all use mathematical algorithms to determine the boundary between one portion of an image and the next. This boundary is then traced to form a line. Vector-oriented software always uses mathematical formulas to represent such lines: that's why you can enlarge and reduce objects without losing resolution. So, either the edges of polygons or Bezier curves will be used to describe the complex lines that make up a typical scanned image. Some programs will use both polygons and Bezier curves.

**Points Determine Accuracy**

The number of points between line segments determines how accurate your traced image will be. The more points used, the smaller the image element that can be represented and the more closely the object will resemble the traced image. Of course, a large number of lines will make your object as jaggy-appearing as the original image.

Therefore, most autotrace programs allow you to adjust the accuracy or tolerance used to trace the image. If you specify high accuracy (small tolerance for variations), many short lines will be used to trace the image, producing somewhat jaggy-looking image. If you ask for reduced accuracy (a higher tolerance for variations), the program will use fewer lines and smooth out the jaggies. You can also use your vector image editing software to adjust the number of control points on the lines which define an object.

I've used the autotrace functions of the leading draw packages, and they range from slow and accurate to fast and sloppy. Streamline is relatively fast, extremely accurate, and flexible to boot. You can command the programs to trace around the edges of lines or to draw down the middle of each line (thinning the image as it does so). Because it is dedicated solely to the autotrace function, Streamline does an especially good job of
it. If you do a lot of raster-to-vector conversions, you owe it to yourself to investigate one of these programs.

Autotracing works best with images that have distinct edges. The best will have solid forms, or silhouettes as the key image areas. In that respect, scanned line art (like most logos) is often ideal. You can convert the bit mapped lines of the scanned original to a vector-oriented drawing that can be touched up, manipulated, enlarged, or reduced as you wish. Conversely, photographs are usually poor subjects for autotracing, unless they are very high in contrast. The autotrace feature simply draws a line around each of the gray regions in the image. Any banding or posterizing effect that shows up in your photo will be dutifully outlined. If your image has many small detailed areas, each of them will be enclosed in a line, too.

Most autotrace packages allow you to choose contour tracing or line tracing. The difference between the two can be more

Canvas is one of the most advanced combination vector/raster image editing software packages.
easily visualized if you picture a simple graphic, such as a box. If contour tracing is chosen, the borders of the lines themselves are traced.

When you ask for line tracing (also called centerline), the vectorizing is performed in two steps. First, the lines of the existing drawing are thinned. That is, the lines that make up the image are eroded until they are only a single pixel thick.

Figure 7.8

Image Studio from LetraSet

This works well if an image is, in fact, made up of various sized lines. However, if other oddly shaped solid areas are used to make up the image, you may get an image that doesn't resemble your original very much.

After thinning is completed, the program works the same as it would with contour tracing. The edges are replaced with line objects that reproduce the image.
Vector-Based Image Editing Software

Scanners produce bit map images, yet you may want to work with vector graphics to produce truly sophisticated artwork for your desktop publications. The vector-based draw programs discussed in this next section, when coupled with their own autotrace features or a stand-alone program like Streamline, let you convert and edit scanned graphics as outline images.

Some programs also allow you to import a bit map image as a template for manual tracing. I don't recommend this technique for large or complex drawings. It can work better than the autotrace option for some types of images, however, because you can often trace more accurately and intelligently than the computer can. That is, you can make judgements.

Figure 7.9

Aldus Freehand
about what parts of an image are or aren't important and how closely the lines need to conform to those of the bit map image.

Since you can't work with a scanned image in a draw program unless it has been traced, you'll want to examine the autotrace functions of your chosen package with a jaundiced eye. I've used some that are very good, but which took 15 or 20 minutes to trace a moderately complex image on a 68030 system like the Mac IIx or a 68040 like the Quadra. Others produced outlines that were so rough and chunky that they were effectively unusable. One simple test is to scan some type at a high resolution to produce large, clearly defined letters. Then, after autotracing, note how closely the outlines resemble the original characters.

Other Features

Draw programs can give you a lot of flexibility in manipulating your vectorized scanned image. They provide the same rotation, stretching, scaling, and slanting options found in paint programs. However, you won't get the jaggy edges that can often result from changing the orientation or size of bit-mapped images.

The file formats that can be imported and exported can be important. While not related to your scanning activities, some of the other features of draw programs can also be useful. For example, if you have a non-PostScript printer, you are limited in the size of typefaces that can be printed. Draw programs incorporate their own precision fonts which you can size, scale, and modify as much as you want. Then, you can export a bit-mapped image that can be used in your desktop publishing program.

Summary

In this chapter you learned about editing and manipulating scanned images. We looked at the features and options avail-
able with paint programs, gray scale editors, vector-based
drawing programs, and several specialized packages.

The image software you use can be as important as the
scanner itself or even your desktop publishing software. You’ll
need both a raster-image (paint) program and a vector graph­
ics (draw) package in many cases.

Paint software is usually built on a tool metaphor. You work
with pencils, pens, brushes, erasers, and scissors. Some of the
key features to look for include:

- **Variable** drawing area.
- **Flexible color/pattern features.**
- A toolbox that includes scissors, airbrush, text mode, brush
  shapes, eraser and color eraser, and smudge and blur tools.
- Support for a broad selection of file types supported, prefera-
bly both TIFF and the package’s own proprietary format (if
any).
- Rulers and mouse position indicators
- Zoom options, with a minimum of 400 and 800 percent.
- Undo options to let you change your mind.

Gray scale editors let you work with continuous tone images.
For these, you should look for the following features:

- Ability to work with more than one image at a time, so you
can cut and paste between images.
- Built-in scanner support.
- File import/export capabilities
- Viewing options, including number of gray levels and zoom.
- Gray scale control through gray maps and histograms.
- Brightness and contrast control
- Image editing controls to allow you to move, cut, and paste
portions of the image.
- Image processing to sharpen, blur, or otherwise filter the image.
- Painting tools to enable you to work with the image on a bit level.

Autotracing and file format conversion programs were discussed just prior to a full explanation of vector-oriented image editing programs.

**Key features of these are:**
- Autotracing, to convert bit mapped images to object-oriented file formats.
- Sizing, scaling, and slanting.
- Support for formats such as TIFF and EPS.
- Support for non-PostScript printers.
For desktop publishers, the process of capturing an image with a scanner, editing it, and, if necessary, applying a halftone screen constitutes some 75 percent of the work. By the time you've prepared an image for importing into your desktop publication, the only tasks that remain are to locate a position for the image in the publication, load it, and do any final sizing, scaling, or halftoning that remains. Compared with the vast number of options available at the scanning and editing stages, your choices now are, thankfully, more limited (but still vitally important).

Nevertheless, there are some important things you'll want to learn to get the most from your scanned images. This chapter and the next describe some techniques for using such graphics in publications. We'll look at QuarkXPress, PageMaker, and Design Studio/Ready, Set, Go, and Ventura Publisher separately, since they treat images differently and each provides its own set of controls.

Overview of QuarkXPress

Several years after my first introduction to Quark, I'm still amazed at how much you can do with this program. It's truly a professional-level program. I've used desktop publishing software to prepare everything from newsletters to full-length
books like this one (including this one) and haven't found any program with more flexibility and features than Quark. If you look at some of the full-color brochures and other pieces produced entirely with QuarkXPress—right down to and including making color separations—you'll wonder why anyone would need an expensive color prepress system.

Those familiar with Ventura Publisher will find much the same flexibility and precision in QuarkXPress. For example, like Ventura, Quark uses a master page called the default page. All subsequent pages take on the layout format of this page. This is particularly useful for very long documents. You can specify Auto Page Insertion and have Quark automatically flow text into additional, identical pages as required.

Objects can be placed on the page with a high degree of precision. You don't have to rely on rulers to drag a graphic or text box to the place you want it. For example, Quark has a
Text Box Specifications dialog box that lets you type in the coordinates for the box (using picas or some other measurement), width, height, size of gutter (the space between text columns), and text inset (indent of the entire column from the left edge of the text box).

The most recent version of the package is QuarkXPress 3.0, which is a major upgrade. One of the most significant additions is the pasteboard metaphor long used by PageMaker. You can move elements off the page onto the pasteboard, where they can be left until you need them again. Unlike the Clipboard, the pasteboard can hold multiple images. In contrast to a Scrapbook, you don’t have to access a desk accessory...
to see what is on the pasteboard; it's there for viewing whenever you want.

The Thumbnail view of documents has been enhanced to provide realistic representations of the pages. You can easily rearrange pages within a document—or between documents—using the Thumbnail view.

Scanner users will most appreciate the enhanced color separation capabilities and a new freeform picture box that allows you to place a scanned image within an irregularly shaped block. That feature helps simplify text runaround. You also now have the ability to reshape picture boxes, and rotate a box and its picture together or independently.

**Quark Imports Variety of Formats**

QuarkXPress imports EPS, RIFF, TIFF, PICT2, and bit-mapped MacPaint graphics. Its object-oriented graphics include tools for drawing lines, circles, squares, rectangles, and ovals. Quark won’t let you flip or rotate graphics; you’d better do that before importing the image.

The program doesn’t store high resolution images in the document itself. Instead, it creates a low resolution version of your EPS, TIFF, or RIFF image and displays that. For this reason, the original file must remain available to Quark at print time.

Quark offers three predefined contrast settings, normal, high and posterized, and one custom (gray map) setting. You can use these to control both gray scale and color TIFF images.

Quark was the first Macintosh DTP program to offer color editing and four-color separation capabilities. You can adjust contrast of each of the color components. It supports RGB, HSB, CMY, CMYK and Pantone color models. Special versions of QuarkXPress are available that can output directly to high-end color prepress systems like Scitex’s Visionary. It links to Atex and DEC TMS systems through QuarkXtensions available from third parties.
Other QuarkXtensions provide valuable features. For example, Graphic List displays a listing of every TIFF, RIFF and EPS file used by but not incorporated directly into the XPress document. That way, if you have moved an original high resolution image, you’ll be alerted prior to print time that these files should be restored. (Quark kindly checks your document and display a list of missing files for you, but by then, you may not have time to scrounge up the files). Graphic List also shows all fonts used by an EPS file. That list can be provided to your service bureau so they can save time by downloading only those fonts into their imagesetter before running your job. The Xtension also spots missing and modified files for you.

The Printer Calibration Xtension allows modifying the density of halftone screens created by Quark so they more closely

![Figure 8.3](image)

Inserting a Quark picture boxes. Rectangular, rounded-corner rectangle, and ovals are available.
match the actual output of a printer. Because a printer's dot sizes may vary somewhat over time, a 20 percent screen generated by Quark may not actually be a 20 percent screen on the page. This XTension enables you to match the two. You don't need to own or use a densitometer (a device that measures the density of an image) to calibrate QuarkXPress with this XTension, although such a tool would give you greater precision. You can compensate for varying dot sizes on everything from an ImageWriter to a Linotronic.

Adobe Screen Values allows you to use the special dot angles and line frequencies developed by Adobe to minimize moire problems with high resolution color output. This XTension is designed for 600 to 2450 dpi output devices, however.

Adding Scanned Images to QuarkXPress Documents

Quark lets you scan directly from within the program if you have an Apple Scanner, a Howtek Scanmaster, or a Sharp JX-450 scanner. The latter two are color scanners. Since this capability is added through XTensions, other scanners may be plugged in by the time you read this. This following section is
not intended to be simply a re-hash of the Quark tutorials and reference manuals. I've collected a set of instructions that show you exactly how to place scanned images in a Quark document for two reasons. First, you can find everything you need to know in one place, explained in a little more detail. Second, those who are trying to decide which desktop publishing package to purchase may find it useful to compare these important capabilities with those of the other leading systems.

Inserting Picture Boxes

QuarkXPress puts all scanned images into frames called picture boxes, which are placed on the page in which the images appear. Unlike some desktop publishing packages, Quark allows you to define three different shaped picture boxes: rectangle/square, oval/circle, and rounded-corner rectangle/square. Quark 3.0 provides a total of five different picture boxes, and lets you reshape a picture box if you don't like the shape you've chosen. The Polygon Picture Box in Quark 3.0 lets you create irregularly-shaped picture boxes. It may seem odd to call a circle or oval a “box,” but that is the terminology we'll use here.

The three shapes offer some valuable flexibility in layout, although, ideally, you should be able to mask a picture with any shape box you like. Varying the box shape makes it simple to flow text around a graphic: you simply choose a shape that roughly approximates the outline and proportions of the image area you want to use in the publication.

If you have some idea of how you want your finished page to look, you may find it easier to insert all the picture boxes at one time and then import the actual images later. You can move, size, and reshape the picture boxes on the page until they are roughly the way you want them. Additional modifications can be made at any time.

Picture boxes are inserted using the rectangle, oval, and rounded rectangle picture tools in the tool palette. Each is marked with a large X to remind you that an image is con-
tained in the box. To insert a picture box on your page, follow these steps.

1. Select the picture box tool you want to use from the palette and move the cursor to the place on the page where the box is to be placed.

2. Press on the mouse button. The cursor changes from an arrow to a cross-hair and a marquee selection box appears. Drag the mouse to shape the picture box. Hold down the shift key as you drag to constrain the shape to a perfect square, circle, or rounded square. Release the mouse button when the box is approximately the correct size.

3. If the picture box is not in the correct location, move it with the mover tool.

Importing an Image

The next step is to load a picture into the picture box. You can choose color, gray scale or black-and-white EPS, TIFF, PICT, PICT2 or bit-mapped graphics. If you have a Mac without color or gray scale display abilities, Quark dithers the image for you. To import a picture, follow these steps:

1. Use the editing tool to select the picture box you in which you want to place the image.

2. Pull down the File menu and choose Get Picture. The Get Picture dialog box is displayed.

3. Find the file you want to import and either double click on it or highlight the file name and click on Open.
In a few seconds, part of the image is displayed in the picture box (unless you are loading an EPS file without an image header, in which case an X appears in the box.)

**Sizing the Picture Box**

Before you crop or size the image, you’ll want to make sure that the picture box is the size you want in your document. You may not particularly care whether the box is 2.5-inches square or 2.6-inches square, in which case the sizing you did by eye when the box was created may be okay. You can resize the box at any time by using the edit tool to drag on the handles.

In other cases, you may want your picture boxes to be an exact size. Quark lets you specify the size of picture and text boxes with great precision. You can even type in the coordinates of the upper left-hand corner of the box to position the box within a thousandth of the unit of measurement you are using. To size the picture box, follow these steps:

- 1. Use the edit tool to select the box to be sized.
- 2. Pull down the Item menu and select Modify...

![Quark picture box specifications.](image)
The Picture Box Specifications dialog box appears.

3. Type in the width and height for the picture box. If you like, you can also type in the position of the upper left-hand corner of the box on the Origin lines.

4. Click on OK when finished.

**Cropping an Image**

There are several ways to eliminate parts of the picture that you don't want to appear in your document. If the image is larger than the picture box, you can move the image around within the picture box, using the box as a window to view some portion of the image. The parts that lie outside the picture box won't appear in your document.

The second way to crop an image is to change the scale of the image by enlarging it or reducing it. This automatically makes more or less of the image visible through the picture box window. You may need to use some combination of positioning and scaling to set the image the way you want it.

**Positioning a Picture**

To move a picture around within its box, follow these steps:

1. Use the edit tool to select the picture box containing the image to be positioned.

2. Move the cursor into the picture box. The cursor changes to a grabber hand icon.

3. Hold the mouse button down and drag the picture around within the box. When you have the cropping you desire, release the mouse button and move the cursor outside the box.

Note: You can quickly center an image within a box using the keyboard shortcut Command-Shift-M.
Sizing and Scaling a Picture

If the size of the picture box is okay, but you need the image to be a different size, Quark allows you to change the size or scale in either the X or Y direction alone or in both directions at once. Changing only the X or Y scale has the effect of stretching the image either horizontally or vertically, producing distortion. Depending on the type of image and the amount of change, this stretching may be barely noticeable or produce a comic effect. For example, you can’t change human faces and figures too much in one direction or another without producing a fun-house mirror effect. You can probably get away with a lot more distortion with scenics (who knows how thin the tree is supposed to be?) and abstract images.

Figure 8.6

Quark has a keyboard shortcut that automatically stretches or shrinks your image enough to fill the picture box entirely Command-Shift-F. If necessary, the program stretches or shrinks more in one direction than another to fill the box, which can cause some distortion. A couple examples will show you what I mean.
Assume in the first case that your image was roughly square and was imported into a square picture box, of which it fills only half. When Command-Shift-F is typed, the image is modified to fill the box completely. Since both box and image are square, the same amount of enlargement is needed in both horizontal and vertical directions to fill the box. No distortion results.

In the second case, your image is rectangular, with its horizontal dimension longer than its vertical one. It is placed in the same square box. Quark may have to expand the image only slightly in the horizontal direction to reach the edges of the box, but it may need to stretch it quite a bit in the vertical direction to conform to the square format.

In addition to Command-Shift-F, QuarkXPress provides several other ways to size and scale a picture. If you’ll recall the Picture Box Specifications dialog box, there were two boxes,
one for a Scale Across and one for a Scale Down percentage. The default values are 100 percent: the actual size of the image as it appears in its original file.

If you change both of these values by the same amount, the picture is reduced in a proportional way. That is, setting Scale Across and Scale Down to 50 percent would reduce a 4 x 4-inch image to 2 x 2-inches. There would be no distortion. If you happened to change one more than the other, the same type of distortion would occur as when Command-Shift-F is used to fill a square picture box with a rectangular image (or vice versa).

There will be many times when you'll need to scale an image to an exact percent. For example, frequently line art images are scanned at high resolutions to get the best image quality, then reproduced at a smaller scale. If an image is 150 percent of the actual size needed, you'll need to rescale it at 67 percent (in both directions) to produce the proper image.

Other times, you simply need to reduce or enlarge the picture a little at a time to make it fit. Quark also has a quick way of doing this. To resize an image in 5 percent increments, follow these directions:

1. Use the edit tool to select the picture to be resized.

2. Hold down the Command-Option-Shift and (greater than) keys. The image is reduced 5 percent. Each time you press the key combination again, the image is shrunk another 5 percent.

3. To enlarge the image, hold down Command-Option-Shift and (less than) to size it up in 5 percent increments.

Note: you can change both the size of the picture and that of the picture box at the same time using another keyboard shortcut. Simply hold down the Command key while dragging on the handles of the picture box. As the size of the box changes, the image size follows proportionally.
Advanced Image Placement Options

Quark's picture box shapes make it convenient to shape images so text can run around them, but you're not limited to those exact shapes. The package provides other controls that you can use to modify the way text flows around your image.

The first of these is the Text Outset specification available from the Picture Box Specifications dialog box. It is available for rectangular picture boxes and then only when Run-Around and Transparent are both checked. Text Outset defines the margin separating the text from the edge of your image. Text flows only to that point or to the edge of the picture box (whichever value is smaller).

In rounded-corner picture boxes, you can specify corner radius rather than text outset. The corner radius, measured in inches, determines the smoothness of the corners of the rounded figure. A radius of two inches (the maximum value allowed) changes the corners into arcs of a circle with a two inch radius; for many picture boxes, that produces very rounded edges. Smaller radii result in less rounded boxes; a zero radius produces a rectangle.

Other Quark 3.0 Enhancements

With Quark 3.0, you can rotate a box and the picture, or rotate the picture independently. You may use the Rotation tool to do this manually, or you can type in a value in the range 360 degrees to -360 degrees for either the box itself or the picture. A value can be entered in the Skew field to slant the picture box right or left.

The latest version of Quark also includes an Auto Import feature which will reimport lower-resolution image files when their associated printing files have been moved or modified.

A new Picture Greeking option will reduce the resolution of the screen image of a picture file. You'll see enough detail to
know what the picture is, but screen redraw will be accelerated considerably.

You can elect to print or not print pictures selectively, in order to speed up the printing process when doing proofs. If you're not interested in how a picture looks at this time, there's no need to waste time printing it with its associated page.

Finally, Quark 3.0 lets you save a particular page as an EPS file (in color or black-and-white). You can then load those files into any program that can handle them (including Quark itself). One application might be if you wanted to have a sample page of your publication presented in the publication itself as an illustration.

### Modifying Color and Gray Scale Images

QuarkXPress allows you to change the contrast of images and to specify halftone screen angles for color and gray scale TIFF and RIFF images. You can also specify color/shade information or reverse an image to a negative for and black-and-white and color paint images. These choices are all selected through the Style menu.

Default screen and contrast choices are provided. The Normal Screen settings specify a 45 degree angle, and whatever halftone screen angle you selected when you set up the page originally.

Three other standard screen rulings/angles are provided: a 60-line screen with 0 degree angle; a 30-line screen with a 45 degree angle; and a 20-line screen with a 45 degree angle. The Other Screen menu choice calls up the Picture Screening Specifications dialog box, from which you can select a screen frequency, angle, and dot, line, ellipse, square, or ordered dither pattern (the latter is a coarse screen suitable for ImageWriter output).

The Normal contrast default is an unaltered gray map, as discussed in Chapter 6. If you select the Other Contrast choice,
the Picture Contrast Specifications dialog box appears, with its familiar gray map and a novel set of tools. Quark's gray map tool palette lets you quickly make modifications to the gray scale representation. Note that you can modify the gray scale for each color in the model when working with color files.

Quark's gray map controls can be used with color bitmap pictures, gray scale and color TIFF images, and gray scale RIFF files.

Several other image controls are available under the Style menu for appropriate file formats. For example, with black-and-white paint images and TIFF line art you can add colors from the current palette. With gray scale TIFF files, you can add color to the shadows or background. The Shade menu lets you adjust color saturation of black-and-white paint or TIFF line art.

If you want to use Quark to produce full color separations of scanned photos, you can use a product like PhotoMac. Instructions for doing this are included under a discussion of PhotoMac in Appendix C.
An Overview of Ready, Set, Go and Design Studio

The original version of Ready, Set, Go from Manhattan Graphics was my very first desktop publishing program. Back then, in the mid-1980's, the concept of DTP was new and exciting, and I used RSG for a lot of things that didn't even need desktop publishing. I'll admit I'm an inveterate publisher, having put together tiny newspapers using hand-set rubber type and those weird drum presses available during the 50's. Even when I worked as a newspaper reporter on the 6 p.m. to 2 a.m. shift, I couldn't resist going back into the deserted composing room after midnight and adding little touches to the pasted-up flats of the next day's afternoon edition (harmless things like inking a few darns and hells into Mary Worth's thought balloons).
Ready, Set, Go brought me the thrill of seeing my own scanned images and text brought to life in neatly arranged in columns and frames. Even though the final copy was printed by an ImageWriter, the results were impressive for many applications. LetraSet eventually purchased the rights to RSG from Manhattan Graphics, and I followed along through several reasonable but cumulatively expensive upgrades to Version 3.5. Then they lost me; I'd gone on to programs that were, I thought, more sophisticated.

The upgrade path has continued to this day. Ready, Set Go has been enhanced to Version 4.5 at this writing, and advanced users of that program are able to upgrade yet another step to an even more sophisticated program called Design Studio. I'll describe Design Studio in this chapter, but most of the discussion will center on the far more common Ready, Set, Go. The two programs are similar in concept, so many comments apply to both.
It was like renewing an acquaintance with an old friend who's been off to college when I received a copy of RSG 4.5 to evaluate for this book. Ready, Set Go has added some valuable capabilities and works very well with scanned images.

Ready, Set, Go uses linked blocks of frames, laid out on a grid structure, to hold text. It imports EPS, TIFF, PICT2, and bit-mapped graphics and was the first to allow you to flip a graphic 180 degrees. Like the other leading programs, RSG lets you adjust the contrast and brightness of an image, do solarization effects, and edit the gray map. Halftone screens can also be selected. RSG uses a virtual memory scheme that allows you to work with images larger than RAM. The extra portion of the image is stored on disk and loaded as required for viewing and editing.

While you can place and display color images with RSG, you can't edit them or color separate them. For that, you need the more advanced layout program DesignStudio. You can, of course, create spot color separations with Ready, Set, Go. The package supports the Pantone Matching System, but the current version does not let you specify colors using the CMYK model.

Design Studio has all the color capabilities that RSG lacks. You do need to purchase the Design Studio Separator, a $395 upgrade to get the full power of the program. While RIFF and TIFF format pictures can be edited, you can't assign colors to them. You need to capture your scanner images in color or apply the colors with another program before importing the image into Design Studio.

Inserting Picture Blocks

Like Quark, Ready, Set, Go and Design Studio put all scanned images into frames, which are called picture blocks. You may use only a rectangular/square block, but you can specify that text either run around the block itself or around the image contained within the block.
You can place picture blocks one at a time and then load in images, or you can put all the picture blocks on a page or in a publication if you wish. The blocks can be resized and the images within them scaled and cropped at any time. Picture blocks are inserted using the picture tool, which is a box with an X in it. To insert a picture block on your page, follow these steps.

1. Select the picture block tool from the palette and move the cursor to the place on the page at which the block is to be placed.

2. Press on the mouse button. The cursor changes from an arrow to a cross-hair and a marquee selection block appears. Drag the mouse to shape the picture block. Hold down the Shift key as you drag to maintain the shape as a perfect square. Release the mouse button when the block is approximately the correct size. If the Snap To option is on, the block snaps to fit the grid.
3. If the picture block is not in the correct location, move it. You may need to turn off Snap To to position the block precisely.

**Importing an Image**

Next, you can load a picture into the picture block. RSG and Design Studio support color, gray scale and black-and-white EPS, TIFF, PICT, PICT2 and bit-mapped graphics. To import a picture, follow these steps:

1. Use the cropping tool to select the picture block in which you want to place the image.
3. Find the file you want to import, and either double click on it or highlight the file name and click on Open. In a few seconds, part of the image is displayed in the picture block (unless you are loading an EPS file without an image header, in which case an X appears in the block).

**Sizing the Picture Box**

Like Quark, RSG and Design Studio let you specify the size and position of the picture block in several ways. You can drag the block to the desired location and size it by dragging its handles.

Or, you can use the Specifications menu to type in the exact coordinates for the upper left-hand corner of the block and size, using measurements ranging from inches to picas and points.

To size the picture block, follow these steps:

1. Select the block to be sized.
2. Pull down the Edit menu and select Specifications... The Picture Block Specifications dialog box appears.
3. Type in the width and height for the picture block. If you like, you may also type in the position for the upper left-hand corner of the block on the Start Across and Start Down lines.

4. Click on OK when finished.

Cropping an Image

As with Quark, there are several ways to delete parts of the picture. If the image is larger than the block, you can move the image around within the picture block window. You can also scale the image by enlarging it or reducing it.

Positioning a Picture

to move a picture around within its block, follow these steps:

1. Select the picture block containing the image to be positioned with the mover tool (the X with arrows on all four ends).

2. Move the cursor into the picture block, and hold down the mouse button.

3. As you move the cursor, the picture moves within the block. When you have the cropping you desire, release the mouse button, and move the cursor outside the block.

Sizing and Scaling a Picture

Like Quark, RSG lets you change the size or scale in either the X or Y direction alone, or both directions at once. You can change an image size proportionally or stretch it along only one axis or the other.

The Picture Block Specifications dialog box has two blocks in which you can type a Scale Across and a Scale Down percentage. The default values yield an image at 100 percent—the actual size of the image as it appears in its original file.

Before you leave this dialog box, look at another set of options. At the right side of the box is a column that lists
Runaround, Frame, and Graphic choices. When the Runaround box is not checked, text flows into your graphic image as if it were transparent. When Runaround is checked, two radio buttons beneath become active. You can choose Frame, in which case text runs around the entire picture box frame, or Graphic, in which case the text flows around the image itself as closely as possible.

The spacing between the box or graphic and the text can be specified with the Text Repel Distance entry in the left-hand column.

**Modifying Color and Gray Scale Images**

When gray scale or color images are loaded into a picture block in the form of a TIFF or RIFF file, the Image Control menu choice under the Edit menu becomes active. The Image Control box consists of a gray map and contrast/brightness controls and other choices such as Posterization and Halftone... The latter allows you to specify halftone screen angles for color and gray scale.

To change the contrast and brightness of the image, you use the appropriate sliders. The gray map can be edited directly with the mouse. A helpful zoom in feature lets you work with individual parts of the gray map up close.

You can also posterize the image (choosing from 1 to 128 different gray levels) or flop the image left to right. The software allows you to specify only line or dot screens, but you can also type in a screen angle and frequency.

RSG is furnished with a default color palette containing 20 standard colors and the entire Pantone set. The palette can be customized and used to apply spot color to the image, text, or graphics you create. As noted, Ready, Set, Go, doesn't allow you to create process color separations.
Summary

This chapter provided an introduction to the capabilities of QuarkXPress and Design Studio/Ready, Set, Go for using scanned images. Both programs can import a broad variety of RIFF, TIFF, bit-mapped, and EPS formats. Quark has the added ability to color separate those images and output directly to imagesetters. Both allow you to place these images on the page with a high degree of precision. Contrast, brightness, and gray maps can be adjusted in both cases, and you can set line screen frequency and halftone dot angle.

QuarkXPress has more flexibility in choice of screen type and lets you control contrast individually for each of the colors in the color model selected. Both programs are powerful desktop publishing packages; Quark is obviously more advanced for applications requiring color and gray scale manipulations.
Half a decade ago, there was no such thing as desktop publishing. Publishing was something you did on a $40,000 workstation, connected to a $100,000-plus computer. PC users had word processing programs which, if they were lucky, would let them do tricky things like arrange text in columns. Until laser printers became common, we could select from an elite- or pica-like font and, perhaps, an expanded or condensed version of each. Any form of graphics was rather difficult to incorporate into a document.

Then came the Apple Macintosh, which made graphics a standard feature and included support for fonts and other essentials of desktop publishing. Shortly thereafter, PageMaker for the Mac was introduced, and a new industry was launched.

PageMaker, then, is the grandfather of all desktop publishing programs. Yet, it is a venerable old-timer that has been kept fresh and lively with the latest features, as even a cursory look at PageMaker 4.0 will reveal. There is very little you need to do that can’t be done with PageMaker. Scanner users who have selected this program will find it is a robust, fully-featured desktop publishing package.
PageMaker and the other DTP packages including Quark and Ready, Set, Go, benefit from the Mac Clipboard, which allows you to copy or cut images (or text) from one application and paste them down in another. While PageMaker supports a variety of file formats, the Clipboard can provide even more flexibility.

For example, you can split your screen into two windows and run your word processing program simultaneously with one of these programs. You can then load various word processing files in succession and cut and paste portions of them into your document. You could also run a spreadsheet program and develop charts and graphs that can be extracted for your publication. While many of the benefits of the Macintosh are generic to all the DTP programs under review, there are some special advantages to PageMaker.

An Overview of PageMaker

For some reason, comparing Ventura, PageMaker, Ready, Set, Go and Quark XPress has become a popular thing to do. I suppose the goal is to prove that one or the other is better, but with desktop publishing packages as much as with any computer software, the WYUIWYL rule applies: What You Use Is What You Like.

PageMaker conforms to a desktop or drawing table analogy. Your document pages are seen against the background of a pasteboard.

Like Quark and RSG, PageMaker uses frames to store your scanned images. It can import the most common formats, including TIFF and bit-mapped files, PICT, and Encapsulated PostScript files.

PageMaker supports HSB, RGB, and CMYK color models. With earlier versions, Pantone Matching System support could be obtained with the PageMaker Color Extension; which has been incorporated into Version 4.0 as a standard feature.
Spot color has long been supported by PageMaker, and users can use color EPS files with ease. The new version allows displaying color illustrations and printing separable output using an OPI-compatible separator program, called Aldus PrePrint.

Aldus PrePrint will handle files produced by PageMaker Color Extension or PageMaker 4.0. It provides only limited editing of TIFF images, but you can print composites on a laser printer or output film separations, including masks, on a Linotronic. You can select screen angles and ink overprints and compensate for dot gain.

Most of the big news about PageMaker 4.0 is of interest to those who do extensive work with text. The new integrated Story Editor has advanced word processing features, including an 80,000 word spelling checker. There are powerful new typographic controls over kerning, tracking, text rotation, and justification. Aldus has added some wonderful features for long document creation, too, including automatic table of con-
I'll try to point out important differences between Version 3.02 and Version 4.0 as they apply to use of scanned images in the following sections. In talking to users, I found there are still, at this writing (October, 1991) many who haven't upgraded to the latest version. So you'll need this information. Some may not seem crucial at first, but can have significant ramifications. For example, the document formats are not compatible between the two programs, but PageMaker 4.0 automatically converts your PageMaker 3.0 document when it is loaded. That seems nice. However, the converted documents are 10 to 30 percent larger and are no longer compatible with the earlier program—including PageMaker 3.0 for the PC. If you will be swapping documents among different versions, that's something you need to be aware of.

Another key change is that PageMaker 4.0 automatically links or associates text and graphics with the original file, which is external to PageMaker itself. That allows you to keep scanned images in a format that can be modified by your image editing software at any time. When you load a publication, the latest version of the image will automatically be inserted in your document.

**Loading Scanner Files into PageMaker**

Images are loaded into PageMaker in one of two ways. You can, of course, copy image elements to the Clipboard while you are using another application. When you return to PageMaker, pull down the Edit menu and select Paste, or press Shift-Insert. The contents of the Clipboard will be deposited in your document.

The second method is to use the PageMaker Place command, which is found in the File menu. When you activate it, you'll be shown a Place File dialog box like the one in Figure 9.2. You
can navigate through your subdirectories and disks in the usual manner to locate the file you want.

If the selected file is of a type recognized by PageMaker, the Place: As new graphic button will be highlighted in PageMaker 3.0. With Version 4.0, the choices will include As independent graphic instead. Click on OK to accept the image.

If the graphics application saved the size or resolution of the graphic, PageMaker places the graphic at the same size at which it was created with PageMaker 4.0. Otherwise, you can drag-place the graphic to create it in the desired size.

If the file contains a binary bit-mapped image, PageMaker displays a corner-shaped cursor with a paintbrush inserted. Scanned images, such as TIFF files, are indicated by a cursor with an X'ed box (a gray box in Version 4.0). Vector-based graphics are shown by a pencil icon. For EPS files, the cursor designates that it is a PostScript file with a PS notation. In any case, you then can create the size box you wish by positioning the corner cursor at the point at which you want the upper left-hand corner of the image to appear. Click the mouse and drag the cursor until the box is sized. Release the mouse

Figure 9.2

Place Document dialog box.
Cropping Images

PageMaker has a special cropping tool, which resembles overlapping corner icons. It’s derived from the physical cropping tools traditionally used in publication design. These are made of two separate pieces, often of cardboard, with a 90 degree cutout in each. By sliding the cropping corners together you can produce square and rectangular openings of various sizes.

PageMaker’s cropping tool works in much the same way. It allows you to delete any part of a graphic that you don’t want to include in your publication. To crop an image, follow these steps.

1. Use the mouse to select the image you want to crop. Then choose the cropping tool from the toolbox. The pointer will change to the cropping tool icon.

2. Move the cropping tool to a handle of the graphic, so that the handle shows through the center of the cropping tool. If you want to crop your image horizontally and vertically, choose one of the corner handles. To clip it only vertically, select the top or bottom handle. The side handles let you trim only in the horizontal direction.

3. Click and hold the mouse button. The pointer will change into a double-headed arrow. Move the mouse to trim the image to the composition you want. Release the button when you are finished.

Remember, you can adjust what portion of the image is displayed in the frame by placing the cropping tool in the center of the graphic and pressing the mouse button. As you hold the mouse button, you can move the image around in the frame.
Using Image Control

PageMaker allows you to specify image settings for TIFF files. As I explained earlier, you will probably want to use a more sophisticated program to do image editing of continuous tone subjects. You may also apply the halftone screen before an image is placed into PageMaker.

However, you can perform these functions with a little less flexibility within PageMaker itself. When an image frame is selected, the Image Control option becomes available under the Options menu. This dialog box looks like the one shown in Figure 9.4.

You can use the slider controls to adjust lightness and contrast. For screen type, you can choose dot, vertical, horizontal, or one of two types of diagonal line screens. You can choose from a variety of screen angles. As noted earlier, a 45 degree angle works best for black-and-white publications. You might want to change the angle if you are producing color separated halftones and want each color to print using a different screen angle. That process is covered in Chapter 13.

You can also select the screen frequency, or number of lines per inch. The factors for choosing an appropriate frequency to trade off between resolution and number of gray tones are covered in Chapter 6.
Keep in mind that particular PostScript output devices have default settings for halftoning and produce their best quality if you use those parameters. For example, the Apple LaserWriter, a 300 dpi device, has a default line screen of 53 lpi. That's the default value provided by PageMaker. The Linotronic 100, 200, and 300, which produce output at 1270, 1693, and 2540 dpi, respectively, are optimized for 90-, 120- and 150-line screens.

![Figure 9.5](image)

EPS files without image headers display only this bounding box.

**Working with EPS Files in PageMaker**

As with Quark, you'll only be able to see what an Encapsulated PostScript file looks like on your screen in Quark if the application program that created it also provides an image header.

If your EPS document doesn't contain a screen version that can be displayed, you won't be able to see what an Encapsulated PostScript file looks like on your screen in PageMaker. The frame will list the type and name of the file, as shown in
Figure 9.5. In that case, be sure to make all your changes to the EPS file in your graphics editor and crop out unwanted material. If possible, edit to the proportions you'll want to use. You can then import it into PageMaker and size and scale blind.

A Final PageMaker Tip

PageMaker doesn't allow you to suppress the display or printing of graphics. Instead, simply drag them off the page and place them on the pasteboard until you need them. Or, you can scan a low resolution version of an image and use that for position until you are ready to make your final copy.

Using Images In Ventura

Ventura Publisher is attracting a lot of fans on the Macintosh. Many of them are refugees from the PC world who already knew how to use Ventura Publisher on an IBM compatible. It's a relatively simple transition to the Macintosh version. Others work in environments which must exchange files with PCs. Again, Ventura/Mac will read PC files easily and translate them into the proper format with few glitches.

Others just like Ventura Publisher for its own merits. The Mac version still has some catching up to do to beat QuarkXpress in things like color separating capabilities, but it is still an excellent tool for long documents.

Ventura For Business Forms

One of my first applications for Ventura was to produce a series of business forms for organizations. Ventura wasn't the best tool for such work at that time, but it was the only software I had that would let me position lines and boxes within a hundredth of an inch. Ventura also made it simple to work with the various soft fonts I needed to build business forms.
So, I scanned in the logos required for the forms, touched them up with a paint program, and then created the form itself using Ventura's various Box Text and Frame features. The ability to position frames precisely and include multiple lines under, over, and around frames made it possible to reproduce any form reasonably quickly.

Because of its power, Ventura has become a favorite tool for those who create newsletters and other desktop publications that can benefit from scanned images. It is useful for projects with tight deadlines and changes right up to the last moment because of the way in which it handles documents.

Ventura is now available in several versions, for Windows, OS/2 and the GEM environment, in addition to the Mac.

**About Ventura Publisher**

The basic component of a Ventura document is the chapter. Several chapters can be grouped into a larger category called a publication, but this entity is generally used only for long documents, archiving, and certain global operations that affect all the chapters in a given project.

**Ventura CHP Has Pointers**

A Ventura chapter file actually consists mostly of pointers to other files which contain the actual text and graphics of the chapter. You can think of pointers as a list of file names and folders that Ventura uses to load all the components of a particular chapter.

What Ventura displays on the screen, then, is a collection of these components, arranged and laid out in the format you have specified. Figure 9.6 shows a typical Ventura chapter. Your individual text and graphics files remain unchanged on your disk in their original formats. If you mark your text with tags, which specify type styles, indentations, and other formatting information, the code names for each tag will be embedded in the text when you save it back to disk. However,
the basic text is still there and can be edited with the word processing program which created it (or another program, if you tell Ventura to convert the text file to a different format).

**Graphics Remain Unaltered**

Similarly, the graphics you load into your publication aren't altered as you size and crop them in Ventura. If you've included a TIF file, you can go back and edit that file with PhotoShop or another program at any time. When Ventura loads the chapter again, it will automatically incorporate the updated paint file.

Ventura documents are laid out in *frames*. A frame can be the underlying page (the format of which will automatically repeat on following pages) or a frame you create and place on a page as a separate window for text or graphics. (These frames, too, can be specified as repeating, so they can be duplicated on successive pages.)

Frames hold your scanned images. Ventura Publisher supports several different file types. The program differentiates
between line art and image art, using distinctions I’ve not always adhered to rigidly in this book.

Under Ventura, the term line art refers to vector-based images (outline artwork), rather than any binary, black/white image. Compatible line art file types (and their extensions if you import them from the PC environment) include those produced by GEM Draw (.GEM), AutoCAD (.SLD), Lotus 1-2-3 (.PIC), MacDraw (PICT files), Encapsulated PostScript (.EPS), computer graphics metafiles (.CGM), VideoShow (.PIC), Windows (.HPG), Hewlett-Packard Graphics Language (.WMF), and Mentor graphics files.

Bit-mapped files are called image files in Ventura terminology and include GEM/Halo DPF (.IMG), PCX, MacPaint, and TIFF formats.

**Loading Scanner Files into Ventura**

To load a raster or vector image file into a Ventura publication, you must first make sure you have activated Frame mode and that the frame in which you want to load the file has been selected. Then, follow these steps:

1. Pull down the File menu and select Add Picture... Choose the file type you want to load from the list, or leave the default All Available selection in place. That will let you choose any of the compatible file types. If you'll be loading an image that was created in a PC environment, you can click on the Identify by PC Extension box. The dialog box is shown in Figure 9.7.

2. If you want to load a single file, the default is selection. You can also check the Add Multiple box to load several files to the Assignment List, one after the other. You can then copy them to individual frames if you want.

3. Click Open when you’re ready to proceed. You can navigate through your Desktop’s folders in the usual way to find the file you want to load.
4. Select the file you want and click Open once more. If the image doesn’t appear in the frame highlight the frame and double-click on the image file name in the file list. Because Ventura doesn’t actually import your image into its file, you can continue to make changes, using the original editing software that you worked with. You can even scan an entirely new version of an image and give it the same name and folder location. Each time Ventura loads that chapter, the updated version will be incorporated.

Sizing and Scaling Images

Once the image has been loaded into the frame, you have several options. You can adjust the size and proportions of the frame by dragging the handles with a mouse. You can also change these parameters using Scaling and Cropping and Size and Position options in the Frame menu.
How Ventura displays your image in the frame can be determined by the other choices in the dialog box. For example, if you choose **Fit in Frame** in the Scaling and Cropping menu, the image will be reduced in size or enlarged so that the entire image will fill up its frame. This may result in some extra white space around the edges if the **Aspect Ratio: Maintained** button is highlighted and the image doesn’t match the proportions of the frame.

A scanned image that is a horizontal rectangle, for example, won’t fit in a square frame. Ventura will adjust the size of the image so the left and right edges just fit in the frame, leaving unused white space in the horizontal direction if **Fit in Frame** and **Maintained** are highlighted. If, instead, you select **Aspect Ratio: Distorted**, there will be no extra space. The rectangle will be compressed horizontally so the entire image can fill the square.

Figure 9.8
You May Not Want Entire Image

In many cases, you won't want to use the entire image. For example, you may find it convenient to keep more than one image in a single file. Or, you may prefer to crop the image a little more after you have loaded it into Ventura.

In that case, you'll want to select the By Scale Factors choice. When you do that, the relative size of the image will be determined by the Width setting. If you select a scale width that won't allow the entire image to fit in the frame, some of it will be automatically cropped to fit in the available area. This, in effect, makes the frame a zoom window on your image, which you can adjust until only the portion you want to use fits within the frame.

When Scale Factors are used, you have same Aspect Ratio Maintained and Distorted choices as before. If you select

Figure 9.9

Size and Position dialog box
Maintained, the Scale Width selection will become available. You can then type in a width for the image. Scale height is adjusted automatically and is not under your control, as Ventura must calculate the proper height to use to maintain the aspect ratio. When you choose to distort the aspect ratio, both Scale Width and Scale Height can be modified.

You'll find that it is sometimes easier to use trial and error to find the correct Scale Width if you're not doing precise scaling of an image.

Keep in mind that you'll want to adjust the size of an image only if you're working with line art and gray scale images that will be dithered by Ventura itself. If your images have had a halftone screen applied earlier in the process, by either the scanner or your image editing software, you'll want to leave the size alone or make changes only in even multiples, such as 2X, 4X, .25, or .50. Significant enlargements at this point will cause the halftone dots that are already present in your image to enlarge until they become objectionable. If you reduce a halftoned image, the dots will start crowding together until they begin to fill in and muddy your image.

**Cropping Images**

Ventura offers two methods for cropping images within a frame once you have arrived at a satisfactory frame and image sizes. You can move the image around in the frame with the mouse or type crop offset values in the Sizing and Position dialog box.

To crop with the mouse, choose Frame mode and select the frame containing the image. If you have hidden the picture, you'll need to unhide it through the Options menu first. Place the cursor in the center of the frame and hold down the Option key while pressing the mouse button. A grabber hand will appear, and you can then move the image around in the frame using the mouse.
You can also move the image to the left or right by typing negative or positive values, respectively, into the X Crop Offset line of the Scaling and Cropping dialog box. Plus and minus values typed into the Y Crop Offset line move the image down and up, respectively. This method can provide very precise positioning of the image within the frame.

Changing Image Settings

Ventura allows you to halftone a gray scale image if you will be using a PostScript printer. If you don’t have a PostScript compatible output device, you must create the halftone with an image editing program and then import the file in Ventura as a binary image file.

So, Image Setting can be accessed from the Scaling and Cropping menu only if you have selected a frame containing a gray scale image, and Ventura is set to print in PostScript mode. The Image Settings dialog box is located under the Frame menu. The box is shown in Figure 8.4.

Halftones are discussed in some detail in Chapter 6, so most of Ventura’s image setting options should be familiar to you. Three basic settings can be adjusted: halftone screen type, halftone screen angle, and screen resolution/frequency.

For screen type, you may choose from dot, line, ellipse, default, and custom halftone cell types. You can choose from a variety of screen angles. Generally a 45 degree angle works best for black-and-white publications. You might want to change the angle if you were producing color separated halftones and wanted each color to print using a different screen angle. That process is covered in Chapter 13, although desktop process color is probably too ambitious and complex for most of us, given the capabilities of current technology.

You may also select the screen frequency, or lpi. The factors to consider when choosing an appropriate frequency to trade
off between resolution and number of gray tones are also covered in Chapter 6.

Keep in mind that particular PostScript output devices have default settings for halftoning and produce their best quality if you use those parameters. For example, the Apple LaserWriter, a 300 dpi device, has a default line screen of 53 lpi. The Linotronic 100, 200, and 300, which produce output at 1270, 1693 and 2540 dpi, respectively, are optimized for 90-, 120-, and 150-line screens.

Working with EPS Files in Ventura

You’ll only be able to see what an Encapsulated PostScript file looks like on your screen in Ventura if the application program which created it also provides an image header. If the application doesn’t create an image header, the frame will be filled with a large X, instead. This frequently happens when PC EPS files are transferred to a Mac. It’s difficult to get the bit maps to match between the two systems, because the screen formats are different. Since both Mac II’s and IBM compatible VGA systems have a 640 x 480 mode, exchanging image headers isn’t totally out of the question.

Make Changes To Original File

If you aren’t able to display an image on the screen with your EPS file, you should make all your changes to the file in your graphics editor and crop out unwanted material. If possible, edit to the proportions you’ll want to use. You can then import the image into Ventura and size and scale blind. If the image is already in the proper proportions, you can create a frame with the same proportions and choose Fill Frame. There is no need to position the image within the frame. A frame containing an EPS image is shown in Figure 8.5.

If you have some knowledge of the PostScript language, you can edit EPS files by manipulating the PostScript instructions themselves. Since EPS commands are ASCII files, the Post-
Script file can be loaded into a Ventura frame as text. You can then edit the file, save it, and reload the chapter to incorporate the modifications.

Summary

In this chapter, you learned how to use scanned images in PageMaker and Ventura Publisher. PageMaker is the grandfather of all desktop publishing packages and, as such, first to use scanned images. Yet, it has remained fresh and at the forefront of the industry with new features in each release.

PageMaker stores scanned images and other graphics in frames. Unlike Quark, it uses a pasteboard analogy that allows you to move elements onto and off a page very quickly. PageMaker lets you import TIFF, EPS, and paint-type files. You can copy these images from another application through the Clipboard, or you can use PageMaker's Place command.

When a recognized file extension is found, PageMaker changes the cursor to a corner-shaped cursor that indicates whether the file is a bitmapped image, PostScript file, or vector-graphics image. You can size and scale the image by dragging the frame handles. An image can be resized while retaining its current proportions, or stretched or compressed in only one direction, if you wish.

PageMaker has a special cropping tool that allows you to delete any part of a graphic that you don't want. PageMaker also can be used to trace scanned images, but the tools available are quite limited. You're better off with a specialized package, such as Adobe's Streamline.

The Image Control option provides slider controls that can be used to adjust lightness and contrast. Halftone screen type can also be selected.

This chapter also provided some specific tips for using scanned images with Xerox Ventura Publisher. It included an overview that described the benefits of this package.
The basis of a Ventura document is the chapter. The chapter file stores pointers, which indicate where other files used by the chapter are located. Because these are reloaded each time Ventura works with a chapter, you can make changes to the original scanned image files at any time, and they are automatically incorporated into your document.

Ventura differentiates between line art and image art in a slightly different way than has been used in this book to this point. Vector-oriented images are considered line art. Typical file types include GEM and EPS. Image files are bit mapped graphics with .PCX, .TIF, and .IMG file extensions when imported from IBM PCs.

Ventura loads graphic files into frames, using the procedures outlined in this chapter. Gray scale images may be displayed in dithered form or as a continuous tone image if you have a gray scale monitor. You also learned two ways to size and scale images—by dragging the frame handles and by setting the exact size. Retaining and distorting the aspect ratio (or proportions) of an image was also explained.
Experience is what allows us to recognize our mistakes when we repeat them. Fortunately, you don’t have to make all the same mistakes I did to get the most from your scanner, because I’ve been kind enough to expose many of my gaffes throughout this book. Other valuable learning experiences have been collected in this chapter of tips and tricks.

This chapter will show you some generic techniques that apply to most scanners, along with others tailored to specific scanner types. You’ll also learn what to expect when installing your scanner. Some of these tips were mentioned briefly in earlier chapters. I’ve collected some of the better ones here along with new suggestions, for ready reference.

Some Free Advice

- Don’t learn the tricks of the trade; learn the trade.
- Experience is knowing a lot of things you shouldn’t do.
- If at first you don’t succeed, you’ll get a lot of advice.
- No problem is so formidable that you can’t just walk away from it.
- Entropy isn’t what it used to be.
- If everything is coming your way, you’re in the wrong lane.
- An expert is someone from out of town.
- To every rule there is an exception, and vice versa.
Keep these things in mind as you work with your scanner. You'll find that a lot of the problems you encounter aren't problems at all, but opportunities to learn how to do things better. Every knotty situation you encounter will better prepare you for the next seemingly insurmountable opportunity.

Installing a Scanner

Many of the most common scanners for the Macintosh environment provide their own interface box which plugs into the SCSI port of your Macintosh. You can, therefore, use them in a compact Mac which doesn't have an internal expansion slot, or with any Mac without using up a valuable slot. All you do is plug the interface in. There is usually a daisy-chain-type connector right on the box into which you can plug your other SCSI devices. Other devices, particularly video frame grabbers, require a separate board that must be installed in the computer—Mac II, Mac SE or Mac SE/30—itself.

If you've never installed a board in your computer before, now is a good time to learn. Opening the computer voids Apple's 90-day warranty, but this need concern you only if you've had your Mac less than 90 days, or if you are so careless that either your computer or yourself might be seriously endangered by your efforts.

If you want to install a board in a Mac SE or SE/30, you'll need a special toolkit to open the case. Special Torx-head screws, which fasten at the front of the case, must be removed through the back, using a long tool. You'll also need a case cracker, with which you can safely pry apart the two halves of the Mac case. MacWarehouse sells such a kit for about $17 and throws in a grounding adapter to help you dissipate static electricity. I've also found the tool perfect for removing the Torx screws on General Motors automobile headlight bezels.

The first step is to turn your computer off and unplug it. Keep in mind that very high voltages can remain in the computer for long periods even when it is unplugged, partic-
ularly around the CRT tube and analog circuit board mounted at the side of a compact Mac. Don't touch any of these areas as you work. Mac II systems are a little easier to work inside, since the dangerous video circuitry is housed separately in your monitor. (The video board in your Mac II isn't dangerous to you; however, you may be dangerous to it. Static electricity can harm many sensitive solid state components. Be certain to ground yourself for a moment to bleed off static electricity before poking around inside.)

Figure 10.1

An atypical computer system: lots of empty slots.

If you've made it this far in this book, you can probably figure out how to remove the cover of your computer. Once you've removed the cover, you should spot the slot or slots on the motherboard. Choose an empty one and install the board.

Replace the cover and turn your computer back on. Make a copy of the installation diskette supplied with your scanner. Then use the copy to run the installation program according to the instructions in your scanner manual. There is usually
a batch file or another program that will copy the scanning files to your hard disk and do any setup necessary. Most scanners have a test program you can run to make sure everything is working properly. Once you’ve scanned a few images to check everything out, go ahead and put the cover back on your computer.

Tips for All Scanner Users

- Scanning on a network can be problematic at times. If the scanner stops in the middle of a scan for no obvious reason, try again with the Appletalk network disconnected.

- Prepare the original carefully. It’s better to take the time to clean up your original before you scan than to spend hours fixing up the scanned image afterward. Use a pen or pencil to repair broken lines and blot out unwanted spots. Use correction fluid if necessary.

- If you can’t edit the original because it has some value in its present state, work with a photocopy or Photostat. Making a copy provides you with some added control over size and density of the original, too.

Figure 10.2

One type of DIP switch has sliding toggles, like those shown above. Others use rocker switches.

- Watch the alignment of the original carefully. If the original material contains horizontal or vertical lines, misalignment
Figure 10.3

Jumpers are a simple way for a user to adjust the settings of a computer device.

- Make certain you’ve selected the correct mode. Generally use Line Art for black-and-white, binary images, and the Halftone setting for more than two colors or shades. High contrast material can benefit also from dithering in halftone mode.

- Learn to differentiate between Bayer, Spiral, and Fatting, the most common dithering methods. Only through experience can you estimate which will be best for which original.
Choose the right resolution for the image. Line art frequently calls for the maximum resolution of the scanner if you have sufficient memory or disk space. For halftones, use a setting that will allow the gray scale you want at the printer resolution you'll be using. If an image will be used for position only or as a template, you don't need maximum resolution.

Use preview scans if your controller software offers this option. This will save you considerable time that might otherwise be wasted entering coordinates or working with extra image area.

Add halftone dots as late in the process as possible. Your scanner may have no gray scale capabilities other than its built-in dithering. However, if you are using a gray scale scanner and have image manipulation software that allows halftoning, don't dither during the original scan. That way, you can size and scale the image and add the halftone effect when you are finished.

Selecting Copy for Scanning

The best line art images for scanning are sharp and have good contrast between the black (or colored) lines and the background.

The best continuous tone copy for scanning has a broad, even distribution of gray values. The most important elements should be clustered in the middle range of grays, if possible. That way, you can concentrate the number of grays you have available in that range and not worry about the highlight and shadow areas.

With some scanners, the darkest tones are reproduced as inky blacks. Avoid originals with detail concentrated in shadows and dark areas.
• Try not to scan photocopies of originals unless you have no choice. Photocopying increases contrast and may make a continuous tone original too contrasty to reproduce well.

Scanning Existing Halftones

• Avoid scanning existing halftones if you can, since adding another halftone screen may produce a mottled, moire effect.

• A few image editing programs have despeckle and blurring filters which can reduce these effects.

• Try scanning an existing halftone at a slight angle. It may reduce the effect of the previous dot pattern.

• Four-color halftones scan better than black-and-white halftones, because the scanner sensors tend to blur the complex dot pattern into a more continuous tone image.

Coping With Difficult Originals

• Colored filters can help you eliminate unwanted smudges or tones, if you can find a filter that is close to the same shade as the image to be eliminated (or dropped out in reprographics parlance) and your scanner doesn’t use a colored light source. For example, blue lines on an image can be dropped out by placing a blue sheet of acetate over the original before scanning. You can use this technique to reduce the amount of certain colors in a multicolored original, too. Make sure your acetate is not too thick and is free of defects. Photography stores frequently sell high quality transparent color sheets which photographers use to filter electronic flash light sources.

• If you are having difficulty scanning a photograph that you simply must have in electronic form, see if you can get it reprinted on a less contrasty grade of paper. Images that appear very low-contrast to the eye scan better than snappy, high-contrast images.
With color pictures, you may not have many options. Professional color papers come in a regular grade which is used for portraits and a "plus" type that is preferred for commercial photographic illustrations. Only professional color labs usually stock and work with both types.

Black-and-white prints are more easily adjusted for contrast. Any amateur darkroom enthusiast will have worked with either graded papers or so-called multicontrast papers which are adjusted through the use of filters. Your problem negative can be printed for you by a friendly photographer, or you can use a custom lab.

Expect to pay a minimum of $10 for a custom color print from one of these labs and not much less for a custom black-and-white print. The price can go much higher, too, since you are asking for hand work.

**Hand Scanner Tips**

Hand scanners require a little more attention during use, since additional variables are involved. This section will provide some tips on getting your hand scanner working, as well as how to improve the quality of your scans.

Hand scanners are limited to scanning a width of about 4 inches with most units, up to as wide as 8.5 inches with others. That width is usually used as the default value by the scanner control software. The length of the document you can scan may be limited by the amount of available memory. Most hand scanners store the image being captured in memory, so the longer the image swathe, the more you need to hold all of it at once.

For example, with a binary scan at 200 dpi and a 4-inch wide image, you need about 20,000 bytes of available RAM. A 6-inch long scan would require 120K. Depending on the resolution you select and the ability of your software to use any extra
memory you might have, the image length may be limited to from 3 to 14 inches or so.

- **Some** hand scanners have only a fixed resolution, which may be 200 to 300 dpi. Others, like the Logitech ScanMan, let you choose 100, 200, 300, or 400. Your maximum scan length may be limited by the demands the higher resolution puts on your available memory.

- Another consideration in scanning is the color of the light source used in the hand scanner. Those that use a red light, for example, see any red in your original as white. Your best bet is to photocopy or photostat the original and scan that. You’ll lose a little image quality, but you will be able to capture red-hued areas of the original.

- The latest hand scanners have a number of controls on the scanner itself. Additional features can sometimes be selected through the scanner control software. All hand scanners have a scan button that you depress to start and stop the scan. Another switch allows you to change from line art mode to halftone mode. Often you’ll also be able to select from among several dither patterns. A resolution switch enables you to choose one of the available dpi ratings, while the contrast control adjusts brightness between the dark and light areas of the image.

- Move the scanner slowly and evenly down the image. Try to maintain the movement at exact right angles to the top of the image.

- You may want to make a “jig” on a legal-sized clipboard to help steady your hand. Glue a strip of wood to the left or right side of the clipboard, at a right angle to the clip at the top. You can then clip your original artwork to the board and rest one side of the hand scanner against the strip of wood. The guide will function like the fence of a table saw to keep the hand scanner parallel. The latest Lightning Scan hand scanners are come with a tool that performs this function.
Look at your original carefully to decide how it can best be scanned. If the image is larger than the maximum width of your scanner, there are some techniques you can use to make it easier to combine images later. For example, you might find it easier to turn a portrait-oriented document sideways and scan from the right or left edge to the opposite edge instead of from top to bottom.

Each pass will be shorter—8.5 inches instead of 10 or 11 inches—so it will be easier to move the scanner evenly over the reduced distance. Moreover, you’ll be better able to capture the entire image. In portrait mode, a full-page 8.5 x 11-inch document takes most of two passes with little margin for overlap. In landscape orientation, you can make three 4-inch scans with a good half-inch or more of overlap in each image. The images will be much easier to match up later on.

With text or other material that is horizontally oriented, turning the sheet sideways places the horizontal lines up-and-down on the page. When you do combine files, the “seam” can be placed on the gaps between lines. Most scanner software and image editing packages have a Rotate option that lets you turn the image around when you’re ready.

Experiment with scanning speed to find the right rate for your scanner and computer. Something between a half inch and 3 inches per second should be best. Moving too slowly doesn’t buy you much, but moving the scanner too quickly can distort the image.

To maintain even hand movement, start the scanner an inch or two before the image and continue for an inch or so past the end of the image before releasing the scan button. If you try to stop and start the scan at the edges of the image, you’re likely to add a couple small jerks to your movement.

To scan a paste-up, a rough-textured original, or a piece of art that is very small, cover the original with a sheet of transparent acetate. Tape the art to a piece of paper first to hold it in place.
Flatbed Scanner Tips

- Keep your platen clean. The large, flat surface of the platen is a veritable magnet for fingerprints and dust. A bit of dirt won’t show up on most scans, but enough can reduce the resolution of your scans or show up as unwanted artifacts. Don’t tape anything to the platen unless you must. Find a cleaner that doesn’t leave behind a film.

- It is possible for the user to change the bulb in some flatbed scanners. If yours is one of them, keep an extra handy, and learn how to make the switch before you find yourself with a dead bulb and a tight deadline.

- Some scanners and/or controller software allow you to adjust the speed of a scan. Usually, the slower the velocity, the sharper the image. Experiment to see if this helps you.

Overhead Scanner Tips

- Even if your scanner operates solely from room illumination, consider placing special lights on either side of the scanner bed. That way you’ll avoid shadows that can mar your scanned images.

- Don’t bump the scanner or its table during scanning. Because overhead scanners are taller than other models, the distance between the sensor and the original will magnify any movement. You might want to isolate your scanner on a sheet of foam cut to fit the base.

- Keep the sensor window clean. The window that protects the sensor is more exposed than on other types of scanners and so can collect dirt and fingerprints.

Sheetfed Scanner Tips

- Keep your rollers clean to insure smooth scans and reduce damage to imperfect originals.
If an original is too large to feed through your scanner, make a reduced-size photocopy.

Have a clear acetate envelope handy for undersized and tattered originals.

**Increasing Scanner Productivity**

At times, you'll want to maximize the throughput of your scanner. As an example, I've recently worked on projects that included scanning hundreds of cigar box labels for a catalog and converting a file of several hundred photographs to an online image database. In similar situations, you can do several things to minimize the amount of time your computer is tied up.

Consider adding a second computer or scanner. If your business does a lot of scanning, you may be able to justify another computer or scanner dedicated to that task. A second computer can be used for scanning while the first computer is being used productively for other work.

A second scanner can make it easier to do two different types of scanning at once. Artists and graphics workers frequently need to interrupt their main work to scan an image quickly. If the scanner is tied up doing OCR work, their productivity may drop. Consider having one scanner for each function. In a pinch, you can dedicate two scanners to the same type of work and handle really big jobs twice as fast.

Organize your motions carefully. You don't need to be a time-study engineer to use your common sense here. For example, when scanning a series of images with a flatbed scanner, you usually open the scanner cover, place your original, activate the scanner with the controller software, save the image to disk, and then repeat the process.

Since storing the new file to disk takes a few seconds, it makes sense to scan and store one original and then remove it and insert the next while the disk activity is going on.
However, if your system is such that it takes a few seconds for the scanned image to be displayed on the screen, you might want to start swapping originals as soon as the scanner light source goes out. You’ll then be ready to store the last image and begin scanning the next.

- Sort all your originals so you can scan the same size documents one after the other. Minimize the number of times you must change scaling, halftoning, brightness, and contrast or other settings by grouping like originals together.

- Consider using two workers: one to sort and feed originals and one to work the scanner. There are jobs which can be more efficiently handled this way.

- Don’t capture any more information than you need. If you’ll be scanning a series of half-size originals measuring 5.5 x 8.5 inches, set up your scanning window for that size. Scan only at the resolution you require. Using 300 dpi when you don’t need it costs you three times: once when the scanner takes longer to capture the image, a second time when the larger file is stored to disk, and a third time when you must load and reduce the image at the editing stage.

**Summary**

This chapter revealed some tips for using scanners that apply to users of any desktop publishing package. You learned that installing a scanner isn’t as difficult as you might have thought. You also found some tips on working with difficult originals, selecting copy for scanning, and scanning existing halftones.

A special section on hand scanner tips provided you with some techniques for getting the most from these low cost devices. Flatbed and sheetfed scanners were also addressed, and I described some specialized software you may find useful.
Using OCR Software and Hardware

Everything you ever knew about OCR is wrong! Other than color display technology, probably nothing I covered in the first edition of this book has changed so dramatically as optical character recognition (OCR.) Consider these myths that you can now safely discount:

Myth: OCR is expensive and requires high-end hardware.

Truth: The very best OCR programs, which cost $1000 or so when this book was first published are available in new versions for $500 or so. They run on the computer you have right now (if you have a 68020 processor or better.)

Myth: OCR is inaccurate. Even the best programs have only a 95 percent success rate with clean, typewritten or laser printed text. That's 100 errors on each page with 2000 characters of text. Proportional spacing or text in magazines or newspapers is out of the question.

Truth: The best OCR software can perform nearly flawlessly. I regularly scan in four- and five-page typewritten documents with only one or two errors in the entire document. I recently completed a project that involved scanning in 90 articles directly from tear sheets removed from magazines and newspapers. Many of these scanned with only four or five total errors, and even the worst of them could be cleaned up a lot faster than they could be typed in by hand.
**Myth:** High resolution scans take so long to interpret that you’re better off using a lower resolution.

**Truth:** A scanner with 400 to 600 dpi resolution will produce better OCR output, and won’t take an inordinate amount of time with a 68030 or 68040 computer or accelerator card. The time you save not cleaning up the document quickly reclaims the extra processing required.

This chapter will tell you a little about the latest in OCR technology. Up until this point, I’ve concentrated on the capture of images that can be used directly in desktop publications. These images might be dropped in as-is, modified before merging with the document, or simply used to show approximately what a piece of art will look like when reproduced by conventional photographic techniques.

**Captured Images Not Final Product**

There are times, however, when the captured images themselves aren't the final product. Frequently, we'll want to use words that are stored in hardcopy form. An image of the words is not what we want, though. What we're really looking for is to have the computer translate a picture of the text (which is all a graphics scanner can capture) into the characters themselves.

Scanners come into play here as part of the science of optical character recognition. Make no mistake about it, compared to simply capturing an image, the technology required to translate that simple bit map into letters, numbers, and punctuation is extremely complex.

It’s akin to giving your computer a bit map of a beach scene and asking it to sort out where the sand ends and the beach towels begin. As the next step, the computer is asked to identify which areas of the image constitute Cousin Michael and which represent Aunt Cathy.

Yet, how far we’ve come in only a few years! I’ve been using OCR software for several years, but generally only as a last resort to avoid re-keying a lengthy document. Until recently, the number of errors generated by reasonably priced OCR
systems made them barely viable for most applications. For example, the software I used most frequently could translate scanned text with about 98 percent accuracy. That may sound pretty good, but that 2 percent error rate meant about 40 unrecognized or incorrectly recognized characters in a 2000-character page of text. Since the bad characters always seemed to be distributed fairly evenly over the page, I usually had to correct 30 or 40 misspelled words.

It was almost faster to retype the page. In fact, I generally used OCR only because I hate tedious, repetitive typing tasks. I found it more interesting to spend an hour correcting a scanned document than to spend exactly the same amount of time retyping it.

Retrieving a Lost Document

My longest foray into OCR came when I lost an entire 20-page document. All I had left was a printout of the pamphlet. I soon discovered all the shortcomings of OCR systems of that time. Different type sizes caused the OCR software to choke. It wanted me to train it to recognize each size and typestyle used in the document. Kerning (adjusting letter pair spacing for better appearance) really confused the program, and any two letters that happened to touch (even a little) were received as blankly as if they had been Russian Cyrillics.

Some amazing changes have taken place since then. OCR software like OmniPage can translate pages into text with 99.5 percent accuracy—or better. I’ve personally scanned documents with only four or five errors per sheet, page after page. OCR software can recognize and ignore graphics and use a wide variety of fonts with equal facility.

Given the snail’s pace at which some earlier systems operated, today’s OCR software/hardware seems remarkably speedy, as well. If you haven’t used optical character recognition before, the process may seem unbelievably slow. However, a minute or two per page is much, much faster than the 80 words per minute typing rate I can sustain for short bursts.
Only a year ago, I was hesitant to recommend OCR to any PC user. Today, it’s entirely practical.

According to a recent industry survey, some 95 percent of information is still stored on paper. It is obvious that the paperless office will never arrive, or, at the very least, not for many years. OCR will take on increasing importance in the meantime.

This chapter will explore some of the technology behind OCR, look at a few applications in desktop publishing, and provide you with criteria you can use to decide if it’s practical for you. We’ll also look at some of the leading OCR packages.

**OCR Background**

Some big bucks are being invested in perfecting OCR technology. As a desktop publisher, you may not think that capturing text is a huge deal. Much of what you use in your documents is created on computers anyway. It's not that difficult to retype something if it is available in hardcopy form.

In many other business realms, key entry of hardcopy data is a major drain on human resources. Insurance companies receive hundreds of thousands of typed and handwritten applications and claim forms every single day, and much of the information they contain has to be manually keyed into the computer system. Some companies have gone so far as to set up off-shore data entry facilities in countries where labor costs are low. The first OCR systems cost $50,000 to $100,000 or more, and big corporations lined up to buy them for awhile. Today you can get better results from a $500 software package on your $2000 personal computer.

Text is actually the simplest form of information to enter into a computer—as long as a human brain functions as the character recognition device. We are quite efficient at interpreting alphanumeric characters—the upper- and lowercase alphabetical characters, numerals, punctuation, and symbols used
for text and figures. Each of these 96 characters can be represented by a single number, whether ASCII or some other code, that is easily captured, stored, sorted, and retrieved by a computer. However, ASCII-type information can convey to the computer nothing more than the fixed set of symbols.

Often, a document will contain other image information. A letter A in a document may not be simply a letter A. It may be boldfaced, underlined, printed in a particular font or typesize, or otherwise contain information that is useful, particularly in office publishing applications.

Documents Contain Image Information

Documents can contain other image information with broader uses, as well. Signatures may be included for verification. Photos or line drawings might provide valuable information for, say, insurance underwriters deciding whether to approve coverage of real property. Charts and graphs might be included in a drawing to present numeric information in a way that is easily understood.

The need to capture both text and image information has led to the development of graphics scanners, intelligent scanners, and several different types of optical character readers.

The graphics scanners discussed so far in this book are the dumbest type of image/computer interface. These devices read many different points on thousands of individual lines of a document, breaking up the full-page image into a bit map representation of that page. The computer can then store, manipulate, and reconstruct the picture elements, or pixels, in such an image.

Computer Knows Nothing of Content

However, this form of capture tells the computer nothing about the content of the document. To the computer, the bit map image of a blank sheet of paper is equivalent to that of one filled with text and graphics.
Optical character readers are graphic scanners with some sophisticated software that is either stored permanently on ROM chips in an add-on board or residing in your computer. They were developed to intelligently extract and capture text information from printed documents. Early OCRs were primitive devices—slow, prone to mistakes, and able to scan only a limited number of fonts. In fact, OCR-A, OCR-B and some other specialized fonts were developed precisely to provide standardized characters that could be easily read by such devices.

There are basically three classes of OCRs. Intelligent scanners, or compound document processors, are hybrids that can differentiate between graphics areas and text in a single document. Except for a couple systems that require an add-on board or a coprocessor (at $900 to $3000 and up), these are expensive devices, not generally used for desktop publishing. Within areas containing graphics, such a scanner functions as a bit-mapped graphics scanner, capturing the image-intensive information. It also recognizes text information and attempts to interpret the alphanumeric characters in a form the computer can use.

**Page Scanners Read Text Anywhere**

Page scanners are capable of reading text information anywhere on a page, but they ignore graphics. This type of scanner is useful when many different kinds of documents—incoming correspondence, for example—must be scanned and interpreted. A forms reader is a more specialized type of OCR, which can be trained to read specific document layouts, scanning for typewritten, printed, or handwritten information. A forms reader is generally faster than a page scanner, because it ignores any incidental text that may appear on a page in favor of the key information.

For desktop publishing applications, the volume of OCR work is usually low enough that a dedicated OCR device can't
be easily justified. Most of us will rely on our graphics scanners and special software packages like Read-It and OmniPage.

Figure 11.1

Pattern recognition algorithms allow matching groups of pixels with specific characters.

**OCR Algorithms**

OCR technology is for the most part software technology. Certainly, though, the quality of the scanned image can have an effect on how well the OCR system functions. You should make especially sure that the glass platen on a flatbed scanner is clean and that your original is of the best quality. A tiny defect that you can ignore or retouch on a graphic image can cause an error that must be found and fixed in a text file.

Aside from quality problems with the original itself, once you reach 200 to 300 dpi resolution and have sufficient contrast, most scanners work about the same with most OCR software. The exception would be very small typefaces, which can benefit from 400 dpi resolution or higher.
Regardless of the type of OCR solution you need (or can afford) the package will use one of two systems to translate a bit map into a useful stream of characters. All types of OCR packages use one or more algorithms to determine what a given character is.

**Pattern Matching**

The simplest algorithm is based on pattern matching. A matrix is used to mask both the character being read and sample characters stored in the OCR's database. The number of congruent bits between the two patterns is used to determine which character is the most likely match for the one being read.

Figure 11.1 shows part of a character library used by one program, TextPert in its pattern matching scheme. The program compares each letter with this library to look for a match. There will probably be several examples of each character, especially if the operator has trained the software for this font. The algorithm will score one point for every dot in the scanned character that also contains a dot in the reference character. If the score is high enough, the character is deemed identified.

Pattern matching allows scanned characters to vary somewhat from the ideal pattern stored in the software's library of characters. If a given character scores 88 percent and the next closest match is, say, 70 percent, the software can be fairly confident that it has chosen correctly. Sophisticated packages, like TextPert, allow you to specify how much variation is allowed, so you can fine tune the system for high quality, low quality, and damaged originals.

Other techniques can also be used as tie-breakers or for confirmation. Some use context checking. (Is the 1 located in the middle of a word or is it surrounded by numbers? If paired with numbers, it is likely to be the numeral one; if with other alpha characters, it is probably the lowercase l.) Context
checking can be turned on and off using a Check Look-Alikes option. Context checking can also involve word lists and spelling dictionaries. If a program locates a word that it determines to be stork, it may find that a word list can help it narrow down the final letter to k, e, m, or y (for stork, store, storm, and story). Since these are very different letters, the final choice should be an easy one.

Statistical modeling can also be used to improve guesses. That is, how often does the letter combination that would result from a given choice actually occur in English? An h might follow a t a high percentage of the time, but not a k, so the software could easily differentiate between the somewhat similar h and k. It might even be useful (someday) to have OCR software that could build a statistical model for a specific document. That would help improve accuracy even when reading highly technical material with many buzz words and jargon not found in standard dictionaries (or foreign languages).

Higher Resolutions Equal Higher Accuracy

Obviously, the higher the resolution of the pattern used for comparison, the greater the accuracy. The price, however, is a much slower OCR program. A character cell that is divided into a 100 x 100 pixel matrix will contain 16 times as much information as one divided into a 25 x 25 matrix. That could mean the difference between identifying eight characters a second (four minutes for an average page) and one character every two seconds (an hour a page). Unfortunately, as the matrix shrinks, the error rate goes up. Evaluating eight characters a second isn’t useful if one of them is wrong.

That’s why a faster computer system is almost mandatory for some OCR software. Given a sufficiently speedy computer, you can retain fine resolution for accuracy at decent processing speeds.

Pattern matching is limited because each font the OCR can handle must be learned; a pattern must exist in the machine
for each character in that font. If many different fonts are used on a page, the process can be slowed down while the OCR's processor compares a character against many different sets of patterns. Of course, the more fonts this type of OCR can handle, the slower it operates. Some packages allow you to specify which fonts will be used to check a page, even though they are capable of automatically selecting the most suitable character sets in their libraries. Most OCR software that uses pattern matching also allows the page to be separated into various zones to avoid tedious comparisons with graphics areas.

Feature Extraction

Feature extraction is another technique for interpreting characters on a page. Each symbol is broken down by the features that make up that symbol. That is, a letter A consists of two slanted lines joined at the top and by a crossbar. As the OCR operates, built-in algorithms extract the features of the character being read and provide a match. The chance of spotting an A, no matter what font happens to be used, are excellent. Feature extraction can even be used to interpret constrained handwriting—that is, characters printed with a modicum of care roughly on or inside a box printed on a form (in an ink invisible to the OCR).

Because no character has more than about 20 different features, and because a lengthy list of patterns does not have to be compared, feature extraction has the potential of being a very fast OCR method.

The chief advantage and disadvantage of this method are the same: you can't train the software, and you don't have to train the software. Theoretically, a really weird font could totally confuse an OCR package using feature extraction. Yet, if the letters were consistent in their inconsistency, a pattern recognition program could be trained to recognize them.
More About Resolution

You might think that if 200 dpi is good for OCR, then 300 dpi would be better, and 400 dpi best of all. However, this is not strictly true. Any OCR program has limitations on the amount of information that it can process. If a package allowed any resolution at any point size, the point of diminishing returns would be quickly reached. For example, a 72 point (about 1-inch high) typeface scanned at 400 dpi would contain 160,000 bits of information in a single character. You simply don’t need that much data to tell characters apart at that size.

So, with most OCR packages, the text size you can interpret depends on the resolution you choose. Higher resolutions are applied to smaller type sizes. For example, with ReadRight, you can scan text in sizes from 4 to 12 points at 400 dpi; 6 to 16 points at 300 dpi; and 8 to 24 points at 200 dpi.

If you examine that listing, you’ll see that 200 dpi allows you to scan just about every text size you are likely to encounter, except for large type in headlines and very small type like that found in sports box scores and stock market listings. In most cases, there is little to be gained from scanning text at 300 dpi.

If you have a faster computer and want the ultimate in accuracy, by all means use higher resolutions. As I noted, the OCR I do with scanners at 600 dpi is nearly flawless. Since I use a spare computer to perform this task I don’t care how long interpretation takes. I’d rather walk over to the scanner every four or five minutes to slap down a new page than spend the same number of minutes cleaning up the document myself.

Using OCR with Different Document Formats

In desktop publishing, documents that you want to capture with OCR generally have no set format. Some will appear as
a single column of typewritten text; others will consist of several columns laid out newsletter or newspaper style. Most OCR packages can handle these varying formats easily, either automatically or by asking you to define manually which zones are to be read and in which order. In the latter case, you are presented with a reduced image of the page and allowed to place boxes around the different zones you want to define.

It is possible that you will be reading the same document format month after month. For example, you receive a publication from your company's overseas office intended for distribution there, and you want to capture certain sections for manipulation and merging with your own newsletter. Several OCR packages let you define page layouts with their own zones, which you can recall at any time.

The newsletter example is not the most likely scenario. A better one is a company that wishes to design forms with certain information placed in standardized locations. This data can include the name of a customer, an account-holder, or insured; a Social Security number or other identifying number; and other key information. Such forms could be quickly scanned by an OCR package using a predefined form layout.

Effective In Certain Applications

This type of system would be particularly effective in applications such as waybills, invoices, and so forth, where not all documents are retrieved. Instead of taking the time to scan the full text—which may or may not be needed—you can capture only the indexing data and rely on low-cost, high-density microfilm for permanent storage.

Even more intelligent OCR devices, which can interpret entire pages, and those which can differentiate between text and graphics will also grow in importance. Such machines may learn to recognize many different types of forms and documents simply from the information they contain. Today,
preprinted forms numbers, bar codes, and other techniques must be used for this.

Anatomy of an OCR Package

OCR packages generally share many components and features. Below is a brief discussion of some of the more common controls and modules you’ll find in the typical OCR package.

Load from Scanner/Memory/File.
This control lets you determine whether the OCR software will operate on an image it obtains from the scanner, one that is already loaded in memory, or one that you have already stored in a file. The first option lets you capture a new image using an attached scanner, without using separate scanner software. The second choice enables you to re-interpret an image that has already been scanned. For example, you may wish to try a different font file for comparison but not want to rescan the image.

There are a several situations in which you might want to process an image stored in a file. In my office, for example, a scanner with a sheet feeder is attached to one computer, while I like to do OCR interpretation on a second. By saving each scanned image to a TIFF file, I can save a large group of pages for OCR processing later.

Then, I can use a program like OmniPage to process the TIFF files. In fact, this set-up lets me use OmniPage on a computer that may not have a scanner attached at all. The files themselves are all OmniPage needs to work.

Set Output Format
This option lets you choose how you want the finished text to be output. Most packages allow you to choose from among several different word processing formats, usually MacWrite, and several other formats. You can also choose plain ASCII text if you want.
Depending on the sophistication of your OCR software, you may get just text in the final format you select, or something more. Some packages can provide the necessary tabs and columns to reproduce multi-columned text just as it appeared on the page. Some software can capture text attributes like boldface and underlining and pass that along to the final file. A few packages, such as OmniPage, can separate text from graphics and output each to a file.

**Retain Columns/Attributes**

Some programs have these as separate options. That way you can choose whether or not to retain formatting when the text is saved. If you will be reformatting it for your own publication, you may not care what it looked like in the original document; only the text itself is of interest to you.

**Single Page/Multiple Page**

Many programs allow you to switch between single-page and multiple-page mode. In single-page mode, each document is

![Automatic zoning can speed OCR operations.](image-url)
treated as a separate entity and saved in a file of its own. You can make adjustments (such as specifying font files and zones) tailored for each page.

If you will be reading a number of similar pages one after another, you may not need this flexibility. In multiple-page mode, successive pages are stored in the same file. Some programs automatically scan the next page as soon as they have finished processing the last. Scanners equipped with sheet feeders can automate the process, but you can still save time with manually fed scanners: while the OCR software is interpreting one image, you can remove the last sheet and insert a new one, then do something else. It isn’t necessary to monitor the OCR process closely and initiate each page manually in this mode.

**Auto Feeder**

This is another way of specifying multiple-page mode. OCR software usually has a separate driver for each type of scanner and can therefore control hardware features such as contrast or, in this case, auto feed, automatically.

**Proportional/Monospace**

OCR software often can work more efficiently if you tell it whether it is looking at proportional or monospaced (typewritten, for example) output.

**Error symbol to Use.**

Most packages use a symbol such as a tilde (~) or asterisk (*) to represent characters it doesn’t recognize. Neither character is common in most text, so you can search to the one your program uses during editing to find words in need of correction. You can then replace the symbol with a character of your choice. Some spelling checkers have a habit of breaking words into two if an odd character is embedded. They will see Massac*usetts as Massac and usetts and ask you to correct both, when what you really want is to fix Massac*usetts. In
such instances, your on-line dictionary may be of little use (it will try to find a match for Massac).

One way to work around this problem is to choose a little-used, but still legal character, such as X or Q as your error symbol. There is little chance that substituting one of these letters for unknown ones will result in legal words. So, your spelling checker can happily look for a match for MassacQusetts.

**Print Contrast**
This allows you to control the contrast of your scanner. Some software provides you with a window showing an image of the text being processed. If the quality doesn’t look good, you can adjust the contrast and rescan.

**Windowing/Zoning**
This control lets you define columns and other areas of the page for the program. In this way, you can elect to ignore graphics, or determine the correct order in which columns are read. Some programs auto-zone for you, while others require that you do this manually. A typical zoom window setup is shown in Figure 11.2

**Font Training/Selection**
Software based on pattern recognition requires you to teach it to recognize each typeface you want to use. Better packages are supplied with a library of typefaces that have been pre-trained.

Once you have a selection of type sizes and faces, you can select them prior to processing a page. Some software chooses the most likely type fonts for you after a quick look at the page. Often, you can use several different font files on a single page.

**Hardware Preferences**
This option lets you set up your system for your particular hardware. You may be able to choose monitor type, display
color scheme, and other default values. Sometimes these are defined in a setup program that must be run again if you want to make changes.

Six Leading OCR Software and Software/Hardware Packages

This section describes in detail some of the leading OCR packages. I’ve had extensive experience with all three of these; they’re my favorites among the available OCR options. I wasn’t able to test all of those packages for this chapter: in some cases the vendors either wouldn’t send an evaluation copy or didn’t make the deadline for this book. That isn’t to say they aren’t fine products; I just can’t give a personal recommendation.

Figure 11.3

Recognized characters can be presented one at a time as they are found.

I’m making that point for a reason: OCR software and hardware packages can be one of the most costly investments you make. It’s easy to be disappointed, since price alone is no indication of how well the OCR package will function with your scanner. A friend of mine paid $700 for OCR software only
to find that it came with a clumsy copy protection scheme that made it useless for his purposes. Fortunately, he was able to get his money back (now there's an advantage of copy protection; the vendor can be slightly more certain that you haven't made an extra copy before returning a product).

Other OCR packages I've used cost two or three times what you'd pay for a more accurate, more fully-featured program. This is one area in which you are well advised to try, try, and try again before you buy.

Here are some general guidelines to follow in choosing an OCR package:

- Examine the types of documents you will be scanning carefully. If you're reading just standard typewritten sheets, most OCR programs will handle them easily. If your documents are complex and consist of many different text blocks, you'll want more flexibility.

- Some programs let you select columns by framing areas of the text. Others will do it for you automatically, saving you from a tedious chore.

- A few programs will capture halftone images as well as text. That's another time saver, since you don't have to load a different application.

- Look for a program that allows you to isolate only those areas of a page you want to scan. Why read an entire page when you are interested only in one paragraph?

- Demand a prescan feature. This is the only way to truly set up text blocks for efficient scanning.

- Omnifont programs don't require training, but may be thrown by unusual fonts and character sets. Trainable programs take longer to get up and running with a new document type.

- The more output and formatting options your OCR package has, the less work you'll have to do on the finished files. Omnipage retains bold and underline type characteristics and
will save text in MacWrite format. Other programs save only ASCII text that you must reformat manually.

- Some programs will insert tabs to reproduce spreadsheets in proper column formats. Others use spaces, which limit your ability to change the column widths quickly.

OmniPage

OmniPage is a powerful OCR package, and it takes a powerful Mac to run it. You must have a machine with a 68020 microprocessor and at least 4 megabytes of RAM. OmniPage in action is shown in Figure 11.3.

The latest version of OmniPage has some new features, including the ability to scan text in landscape orientation. That can come in handy if you have a wide document that won’t fit on your scanner in normal orientation.

OmniPage supports a number of scanners, including those from Canon, HP, Microtek, Ricoh, and Abaton. It can also be used with a computer that doesn’t have a scanner attached. You simply import the (non-compressed) TIFF files you create and examine them with OmniPage.

OmniPage Divides Screen Into Zones

OmniPage scans the page and divides it into zones, a process you can watch onscreen. Each frame is numbered to show sequence. As each zone is examined, it is displayed. You can tell OmniPage in what order to read the marked blocks if you want. A character window shows the scanned letters, so you can determine right off whether the page image is good enough to scan.

Text attributes like boldface, italic, and underline are also captured and carried through to the output. An editing package, for use if you’re outputting to ASCII, is included.
A Partial Page feature allows you to scan only that text relevant to your needs. OmniPage supports 11 languages, including French, German, and Italian.

OmniPage has a Quickscan mode that bypasses the dialog box and uses the current settings. It works directly with the Apple scanner and HP ScanJet. OmniPage is furnished with a Hypercard tutorial stack.

Calera has introduced several enhancements for OmniPage that make this product even better. OmniSpell is a spelling checker that can compare unknown words with a list of possible candidates. It’s been optimized for the kinds of errors that OCR programs make; that is, commonly confused characters like a and s.

OmniDraft will help those who must read dot matrix printing. The module fills in the spaces between the dots to help the OCR program interpret the characters more accurately.

A third enhancement is OmniProof, a stand-alone program that compares changes in a document. You can take two word processing files and, view them separately in split screens or print out a composite version with the changes marked. These capabilities are useful for documents that have several editors, either when the files are worked on electronically, or particularly when each version is retyped or printed. You can scan the printed versions separately with OmniPage, then compare them for alterations with OmniDraft.

**Accutext**

Accutext 3.0 is the OCR package supplied by Xerox for use with its own scanners. It is also compatible with the HP ScanJet Plus and may support other scanners by the time this book is published.

This program deserves mention, if only for the fact that it is based on Kurzweil artificial intelligence technology. Some day I’d like to write a book devoted exclusively to Ray Kurzweil’s
wizardry. Kurzweil scanning systems for optical character recognition can cost up to $23,000 and are so fast and accurate that the Department of Defense counts on them. While a little less functional and a lot less expensive, Accutext has Kurzweil’s typical innovative touch.

For example, it’s available in versions for French, Spanish, Italian, German, Dutch, Swedish, Norwegian, and of course, English. Each foreign language has its own 50,000-word lexicon, which you can customize with an additional 10,000 words. Keep in mind that English is rather unique in having 450,000 words still in common use. French speakers must make do with fewer than 150,000. A 50,000-word foreign language dictionary, then, is likely to include nearly all the words you’re likely to encounter in a document.

Like OmniPage, Accutext requires a 68020 computer, and 4 megabytes of free RAM. A lot of this RAM is expended on lexicons, which Accutext consults to see if each of the words it has identified is, in fact, a reasonable word before continuing. You can add your own lexicons of technical jargon up to 10,000 words if you like.

Accutext will handle text from 8 to 24 points and preserves the text formatting as much as possible. Six expert modules examine the text, automatically avoiding graphic images. It saves text in a variety of the most common formats, including MacWrite, Word and Excel.

Unlike OmniPage, Accutext recognizes the special formats of superscripts and subscripts. It also features extra scanning controls that let you compensate for poor quality originals.

Read-It

Read-It is available in three versions: two for standard scanners and a third for hand scanners. It is a trainable program that works better as you build type tables for each of the kinds of fonts that you read most frequently. Three train-
ing modes are furnished: Easy-Learn, Learn, and Learn-And-Recognize.

The first functions well with monospaced type, such as that produced by a typewriter or computer printer in monospace mode. The Learn mode shows you each letter image in a scanned file one at a time. You then enter the character into the type table. Learn-And-Recognize sets the software itself to work checking individual characters and creating its own type table with your help.

Read-It works with scanners, or TIFF and PICT files. Since it doesn’t have the memory requirements of OmniPage and AccuText, you’ll probably have enough RAM to run both this program and MultiFinder. That way you can be scanning text while you do other useful work.

Figure

11.4

Read mode settings

Reading mode:

- Use Internal Library
- Auto area definition
- Read headlines too
- Inverted text too
- Multiple pages

Alphabet: [Roman]

Context: [Active context]

Reading area settings:

Character at end of area:

Character at end of line:

Character at start of area:

- Return at end of each area
- Tab at end of each area
- Tab at end of each line
- Put tabs instead of spaces
- Return at end of each line
- Financial form

Character set: [English]

Modify  Cancel  OK

Read-It has more than a dozen options the user can specify.
Read-It Professional is an enhanced version with omnifont recognition that allows it to read most office documents without any training at all. When you do want to train the program, it has an improved EasyLearn automatic self-taching mode and a new interactive SmartLearn option. It recognizes all European characters, including Russian and Greek alphabets.

The professional version can also use new ReadForm and ReadSpell add-on modules. ReadForm, as its name implies, is used with pre-filled forms and uses a built-in dictionary to check addresses and zip codes. The user can define fields for dates, numbers, etc.

ReadSpell is a spelling checker designed to correct errors caused by faulty character recognition. For example, it will spot substitution of the numeral 5 for an uppercase S, or use of the number zero instead of an uppercase O.

The latest version of the hand scanner version of Read-It has a built-in merge function to allow scanning a full-sized document in two vertical passes. It includes a new Quick Entry mode for faster training, and has drivers for direct scanning with Logitech ScanMan and Lightning Scan scanners.

**ReadStar II Plus**

This OCR software is another trainable package, which works with both TIFF and PageMaker FOTO files. The version I tested is copy-protected, which may make it too much of a bother for serious business use.

ReadStar II has some unique features, including the ability to zoom in and manipulate the scanned image at the pixel level using a toolbox next to the display window.

Like Read-It, this program has automatic, semi-automatic and manual learning modes. However, the type tables can’t be edited as easily as with Read-It.
TextPert

Among the trainable OCR packages for the Macintosh, TextPert is the winner in terms of flexibility with foreign languages. The program works with six different character sets, including Cyrillic, Greek, and Hebrew. You can select from among the complete character sets of 34 Indo-European languages. Dictionaries aren’t supplied for all of these, however.

TextPert is also one of the most flexible programs. You can use it on a Mac Plus with only 1 megabyte of memory (although it is quite slow on this machine). TextPert works with text from 4 to 72 points and can handle PICT as well as TIFF files. Recognized text can be saved in Word, ASCII, and MacWrite formats. It will automatically zone your page into blocks, like OmniPage, but unlike any of the other trainable packages I tested. It allows you to specify the order in which

TextPert can automatically zone your document.
text is read and change the output format for each of the different text windows.

If you can’t justify TextPert’s price tag, CTA also offers a more economical program, CTA ScanReader, which is priced at less than $400.

ScanReader will run on any Mac Plus, SE or Mac II equipped with 1 megabyte or more of RAM and at least 2 megabytes of hard disk space. It will work with ten different scanners (from Abaton to Sharp), and also accepts TIFF, SCAN and IMAG file formats. It can output to ASCII, MacWrite or Microsoft Word files.

**MacinText**

This program works directly only with Microtek scanners. However, you can also interpret TIFF files captured with another scanner.

MacinText works with monospaced or proportionally spaced typewritten text and will handle multiple type sizes on a page.

**Paper Keyboard**

Datacap, Inc. provides an unusual sort of OCR software in its Paper Keyboard. This software isn’t intended to read printed text but, rather, handwritten forms. It translates scanned images of constrained hand printing (block letters) into text files.

Translation takes place at 10 to 12 characters per second, which is faster than most typists. The only catch to this program is that users must follow some specific guidelines on how to form their letters, to avoid confusing the program. The guidelines aren’t as difficult to follow as you might think, and take only 15 minutes or so to learn.

The program requires a 68020- or 68030-based Macintosh with 2 megabytes of RAM and a hard disk. It can work directly
with Abaton, Apple and HP scanners, or interpret TIFF files produced by other models.

Tips for OCR Scanning

Following are some tips that apply to any type of OCR scanning, no matter what type of hardware/software combination you use.

- **Make sure the page is aligned.** Most software will read your text if the page is skewed slightly. Yet, accuracy can drop drastically if the page is tilted by more than 10 percent or perhaps 5 degrees.
  
  Flatbed scanners usually make it easy to align perfectly square pages. Just butt the edges up against the guides on the scanner platen. Pages that are not square can present a problem, however. You might encounter one of these as a photocopy that was made with the original itself skewed. Or, text might have been deliberately printed at an angle.

  Since pages are put face down on a flatbed scanner, you may find it difficult to align the page. You might need to draw a line on the back of the sheet corresponding with the baseline of the text. Then use that line to align with the guides on the scanner. If your flatbed has a sheet feeder, you may need to scan the pages manually to get correct positioning.

  Overhead scanners and hand scanners are a little easier to line up, since you can see the page during scanning. You might want to use a clipboard as your base for a hand scanner, so the page can be held immobile. The jaws of the clip can also be used to hold a book or ruler at right angles to the top of the page, at one edge or another. You can then use this to guide the side of the hand scanner as you move your hand (much like the guide on a table saw).

- **Make sure your original is of top quality.** Fill in broken lines by hand if they are few in number. You’ll find you can jot
around a page very quickly—a lot faster than you can search
to a word and manually type in a character in many cases.

Repair tears and cover up blots that may confuse the OCR
software. A touch of correction fluid can help. If you aren’t able
to alter the original, work on a photocopy. A copy can also
improve the contrast of a poor original, particularly output
from a dot matrix printer.

If your OCR software can’t ignore graphics or doesn’t allow
easy zoning of a page, cut out pieces of paper and tape them
over the largest graphics. A few minutes with your original
now can save a lot of time later.

- **Watch out for translucent paper.** Newsprint is particu­
larly bad. Some characters from the reverse side can show
through, confusing your OCR software. You can often fiddle
with the contrast of your scanner to reduce this print-through,
but it’s frequently faster and simpler just to put a piece of black
paper on the back side of the page. The black paper absorbs
light that travels though the sheet and prevents it from
bouncing back to the scanner sensor. If you’re scanning a lot
of translucent sheets, consider mounting a black sheet semi­
permanently on the platen cover of your flatbed or on the
baseboard you use for your overhead or hand scanner.

- **Use a spell checker to find “bad” words.**
  Your word processor will allow you to search to the special
character (often a tilde or asterisk) used to mark unrecognized
characters. Usually, though, it’s faster to use a spell checker
with automatic correction. It will take longer to find each word
in some cases, but the spell checker will then be ready with a
list of alternates. You can accept the word from the list faster
than you can retype the bad word yourself.

  Since my spell checker performs badly with non-standard
characters used as markers, I use global-search-and-replace
to substitute another character for the tilde. Then I can spell
check the document. Using this method rather than changing
the character used by my OCR software lets me retain a copy
with the tildes in place. I can double check that if I want to make sure that all the bad words have been located.

- **Doublecheck.** If you do use a spell checker, always proofread one last time with your own eyes.

**Summary**

Optical character recognition is a useful technology for those who want to capture text from hard copies. Extremely sophisticated technology is required to enable the computer to differentiate the broad range of characters we use from the simple bit maps supplied by graphics scanners.

OCR devices are available in several different types, which can read text and mixtures of text and graphics. Sophisticated systems can retain text columns, fonts, and type sizes while the ASCII information is being captured. Hardware solutions with coprocessor boards are frequently the fastest, most accurate, and most flexible. However, some software-only systems also work very well.

An OCR system may use pattern matching, feature extraction, context checking, or statistical analysis to determine what characters are represented by a given set of dots on a page. With pattern matching, a matrix is used to compare the character being read with sample characters stored in a database. The number of congruent bits between the two patterns is used to determine which character is the most likely match. Such systems can be trained to recognize new sets of characters.

With feature extraction, each character is broken down into its components. A letter A, for example, would be defined as two slanted lines joined at the top and by a crossbar. Thus, a wide variety of different fonts can be recognized without training. Resolution of the scan can affect the type sizes a package can read and the accuracy and speed with which it can read them.
A typical OCR package consists of several components, including the module that captures an image from a scanner or loads it from memory or a disk file. You can also define your output file format, decide whether or not you want to retain columns or other attributes, and set the program for single-page or multiple-page documents.

Scanner software also lets you differentiate between proportional and monospaced text, and specify whether or not to use an autofeeder mechanism. With trainable packages, you can select the fonts to use or train for a new font.

The chapter concluded with descriptions of some of the leading OCR software packages, including AccuText, OmniPage, and TextPert.
I'm probably the only person on Earth who thinks it's ironic that we put so much effort into scanning images and text from hard copies, only to turn around and make more hard copies from the resulting electronic files. Yet, it's usually the case that any image we capture with a scanner ends up back on paper before very long.

Our electronic communications are frequently constrained by one or more hardware gatekeepers. The resolution of the scanner itself is only one limiting factor in our efforts to capture and use images in desktop publications.

Your monitor can limit your viewing of a scanned image, both in sharpness and in gray or color scale. The amount of memory or disk storage your Macintosh has available can function as a gatekeeper, too, limiting the size of the images you can manipulate. And, as you discovered in Chapters 5 and 6, the printer you choose can set up the last roadblock you must hurdle. The finest, fastest scanner and computer system in the world won't do you any good if you can't print legible, pleasing hard copies.

Macintosh users have led the desktop computer world in printing technology for some time. When the PC world was struggling to integrate dot matrix graphics printers with applications, we were working with the ImageWriter, which effortlessly provided WYSIWYG output of anything we could see on the screen. The HP LaserJet may have brought laser
printing to the PC realm first, but Apple introduced the LaserWriter and PostScript.

This chapter will take a brief look at some of the options open to you in selecting a printer on which to output your scanned images. You'll learn about PostScript printers and their advantages and disadvantages. You'll also learn that you don't necessarily have to own a PostScript printer to handle PostScript output. I'll also tell you about some of the latest options in high resolution printing. You can now get 600 to 1000 dpi output for $7000 or less.

Some Options

In nearly all cases, the master used to photocopy or offset print a desktop publication is produced by a near-letter-quality dot matrix printer; a page printer, such as the Apple LaserWriter series; or a phototypesetting device, such as a Linotronic imagesetter.

There have been some significant advances made in dot matrix printer technology in recent years. You can now, for example, purchase PostScript interpreters that will work with less expensive printers. However, the prices on page printers have dropped so significantly that fewer dot matrix devices will be used for desktop publishing in the future. The days in which I prepared a yearbook for my high school classmates' reunion on an ImageWriter are long gone.

Inkjet printers, which also use one-line-at-a-time techniques to reproduce images, can offer resolutions as high as 300 dpi. They are, however, considerably slower than even the most sluggish page printer and don't offer much of a price advantage these days. I think inkjet technology, too, will see reduced use for generating reproduction masters in desktop publishing over the next few years. Instead, inkjet printers will be prized for their quiet operation, portability, and ability to print in several colors.
Inkjet printers are also good for making relatively low resolution color hard copies. The new HP DeskWriter C takes color inkjet technology into the 300 dpi realm.

This chapter, then, will concentrate on 300 dpi page printers and, to a lesser extent, higher resolution output devices, since the vast majority of readers will be using something that falls into one of these two categories. Most of you will have at least $1000 to spend for an entry-level laser printer, but will find it hard to justify spending more than about $7000.

How Printers Handle Scanned Output

When it comes right down to it, the printers most commonly used for desktop publishing handle only bit-mapped images of pages. Output devices like plotters can, in fact, process vector-oriented images, but these peripherals are rarely, if ever used for publishing applications.

I've called printers like the LaserWriter page printers so far in this chapter for a good reason. Not all 300 dpi printers of this type use lasers to write an image. What they have in common is that each produces an image a full page at a time, rather than a line at a time like dot matrix and inkjet printers.

Users often confuse the image writing mechanism of the printer with the process used to transfer the image to the page. As a result, so-called "laser" printers take credit for a level of image quality that has nothing to do with the use of lasers. This confusion hasn't been helped by the manufacturers, who have often bowed to the inevitable. For example, there is a printer from Okidata called the OkiLaser 400 which doesn't have a laser in it at all! Instead, the printer uses an LED light bar to write the image. The manufacturer obviously felt that a name like OkiLED wouldn't sell many printers.

The laser device found in the LaserJet and similar printers is nothing more than a very precise light source that is used to expose a pixel from the bit map of your page onto a photo-
sensitive conductor, which may be a belt or a drum. Other, equally precise light sources can also be used. For example, some printers like the OkiLaser 400, use LEDs to make the exposure, while others (like the Qume CrystalPrint Publisher) put a liquid crystal shutter to work to modulate the light that prints pixels onto the photoconductor.

From that point on, the imaging process is more or less identical in all common 300 dpi page printers. Lasers are somewhat finicky devices and require more moving parts than are necessary with other writing technologies. It's theoretically possible to produce better-shaped, more consistent dots with LED systems. Moreover, a laser will eventually burn out.

By comparison, the LEDs used in printers today have useful lives hundreds of thousands of times longer than the printing engines that contain them. When was the last time you discarded a bedside clock because one of the LEDs had failed? Never? Those LEDs are illuminated 24 hours a day; those in an LED printer are turned on no more than tiny fractions of a second per page.

**Printer Components**

Page printers contain several components. The part that receives the page that will be printed and determines how the other components will handle it is called the controller. The controller is usually an integral part of the printer, but may also reside in your computer. Some systems use a more sophisticated controller as a plug-in component in the computer or printer which enhances the capabilities of the primary printer controller.

Printers also have a marking engine, which is used to write the image with light, and a toning engine, which transfers that image to paper. Each of these three major components can have an effect on how your scanned image is reproduced. Let's look at each in turn.
Controller

To print a page containing a scanned image, your computer downloads to your printer either a bit map of the page or instructions on how to build that bit map (if your printer has a PostScript or other page description language module that can interpret those instructions). This bit map is stored in memory until the full image is received.

The controller is sometimes called a raster-image processor (RIP) because a bit map is a type of raster image. The controller has access to the full complement of memory in your printer, some of which can be dedicated to storing bit-mapped images of various fonts, called soft fonts because they are created by software rather than hardware. Your application (often Quark or PageMaker) sends a code to the printer, activating a particular font. Then, when a particular ASCII code corresponding to an alphanumeric character is received, that letter, number, or symbol is printed using the selected font.

Remaining Memory For Page Images

The remaining available memory is allocated to the page images themselves. The more memory you have available, the more pages your printer can hold at one time (providing you with a type of printer buffer). Extra memory also expands the size and resolution options you may have for your pages. That is, if you have only 512K of memory in your printer, a graphic image no larger than a third of a page can be printed at 300 dpi. You may have to settle for 150 dpi resolution to image an entire graphics-filled page.

In PostScript printers, the controller has another function. It receives its printing instructions not in the form of a bit map, but, rather, as a series of commands in the PostScript language. The built-in interpreter then constructs a bit-mapped page image using those instructions.

Another common type of add-on controller is a PostScript interpreter for non-PostScript printers. This functions much as a built-in PostScript controller functions, but may involve
hardware components that are installed both in your printer and in your computer. Software-only PostScript interpreters are also available. However, these translate a page image from PostScript commands into a bitmap image before the image is sent from your computer. Such interpreters don’t do any controlling of your printer at all beyond that provided by any application.

**Image Writing**

The actual writing can be done in one of two ways. The printer can expose the image area (the black lines of your scanned image or text), in which case it is called a *write black* printing engine. The printer can also expose the white areas on the page, skipping over those pixels that are to be printed black. Such devices are called *write white* engines.

Since the laser, LED, or liquid crystal shutter must scan each line on the page in all cases, it doesn’t take any longer to write the white areas than to write black. However, each of these systems has its own advantages and disadvantages.

With *write black* systems, toner is attracted to those areas of the drum that have been illuminated by the writing light source. Such systems are better at defining very fine details, since the pixels and only the pixels of the image are written to the photoconductor. All other areas of the drum or belt are left untouched, so there is reduced chance of spurious pixels that can produce artifacts that reduce resolution.

In *write white* systems, on the other hand, toner is attracted to those areas not illuminated by the writing light source. Because of the toning systems used, this usually results in much denser black areas.

Which do you need? Write black printers are often preferred by those who use their laser-printed pages as masters for offset printing, because ink used in lithography tends to soak into a page and spread (the degree depends on the type of
paper stock). Masters that are not too dark tend to reproduce better on the press.

If you plan to use your laser copy as the final output, you may prefer pages printed with a write white engine, because the black areas will be denser and more consistent. The manufacturers of individual printers can tell you what type of writing technique is used. Such engines as the Canon SX, Ricoh 1060, Casio LCS-130 (a liquid crystal shutter device), and NEC 890 (an LED writer) are all write black devices. These engines are used in the HP LaserJet II, IBM Personal Page Printer II, Qume CrystalPrint, NEC SilentWriter 890, and others.

Write white engines include the Ricoh 4081 and 4150, found in the AST TurboLaser P/S and QMS PS-1500, respectively.

Keep in mind that printers are getting better all the time, and the differences may not be important to you, particularly if you output copy for both offset reproduction and direct use.

**The Toning Engine**

The rotating photoconductor belt or drum and the paper are supplied with an electrical charge from a set of charging coronas. The toner itself is also electrically charged, either through the addition of charging agents or because of its natural electrical characteristics.

Toner contains the (usually black) colored pigment itself and the somewhat larger carrier particles to which the pigment clings. The image areas on the drum are given one charge (positive or negative) while the surrounding areas have the opposite charge. Toner particles also have the opposite charge and are, therefore, attracted to the image areas and repelled by the non-image areas. The toner is picked up by the drum, which rotates and transfers it to the paper, which is charged to attract the toner. The paper then passes through a set of heated fuser rollers which permanently fuse the toner to the paper.
How PostScript Printers Are Different

PostScript is a programming language like BASIC and Pascal, which is optimized for describing printed pages. It was created by John Warnock and Charles Geschke, who founded Adobe Systems.

Because PostScript files contain descriptions of the objects that are contained on a page, rather than bit maps, those objects can be sized and scaled without losing any resolution. The simplified example below will show what I mean.

2-inch Square:

Draw a horizontal line 2 inches long, beginning 2 inches from the left margin of the page and 2 inches from the top margin of the page. Make the line 0.1 inch thick.

Draw a horizontal line 2 inches long, beginning 2 inches from the left margin of the page and 4 inches from the top margin of the page. Make the line 0.1 inch thick.

Draw a vertical line 2 inches long, beginning 2 inches from the left margin of the page and 2 inches from the top margin of the page. Make the line 0.1 inch thick.

Draw a vertical line 2 inches long, beginning 4 inches from the left margin of the page and 2 inches from the top margin of the page. Make the line 0.1 inch thick.

As you might guess, doubling the linear dimensions of this square on the page would involve nothing more than changing all the 2 inches long descriptions to 4 inches long and adjusting the starting coordinates appropriately. By simultaneously doubling the line thickness from 0.1 inch to 0.2 inch, we can keep the relative width of the lines the same. Similar operations could be performed to produce a square 10 inches on a side, or one 0.1 inch on a side.
In actual practice, the descriptions in a PostScript file describe objects much more complex than a square. In those cases, the advantages of PostScript over bit-mapped images become clear. The only thing that can be done to increase the size of a raster image is to increase the size of the pixels used to draw a given portion of it. A smooth curve doesn't retain its smooth shape; instead, the pixels that made up the original image just get larger and jaggier.

With scanned images of line art, we can solve this problem to an extent by scanning at a resolution equal to or greater than the resolution that will be used to print the image. The captured information can match the resolution of the printer and produce a smooth image when reduced to the desired final size on the page.

For example, if you have a 4-inch square piece of art that has been scanned at 300 dpi, it will appear at approximately the same resolution when printed in 4-inch size—or smaller—at 300 dpi. If you want to enlarge the image, you'll always lose resolution with a bit-mapped image, unless it is converted to a vector format, such as Encapsulated PostScript.

PostScript, then, is of little advantage if you plan to reproduce scanned art at the same or higher resolution, but can provide some benefits if you plan to enlarge vectorized artwork. This is an important point: PostScript is often automatically equated with higher quality, but can actually provide poorer image quality for scanned images that are not enlarged, when compared with the output of a bit-mapped printer. That's because of some of the compromises necessary in turning a raster image into a set of PostScript instructions.

**PostScript Advantages**

What is the full complement of advantages to having a PostScript printer, then?
Device flexibility. PostScript files are PostScript files. It doesn't matter whether your output device uses a built-in PostScript interpreter or one that resides on your hard disk. The output device can be a 300 dpi LaserWriter or a 2450 dpi typesetter; it makes no difference with PostScript.

File portability. Your PostScript files can be printed by any other user with PostScript capability. Both Quark and PageMaker allow printing PostScript files to disk. Those files can then be printed by other users with PostScript capabilities, even if they don't have your particular desktop publishing software—or even if they don't have Macintosh-compatible systems. This is most often done by service bureaus, who take PostScript files from their customers and output them using higher resolution imagesetters and typesetters.

Reduced memory and hard disk requirements. I have 15 megabytes of non-PostScript font files on my hard disk, accounting for about eight font families in two or three typefaces each in a limited number of sizes from 6 to 30 points. PostScript fonts, which can be sized at fractional-point increments in sizes much larger than you'll ever use, take up only a tiny fraction of that on a hard disk or in memory (depending on where your PostScript interpreter stores the information).

Not all of these factors affect scanner output directly, of course, but they should be of interest to you as a desktop publisher.

PostScript Options

The PostScript picture has changed dramatically in the past year. Until recently, one factor has kept the price of PS printers artificially high: the royalties demanded by Adobe Systems for the rights to use true PostScript in other vendors' products. This premium, at times, seemed to be as much as several thousand dollars. While the royalty fees themselves weren't actually that high, PostScript printers did indeed cost that
much more than identical devices without PostScript capabilities.

I won't argue Adobe's right to charge a fee for their intellectual property. The development of PostScript was a master stroke that came at the right time. The language itself was a major undertaking that involved a lot of work. Adobe's link-up with Apple Computer in the first LaserWriter was a brilliant marketing move. Having done so many things right, John Warnock and Charles Geschke deserved to be rewarded, and the royalty fees from PostScript have paid for the development of other innovations, including Adobe Illustrator 88 and Streamline. (Think about that the next time you neglect to pay for your shareware.)

However, the stiff entry fee for building a PostScript printer has had all sorts of side effects. First, an Adobe PostScript version of a printer can cost $2000 more than the identical printer without PostScript. Vendors who have developed unauthorized PostScript clones for their own printer controllers have had to invest heavily in re-inventing the wheel, so their PostScript compatible printers haven't been much cheaper. For a long time, PostScript has been out of the price range of many desktop publishers who would otherwise want it and benefit from it.

A recent wrinkle has been the development of plug-in PostScript compatible cartridges, usually for HP LaserJet-type printers. Even more recently, Apple and Microsoft have joined forces in an attempt to escape from Adobe's dominance in the page description language arena. They announced their intention to produce their own True Type PDL that wouldn't be compatible with PostScript. Since True Type has become a part of the Macintosh's System 7.0 and upcoming Windows 3.1 and OS/2 releases, it immediately was established as a formidable contender.

In retaliation, Warnock eliminated the licensing fees for PostScript and published the specifications for the inter-
preter, enabling anyone to build a PostScript interpreter without paying royalties to Adobe. This was important, because PS cloners had found it difficult to break the encryption Adobe used to give printers the “hints” that are needed for maximum quality at reduced type sizes.

So, will the price of PostScript printers plummet? Will PostScript now overwhelm the new Microsoft-Apple alternative? We won’t know for several years the full effect of the PDL war, but things are starting to get extremely interesting.

Meanwhile, we have a selection of laser printers to choose from. Leading the pack are Apple’s own offerings, which include the LaserWriter IIIf and IIg, the top-of-the-line products with a speedy 68030 processors, memory up to 12 megabytes, and an optional SCSI hard disk for font storage. In the middle of the line is the LaserWriter IINT, which has fewer bells and whistles. For less than $3000, you can get the LaserWriter IISC, which is a QuickDraw (non-PostScript) laser printer that can be upgraded to one of the PostScript models at additional cost.

Software-Only Solutions

One reason that PostScript should thrive is that a software-only PostScript-compatible interpreters has begun to reach the market. Even the early versions work very well, are amazingly inexpensive, and provide some valuable features.

The first program of this type on the market for the Macintosh was Freedom of Press. It is designed to serve as a replacement for the hardware-oriented interpreters built into or added onto page printers.

Freedom of Press requires a Mac SE/30 or Mac II with at least 1.5 megabytes of RAM and a hard disk. It runs as an application or as a Chooser-level driver that works with more than 50 different raster-type printers and film recorders,
including the Canon FP510 color inkjet and Mitsubishi S-340 dye-sublimation printers.

All you need to do is save a PostScript version of your file to disk. Then, load the Freedom of Press application and select the file or files you want to print. Several can be queued. Any of the 35 original PostScript fonts provided with the LaserWriter can be selected.

When this utility is installed as a Chooser driver, you might as well be using an Appletalk-connect PostScript printer. Any network user can print files just by making a print request from their application's regular Print menu.

![Figure 12.1](image)

PostScript print options dialog box.

Freedom of Press will use up to 8 megabytes of memory, so it can handle large PostScript files.

Fast on the heels of FOP was UltraScript for the Macintosh. This software is marketed by Imagen, a wholly-owned subsidiary of QMS. Unlike FOP, UltraScript doesn't ask you to save files in PostScript format. Instead, it intercepts printer output and performs the conversion on the fly. It also generates screen fonts for you, so you can preview your documents.
UltraScript is available in two versions. A basic $195 package includes 15 fonts. The UltraScript Plus package includes 43 typefaces and adds a built-in spooler. The latter also allows you to convert the Mac into a print server. Users can direct jobs to the printer, rearrange their order, or cancel them.

Converting Mac Files to PostScript

You'll need to create PostScript versions of your files if you use an interpreters like Freedom of Press or if you send your output to an outside service bureau. In this section, I'll provide some easy, step-by-step instructions for preparing these files.

For All Applications

Regardless of which application you are using, follow these steps first:

1. Be certain to turn off any print spooling programs you are using, such as Background Printing or TOPS.
2. Make sure you have installed the LaserWriter and LaserPrep icons from the System Tools disk in your System folder.
3. Pull down the Apple menu and select Chooser.

Figure

12.2

For PageMaker 4.0 PostScript print options.

PostScript print options

- Download bit-mapped fonts
- Download PostScript fonts
- Include TIFF and PRINT files
- TIFF for position only
- Make Aldus Prep permanent
- View last error message
- Print PostScript to disk: [file name]
  - Normal
  - EPS
  - For separations
  - Include Aldus Prep
4. Select the LaserWriter icon. Ignore messages about needing an Appletalk network.

5. Open the application and the document you will print to a PostScript file.

**PageMaker 3.02**

If you have PageMaker 3.02, follow these additional steps:

1. Choose Print from the File menu.
2. Click on the Options button.
3. In most cases, you'll want to make sure the top five boxes are unchecked. These boxes are labelled:
   - Download Bit-Mapped Fonts
   - Download PostScript Fonts
   - Use Default Paper Tray
   - View Last Error Message
   - Make Aldus Prep Permanent

**Figure 12.3**

[Diagram of LaserWriter Page Setup]

LaserWriter Page Setup

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*Printing Scanned Images* 255
You won’t need any of these if you are sending your file to a service bureau. Indeed, by not downloading fonts to the file, you can reduce the size of the file significantly. Instead, just tell your service bureau what fonts you have used; they can download them to the PostScript device before running your job.

4. Check Include Color Images if you have specified different colors in your document.

5. Check TIFF For Position Only if you want a low resolution image of your graphic to be printed with the file. That will save you money, since imagesetters are much slower in outputting images than text. You can also elect to eliminate TIFF images in your output altogether to maximize savings.

6. Check Print PostScript to Disk.

7. Check Normal for documents that will represent a single color (black or spot colors). Otherwise check For Separations for process color separations.

8. Make sure Include Aldus Prep is unchecked.

9. Click on Set File Name and enter a name for this PostScript file.

10. Click on OK and click Print to print the file to disk.

PageMaker 4.0

If you have PageMaker 4.0, the steps are slightly different:

1. Choose Print from the File menu.

2. Click on the PostScript button.

3. Uncheck the boxes that are labelled:
   Download Bit-Mapped Fonts
   Download PostScript Fonts
   View Last Error Message
Make Aldus Prep Permanent

As mentioned earlier, you won’t need any of these if you are sending your file to a service bureau.

- 4. Check TIFF For Position Only if you want a low resolution image of your graphic to be printed with the file. If you want the full TIFF or Paint representation, check Include TIFF and Paint instead.

- 5. Check Print to Disk.

- 8. Make sure Include Aldus Prep is unchecked.

- 9. Click on Set File Name and enter a name for this PostScript file.

- 10. Click on OK when finished with this dialog box.

- 11. Click on the Options box if you want to set things like crop marks or spot color overlays.

- 12. Click on OK and click Print to print the file to disk.

Figure 12.4

Ready, Set, Go Page Setup.
QuarkXPress

If you have QuarkXPress 2.12 or higher, follow these steps to produce a PostScript file:

1. Pull down the File menu and choose Page Setup. Check any specifications you need for this document. In most cases you leave the following options unchecked:
   - Font Substitution
   - Text Smoothing
   - Graphics Smoothing
   - All six buttons under the Options menu
   - You should check:
     - Faster Bit Map Printing
     - The desired halftone screen ruling
     - An appropriate printer type, such as Linotronic

2. Pull down the File menu and choose Print. Check any options you want, such as page range to be printed. If you want to produce color separations, check off Make Separations now. (A discussion of using PhotoMac for producing separations of scanned photos is included in Appendix C.)

3. Click on the OK button, and then immediately press and hold the f key on the keyboard. Hold down the f key until you see a message on the screen "Creating PostScript File."

4. Rename the file which has been created to something more descriptive. The system uses generic file names, starting with PostScript0 through PostScript9 for each file created in this way. You can create only 10 files before you must rename the first batch to something else.

Ready, Set, Go or Design Studio

If you have Ready, Set, Go, follow these steps to produce a PostScript file. This technique will also work with many other applications:
1. Pull down the File menu and choose Page Setup. Check any specifications you need for this document.

2. Pull down the File menu and choose Print. Check any options you want, such as page range to be printed.

3. Click on the OK button, and then immediately press and hold the f key on the keyboard. Hold down the f key until you see a message on the screen “Creating PostScript File.”

4. Rename the file which has been created to something more descriptive.

**Color PostScript Output**

Several printers that provide color PostScript output have been introduced in recent months. Color scanning is discussed in some detail in Chapter 13.

Color printers use several different technologies to produce images. As you’ll learn in the next chapter, all the colors we see can be produced by combining various amounts of cyan, magenta, and yellow pigments.

At the low end of the price spectrum, are color inkjet printers like the Canon FP510 that direct tiny drops of tinted ink at the page to produce colors. Other color printers use a spool of polyester ribbon that has wax stripes in the three primary colors, plus black.

Color inkjet printers use a separate printhead for each color and print all three hues in a single pass. Wax transfer printers, along with a third type which uses a process called thermal dye sublimation, roll the paper through the printer (or around on a drum) once for each color applied.

Inkjet and wax transfer printers use binary methods to transfer colors, just as most black-and-white printers do. That is, a pixel can either be printed in a given color or not printed at all. There is no way to apply light-blue ink or wax, or to produce any sort of continuous tone image without dithering.
In that regard, these color printers are no better or worse than their black-and-white counterparts.

One popular color printer for the Mac is the Sharp JX-730, a color ink-jet printer that supports 32-bit QuickDraw and uses 35 scalable outline fonts. It offers seven different dither patterns and operates with a Chooser-level driver for transparent operation.

Another example of a binary color printer is the Mitsubishi G3300-70 color thermal transfer printer. It doesn’t connect to the Macintosh the way other printers do. Instead, this printer uses the same analog video signals that drive the Apple Color High Resolution RGB monitor. It prints the same image you see on the screen. It uses a ribbon with three colors to allow you to print up to six different colors.

**Thermal Sublimation Printers**

The third type of color printer like the Mitsubishi S-340 and Kodak SV6500-series printers, uses a thermal process to transfer dye to the printed page. The advantage of thermal dye sublimation is that the heat used to transfer the dye can be varied continuously over a range of 0 to 255; so, different shades of a given color can be printed. The resolution lost through halftoning isn’t a factor, allowing these devices to reproduce photographic quality.

You might find such output useful for preparing special reports and other photo-intensive material in small quantities. Thermal sublimation printers are expensive, slow (about three minutes a page), and not really intended for proofing desktop publications. You’re better off with one of the other printers, all of which have the same limitations as the printing press.

Some of these color printers can accept PostScript output, either directly or through a software interface like Freedom of Press. At $10,000 or less, they can be justified by desktop publishers who do a lot of color printing and want to proof their work and by those who need short-run color documents. Real
estate offices that want to do their listings in color and organizations that need color transparencies for presentations would be typical examples.

Plain Paper Typesetting

At various points in this book we've looked at how the relatively low resolution of 300 dpi printers limits their use with scanned images. Continuous tone images, in particular, can't be reproduced with enough gray tones for serious typesetting applications. In general, 300 dpi printers aren't suitable as output devices for typesetting.

You do, however, have some options you might not be aware of. The chief drawback to imagesetters and typesetters is their cost. A Varityper VT600W, for example, costs $23,000 and comes with a $2500 annual service contract. If you don't do 15,000 pages a year for which you can charge someone else, you can't justify such a 600 dpi device of that sort.

However, you might be able to justify an $8000 printer that prints only a little slower but boasts 1000 x 1000 dpi resolution. Those are the specs on the Lasermax 1000 Plain Paper Typesetter. It's intended for Mac II computers and includes a NuBus controller card, 35 Bitstream typefaces, a Canon printer engine, a cable, and software.

Summary

This chapter discussed some of the concerns scanner users have for printing out their images. While inkjet printers and other options are mentioned, the chapter concentrates on 300 dpi and higher resolution output devices.

The concept of page printers was introduced to differentiate between printers like the HP LaserJet and others that provide similar quality but don't use lasers to write the image. LEDs and liquid crystal shutters can also be used in high quality
writing engines. All three types of marking components are capable of high resolution output.

Page printers have several components: the controller, which receives the page to be printed and supervises the printing operation; the marking engine, which writes the image with light; and the toning engine which transfers the image to paper.

Controllers can either pass along bit-mapped images to the writing engine or contain a page description language (most commonly PostScript). The writing engine can expose either the image areas (black lines) or the non-image areas. Such devices are called write black and write white respectively.

In either case, the image is formed on a photosensitive drum, where a difference in electrical charge causes toner to be attracted to the image areas. Toner contains a colored (usually black) pigment, which is transferred to the paper. The paper then passes through a set of heated fuser rollers which permanently fuse the toner to the paper.

This chapter explained the advantages and disadvantages of PostScript. The pros include:

- **Flexibility.** PostScript files can be printed on any PostScript printer with few limitations (the printer must have the fonts specified available, for example).
- **File portability.** You can send these files to a service bureau, as outlined above.
- **Reduced memory and hard disk requirements for PostScript (non-bit-mapped) files.** PostScript printers may not print some graphics files and bit-mapped printers, however. If you don’t have a PostScript printer, your add-on options include software-only solutions like Freedom of Press.

The chapter next presented step-by-step instructions for printing PostScript files for Quark, PageMaker versions 3.02 and 4.0, and Ready, Set, Go.
We live in a world of color, but our publications remain predominantly black-and-white. But that's about to change. Technological improvements are taking place at a rate that's almost frightening. I'm not a particularly slow writer, but while I was working on this book, the price of the least expensive color-capable scanners plunged from around $4000 to less than $1000; a color PostScript printer for less than $10,000 was introduced; and enhancements like the PageMaker 4.0 were announced. I fully expect that during the life of this book, color scanning will become as common as black-and-white scanning is as I write today.

For the present, color scanning is expensive and limited in scope, since few software packages can handle the color images once you've captured them. At the high end of the desktop arena, scanners like the Truvel T2-3X (almost $15,000) are extremely flexible, but too pricey for those who don't need color scanning on a regular basis.

Color scanners have dropped well below $2000 and found wide acceptance in the general desktop publishing community. Sharp's $7000 JX-450 and $4000 JX-300 color scanners are reasonably priced, while Howtek's ScanMaster II, at $5000, is another strong contender.

It may be Microtek Lab's combination color/gray scale scanner, the ScanMaker 600ZS and the Epson ES-300C which prove to be the breakthrough products. I'll talk about color scanner specifics later in the chapter. To appreciate all the
considerations that go into color scanning, we'll have to lay some groundwork first.

Capturing images in color isn't difficult from a technical standpoint. You'll learn why when we explore color theory a little bit in this chapter. However, working with color images can be a nightmare, and outputting them to hard copy ranges from expensive to out of the question for many users. Still, color is coming, so it will be worth your while to learn about it.

**Spot Color Vs. Process Color**

Color used in publications is of two types. Most common and easiest to understand is spot or accent color. Publishers may use one or two colors other than black to add interest and set off certain information. For example, a company's name and logo might be printed in a second color on a letterhead or newsletter banner. A bar chart might be printed in two or three colors to make trends easier to see at a glance.

When documents that incorporate spot color are printed on an offset press, the individual colors are printed using separate printing plates. Black may be printed first, then red or blue or green or yellow. Just about any solid color can be used for spot color, since there are hundreds of different hues of ink available. Organizations are often quite strict about the colors that can be used to represent their official trade dress.

Spot color is frequently printed on a single-color sheetfed press. After printing the first color, the printer washes down the press to remove the ink, then installs a plate for the next color to be printed. The previously printed sheets are run through the press a second or third time until all the colors are printed. Spot colors can also be applied in a single run through a multicolor press, which has two or more cylinders, each with its own printing plate and ink reservoir.

*Process* color is the name given to the printing process used to produce full-color images. Instead of applying bits of color
here and there to brighten a publication, the goal is to reproduce the precise combinations of color found in an original color photograph or other piece of artwork. As you might guess, process color is considerably more expensive than spot color.

Like spot color, the individual inks can be applied one after another with successive runs through a single-color press. However, it's more common to print process color on a multi-color press, which can apply all three or four inks—one after the other with very precise positioning or registration.

**Spot Color Requires Registration**

Spot color requires registration, as well, but unless the colors overlap or butt up against one another, we have a little more leeway. Therefore, spot color is a lot easier to use in desktop publishing. In addition, most desktop publishing software supports only spot color. The package, for example, might allow you to specify which color a given frame will be assigned. You can then print out each color on a page individually and take the resulting separated pages to your printer for plate-making and printing.

Spot color is usually line art, while process color most often consists of continuous tone images which have been converted to halftones. The same problems with tonal scale and 300 dpi printers discussed in Chapter 6 apply to color photographs. A color photograph is, after all, simply three gray scale images in which each gray spectrum is replaced with varying densities of one of the three primary colors. You still need the 30-to 60-tone scales required for black-and-white images.

Many reasonably priced desktop publishing package for Macintosh computers support process color to a limited extent. Quark leads the way with its capability to do complete color separating jobs. It's a good idea for you to learn a little about how process color works and why it is so tricky to manage. To explain that, we need to look at color theory, an area in which those of you who like to experiment may enjoy exercising your creativity.
How Colors are Produced

You probably already know that colors are produced by combining the three primary colors of light. For systems that add beams of light, such as CRT screens, the three primary colors are red, green, and blue. To produce pure red, green, or blue color, those hues can be used alone. Mixing red and blue together produces the reddish blue color we call magenta. Blue-green is called cyan, while red and green mixed together produce yellow (take my word for it; or, check out the color found between the red and green on any stoplight). Equal parts of all three colors produce white. Because these colors are added together, they are referred to as the additive primary colors of light.

Subtractive colors can be combined to produce red, green, blue, and black.

It’s also possible to produce color by absorbing or subtracting from white light. Pigments and dyes, such as those found in inks and toners, do this. For example, consider a magenta ink on a white sheet of paper. When white light (which contains equal portions of red, green, and blue) strikes this magenta
pigment, some of the green light component will be absorbed. The red and blue light will be reflected, and we will see the mixture as magenta.

Similarly, yellow ink absorbs blue light and reflects red and green, while cyan ink absorbs red light and reflects blue and green. One primary color is subtracted and we see the color produced by the two that remain in the reflected light. For that reason, cyan, magenta, and yellow are referred to as the subtractive colors of light.

You can produce any color of the rainbow by combining proper proportions of cyan, magenta, and yellow pigments. For example, magenta and yellow ink applied on top of each other will absorb both green and blue light, reflecting only red. Magenta and cyan absorb green and red, producing blue. Equal amounts of all three subtract all the light, leaving a neutral black. The color wheel shown in Figure 13.1 shows the relationship between the subtractive and additive primary colors.

**Why Black?**

As you might know, most process color systems use more than the three primary subtractive colors. A fourth color, black is usually added. Why is that?

A key reason is that black ink or pigment is generally a lot cheaper than colored inks. Another is that equal amounts of printing inks don't exactly produce black as they should theoretically: it's more common to arrive at a muddy brown instead. Still another reason is that most publications consist of mostly text with some color illustrations added. Text could certainly be printed in black by printing the characters three times in each of the three primary colors. That would mean that three printing plates would be required for each and every page—even if no color appeared on that page. Those plates would have to be very precisely aligned, or registered, to make sure that all three colors lined up properly over the
whole printed page, and the cost of the ink used to print the black text would be three times as high.

So, text is generally printed using black ink. As long as we're using the fourth color, why not use black in the image area as well? There are several benefits to going this route. First, while deep, pure blacks can be produced in process color using only magenta, cyan, and yellow, a great deal of ink must be used. Adding black to shadow areas of a picture, for example, can produce the same color density with much less of that expensive colored ink. The process of replacing equal amounts of the primary colors in areas of neutral color is called undercolor removal.

In recent years, the process has been extended to include any area of an image where all four colors are present. Again, equal amounts of all three colors are removed and replaced with black. In this case, the procedure is called gray component removal.

**Undercolor/Gray Component Removal Made Easy**

Undercolor removal is easy to comprehend. Gray component removal isn't much harder. Few colors in photographs are pure red, blue, green, magenta, yellow, or cyan. An image of a red apple may also contain a little blue and some green. This is known as neutral density. To make this concept clearer, imagine a unit of measurement we'll call the inkie. (The ridiculous name was selected to remind you that I'm using an arbitrary example, here. Just how much ink is in an inkie doesn't matter.) If you measure the ink used to produce our image of an apple, you may find that the following numbers of inkies are required:
The high quantity of magenta ink absorbs most of the green light, while an almost equal amount of yellow ink absorbs most of the blue light. The small quantity of cyan ink absorbs almost none of the red light, so the color that we see is predominantly red. Since there is more yellow ink than magenta, the apple will have a slight greenish cast. As the small amount of cyan ink will absorb some of the red light, the apple will be just a little darker than it might be otherwise.

In fact, since all three colors are mixed, there is a certain amount of black (gray, actually) in the apple. We can replace that overlap with black ink, to produce the same image effect while preserving the color relationships. In this imaginary scenario, our new values for the inkies involved look something like this:

<table>
<thead>
<tr>
<th>Ink Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black inkies</td>
<td>75</td>
</tr>
<tr>
<td>Cyan inkies</td>
<td>0</td>
</tr>
<tr>
<td>Magenta inkies</td>
<td>265</td>
</tr>
<tr>
<td>Yellow inkies</td>
<td>285</td>
</tr>
</tbody>
</table>

What have we done? We've subtracted 25 inkies each from the cyan, magenta, and yellow components, and replaced those 75 units with 75 units of black ink. All we've really done is remove the 25 inkies of overlap among the three primary colors, which produced neutral density anyway. The cheaper black ink replaces this missing density to insure that the image of the apple looks the same as before. It's a lot easier to produce pure black ink than it is to manufacture clean cyan, magenta, and yellow inks. Substituting the neutral black for equal quantities of the primary colors, therefore, reduces the
color cast introduced by any variation in the colored inks themselves.

Since equal quantities of the colors printed under the image are replaced, this process is referred to as undercolor removal.

The process of deciding which parts of an image need to be printed in cyan, magenta, yellow, or black to provide a realistic full-color image is called color separation. For many years this process was done almost exclusively with cameras, using photographic techniques.

**Color Separations**

For camera separations, the artwork is photographed three times. Each exposure is made with a different additive primary color filter (red, green, or blue) placed between the subject and the separation film. The black-and-white continuous tone negatives that are produced aren't quite like the black-and-white negatives you may be familiar with. Each has distinct variations in lightness and darkness in one of the primary colors, in proportion to the amount of that color in the original subject.

That is, a red apple photographed through a red filter will appear lighter to the film, while the green leaves of the apple stem will seem darker. This film is a negative, remember, so the image taken through the red filter is used to create the cyan color separation (check the color wheel shown in Figure 13.1 to confirm that cyan is the opposite, or complement, of red). Similarly, a green filter is used to produce a magenta separation, and a blue filter to create a yellow color separation. The three continuous tone separations can be converted to halftones, then used to burn printing plates, which will in turn apply the cyan, magenta, and yellow ink in proper proportions. A fourth black printer, which embodies the neutral tones we want to lay on top of the three primary colors, is also prepared.
The techniques involved in creating the black printer, or mask, are quite complex and beyond the scope of this book.

The red apple photographed through a red filter will produce a cyan color separation that will cause very little cyan ink to be applied to that area on the finished page. Similarly, when the red apple is photographed through the green and the blue filter, it will appear darker, and there will be proportionately more magenta and yellow ink applied in that area. Consult the color wheel one more time, and you'll see that magenta and yellow combine to produce red.

That's all there is to color separating. This discussion of conventional color separation techniques was essential, though, to help you understand how scanners perform the same function. All the photographic steps I've described have counterparts in electronic color separation.

**Color Models**

If you begin working with color scanning you'll soon encounter one or all of the four most commonly used color models. These are nothing more than ways of representing colors so they can be displayed on the screen and reproduced by your printer in the finished publication.

I've already covered the cyan-magenta-yellow-black (CYMK) model in this chapter. It is the most commonly used color model for process color printing. The red-green-blue (RGB) model is also used, particularly to specify how colors are displayed on a video screen. Instead of proportions of the subtractive colors used in pigments, the RGB model uses the relative proportions of the additive colors found in light.

Another valid color model is hue-saturation-brightness (HSB). In this model, colors are represented as a continuum (the familiar color spectrum we see in rainbows). The hue is determined by the exact point along that spectrum at which a selected color can be found. Saturation is another sliding
scale, from 0 to 100 percent, used to specify the purity of a color. A hue that consists only of that color is said to be 100 percent saturated. Varying amounts of white (that is, no color when speaking of pigments, or equal amounts of all colors when referring to light) gradually reduce saturation until it reaches zero. An easy way to think about saturation is to imagine a bucket of pure red paint. As you add white paint, the relative saturation decreases. When the mixture contains zero percent red and 100 percent white, the color is entirely desaturated.

The third component of the HSB model is brightness. This parameter is related to saturation in a way. Brightness is the overall density of the color. I think in terms of that same bucket of red paint, only with black paint added.

You can vary any one of the three factors in the HSB model to produce any color in the universe, just as you can with CYMK and RGB.

The fourth color model is called the Pantone Matching System (PMS). Essentially, PMS is a standardized system of printing inks. A swatch book called the Pantone Color Specifier provides more than 1000 color ink samples on both coated and uncoated stock. You can choose a PMS color and give your printer the corresponding number. The printer can then reproduce the ink color precisely using a formula supplied by Pantone Press.

PMS is particularly useful when you need to match a specific color precisely for spot color printing. Large corporations have their own trade colors which are used in packaging, letterhead, stationery, and other official artifacts. Many color software packages used in desktop publishing support PMS and CYMK and one of the other models.
Color Separating with Scanners

Color scanners scan your image three times, using separate red, green, and blue filters. If you had a black-and-white scanner using a white light source and a sensor with a consistent response across the color spectrum, you could actually do this by manually placing the correct filters in the sensor path. You’d have a better chance of keeping the original in perfect register for all three scans if you used an overhead scanner for this.

The individual color scans contain the tonal information needed to reproduce the colors in the original subject. Halftone patterns can be applied to each separation using techniques similar to those designed for black-and-white images.

Screens Must Be Angled To Avoid Moire

There is only one complication. You’ll recall that black-and-white halftones are created with the screen rows angled at 45 degrees to make them more pleasing to the eye. If we angle the cyan, magenta, yellow, and black separations at the same 45 degree angle, they will overlap each other. The dot patterns produced will generate an objectionable moire pattern.

Moire is reduced when the screens are angled 30 degrees apart from each other. Halftone screens themselves consist of rows and columns of dots set at 90 degree angles from one another. That means there are only three 30 degree angles available for the separation before the angles start to repeat.

For color printing, the black halftone dots are assigned their normal 45 degree angle. The magenta screen is angled 30 degrees from that at 75 degrees, and the cyan halftone 30 degrees more at 105 degrees. If we placed the yellow halftone screen 30 degrees beyond that at 135 degrees (or at 15 degrees, which is 30 degrees less than the black screen’s 45 degree angle) the yellow dots would have the same angle as one of the other screens.
The common solution is to print the yellow screen at a 90
degree angle, exactly between the magenta and cyan. The eye
is less sensitive to yellow than to the other colors, so whatever
pattern is produced is minimized.

Color Displays

A variety of display technologies can be found in PC monitors
today. One of the first color systems used with computers was
the familiar NTSC (Never Twice the Same Color) format found
in home television receivers in the U.S. In an NTSC composite
signal, brightness, color, and synchronization signals are com­
bined into one. It's easy to get noise and interference in such
a signal, which is why NTSC is used today only in TV receiv­
ers, VCRs, video games, and low end home computers.

For more critical applications, such as professional video or
computer graphics displays, it makes more sense to deliver
these signals separately.

For that reason, quality PC monitors were originally digital
devices, similar to printers in that they could display only
binary images; a given pixel could be on or off. One additional
mode, an extra-bright highlight mode, was provided by chang­
ing the intensity of the signal. This allows such monitors to
set off certain characters.

Digital Images Start Out As Binary Images

For all intents and purposes, then, digital images started
out as binary images. For color displays, three sets of pixels
are provided, one each for red, green, and blue. (Since we're
adding beams of light together, the additive primary colors are
used.) These three colors can be combined to produce six
different hues (red, green, blue, cyan, magenta, and a yellow­
brown), plus black and white on the screen. Since the colors
can also be displayed in highlighted mode, eight additional
colors can be shown: lighter versions of the original shades.
There are advantages to going the digital route. Since colors are defined by the computer rather than the monitor there is no need to match the computer and display.

**Color and QuickDraw**

As you might expect, displaying full-color continuous tone images on your CRT screen and handling them in files can be quite a challenge for your hardware and software. You'll recall that capturing 256 different gray tones requires a full 8-bit byte. For color images, you must, in effect, manipulate three gray scales, each of which represents a different primary color. Any pixel may contain a combination of values for any or all of those primary colors.

Therefore, it requires three bytes, or 24 bits, to store full-color images. That's the origin of the 24-bit color terminology you may have heard applied to monitors, image capture boards, scanners, or software. It's also possible to work with a fourth component called the alpha channel. It can be used by software developers for a various additional color attributes, such as the transparency of a given color (that is, whether you can see objects in other colors under it). The extra byte accounts for the term 32-bit color. At this time 24-bit color has become the most-used standard for desktop publishing applications. Using one byte for each primary color allows a palette of almost 16.7 million different colors—easily enough for a photographic quality tonal scale.

**Memory and Storage Problems Multiply**

The memory and mass storage problems inherent in image-intensive files (described in Chapter 5) are multiplied threefold for full-color scanned images. Simply displaying these images on the screen can be difficult.

Apple has reduced a lot of the confusion and eliminated many problems with the introduction of its 32-bit QuickDraw.
To take full advantage of it, you need a Mac II or Mac SE/30 equipped with a 24-bit color card and a 24-bit color monitor.

The 32-bit QuickDraw files themselves include new General and Monitors control panel devices with extensions for 32-bit addressed color cards, and a 32-bit QuickDraw INIT (extension under System 7) file which is placed in your System folder. You'll also need the previously released Color QuickDraw.

The 32-bit QuickDraw has many new features, most of which will be of significance only to applications developers. However, you might appreciate the following:

- Support for 32-bits-per-pixel graphics. If your software can handle it, you can capture and store 8 bits of information each for red, green, and blue, plus 8 bits of alpha channel data.
- New 16-bit graphics. To reduce storage and hardware demands, you can also use 16-bit color graphics. In this mode, one bit per pixel is allocated for alpha channel information (a pixel can be transparent, or not, say), while five bits are set aside for each of the three colors. That allows 32,767 different colors—plenty for many applications.
- Dithering to allow display of 32- and 16-bit color images on monitors with lower resolutions.
- Gray scale representation with luminance control. This provides better gray images, even with as few as four bits of information per pixel.

**Color Scanners**

The most common color scanners for desktop publishing are flatbed models. The Sharp JX-450 is an example of this type. It accepts originals up to 11.625 x 17 inches and can scan at 75, 100, 150, 200, and 300 dpi in 24-bit mode. An optional mirror enables you to scan transparencies as large as 8.25 x
11.625 inches. Scanning takes about 1.5 minutes at the fast scan setting.

Like black-and-white scanners, color models determine as many as 256 different levels of tone. However, they capture this image information for three primary colors—red, green, and blue. (Typically, for gray scale images, a color scanner will use only the green illumination.)

All three images must be aligned exactly. If they are not, you’ll get a garbled image or see a phenomenon called color fringing. With the Sharp J450, the original remains stationary on the platen while three different fluorescent lamps—red, green, and blue—light in sequence. Artificial lights provide illumination throughout the color spectrum in a non-linear way (hence cool-white fluorescents and other types of tubes). So, red and blue filters are placed over the red and blue lights to purify their colors a little more. The light from each tube shines through a slit to illuminate a band of the image.

A pair of mirrors reflects the light onto a sensor strip, which contains 3848 cells. The light intensity is read and relayed to the computer. The process is repeated for each of the three colors. Then, the image platen moves, and the next band is read. Since the platen remains perfectly stationary while scanning all the colors for a given image band, there is little chance that one of the colors will be jostled out of register. This is inherently more precise than if the scanner captured each color for an entire document in a single pass, then went back and captured the next color. With such a scheme, the movement of the scanner mechanism itself (the mirrors which direct the light, for example) could cause color errors.

To scan transparencies, the scanner uses a mirror box that directs light from the lamps through the transparency film. A pair of mirrors guides the light from the image platen slit across the scanning table, through the film, and onto a third mirror inside the scanner. This third mirror reflects the light onto the sensor.
Welcome to another issue of the Three-Color Newsletter, dedicated to all matters pertaining to printing in three colors. In this issue we are reviewing a fantastic new book by the noted author, David D. Busch. It is called The Complete Scanner Handbook for Desktop Publishing, Macintosh Edition. Several chapters devoted to printing in color are included in this book. We think you’ll enjoy reading it as much as we did plugging it. Of course, later in this issue, we have some new tips for those of you who want to upgrade from two-color printing to the wonderful world of three-color printing.

A sample three-color publication. The top two pages and lower left page represent the images for a single newsletter page, each in a different color. The lower right example is the finished page.
Studiotronics has introduced a new product called Colorset that can let you capture full color images with any flatbed scanner that has gray scale capabilities. The system consists of three precision red, green and blue filter sheets that you place on the platen between the glass and your original. A different filter is used for each successive scan, providing cyan, magenta, and yellow color separations. The Colorset software allows you to assemble the images in register to produce a full color image. The final composite image can be saved in PICT2 or TIFF formats.

With a $400 list price, Colorset is discounted heavily (I've seen it advertised for $229). For non-critical applications, Colorset lets you play with color images using any grayscale flatbed scanner. Keep in mind that you must somehow orient your original exactly the same for each scan, with no skewing. Minor mistakes in positioning don’t matter as long as you don’t rotate the original. You can always re-register the separate color images later—but not easily if one or more of them has been turned at an angle.

Figure 13.3

PageMaker 4.0's define colors menu allows you to select from spot color and process colors.
Printing Color

Unless your publication has a very short run and you happen to have a color printer, the actual color output for your publication will be provided by an offset printer. You can tell the printer how you want the various colors printed in a number of ways.

The most common way is to produce a separate copy of each page which contains only the parts of the page that will be printed in that color. For example, you might have a newsletter with black text. The banner might be printed in red and blue, with some additional red and blue used for boxes and other accents on the various pages.

In that case, you would print one page with text only. A second copy of the page would show only the red elements of the banner and accents, and a third would show only the blue portions. You should include registration marks outside the page area to help the printer integrate the colors properly. The printer can then photograph each color “separation” individually and use it to produce the printing plate that will print each color.

Figure 13.4

Specifying colors with PageMaker 4.0. You can see that blue is actually 50 percent cyan and 50 percent magenta.
Most desktop publishing packages allow you to specify a color for certain elements and then print out only those parts which have been assigned that color.

Figure 13.2 shows a sample page that has been separated into three spot colors.

Another way to specify colors is on a tissue overlay taped to each page. You can mark the parts to be printed in each color and write instructions for the printer on the tissue. This leaves more work for the print shop, however, which will be reflected in the price you pay for the job.

The techniques described above are the ones most frequently used by desktop publishers for spot color. You can also do four-color process work this way, with mixed results. You must be exceptionally careful about registration, since process colors are laid down one on top of the other rather than side by side. A tiny positioning error that might place a color accent box .01 inch too far to the right would scarcely be noticeable.

**Figure 13.5**

Specifying colors with PageMaker 4.0.
Pantone color selection chart.
The same mistake in a process color job would produce color fringing, moire, or worse.

As I've said before, you'll want to work with process color only if you're very serious about it. An exception might be the use one of the process color inks as a spot color. Since special inks don't have to be mixed to match your spot color, the overall cost can be somewhat lower. If your print shop is small, you may find that it offers only process-color inks.

When you produce a single image with all the elements of your page in color (as to a color PostScript printer), you’re producing what is known as a color comprehensive. Color reproduction will almost certainly not match that of a commercial printer, but will allow you to see quickly what colors you have assigned to various elements. You can then correct your mistakes before it is too late.

**Color and Quark**

The special capabilities of QuarkXPress for color separating deserve separate mention. You can use Quark to produce color separations of full-color scanned artwork as well as EPS files such as those produced by Adobe Illustrator 88 or Aldus Freehand.

Quark has also developed its own set of Desktop Color Specifications (DCS), which offers users and software developers a powerful standard for merging full-color scanned artwork into page layouts.

DCS tools allow you to create four-color separations in a color pre-press program and then import that artwork into QuarkXPress. Appendix C provides some instructions for using PhotoMac to produce color separations of scanned photos.
**Color and Ventura Publisher**

Ventura has a Define Colors menu under the Chapter menu that allows you to create color definitions using cyan, magenta, yellow, and black values. There is an Enable Separation check box that will allow you to print out each of these layers separately. These are fairly primitive capabilities, compared to what you can do with QuarkXpress.

Ventura 4.0 will include additional features, such as Ventura Scan, Ventura Separator, Ventura PhotoTouch and Ventura ColorPro, all developed under a licensing agreement with Pre-Press Technologies, that will give high end color capabilities to this desktop publishing program. However, at this writing, these products are still in the development stage.

**Some Special Systems**

Color scanners have dropped below the $1000 price barrier, but that doesn’t mean there will be no applications for high
end scanners with special capabilities. For example, the following systems are available if you have need for them:

- **Barneyscan slide scanner.** This handles 35mm slides with a resolution of 1520 x 1024 pixels. It is furnished with Barneyscan Mac, a basic capture program, and BarneyScanXP, which is a more powerful program with color correction and painting capabilities. The latter is actually a version of Adobe’s PhotoShop. You can use it to split scanned images into their component colors, so you can make changes to each individually.

- **Eikonix 1435 slide scanner.** This offers extremely high resolution scanning of 35 mm slides, with a 4096 x 3000 pixel resolution, which is approximately 2800 dots per inch over the 1.5 x 1.0-inch area of the slide.

- **Nikon LS-3500 slide scanner.** Nikon’s slide capture device is self-calibrating and self-focusing. It is furnished with Colorflex software that adjusts exposure for the slides tonal range. Nikon recently introduced an even lower cost model, the LS-3510LF scanner that offers 12 bit operation (4096 colors) and includes PhotoShop and ColorStudio editing programs.

- **Howtek Scanmaster 35.** This is a 2000 x 2000-pixel resolution slide scanner that features “oversampling.” That is, it reads 12 bits of data for each of the primary colors, then rounds the values down to 8 bits for storage. That capability provides extra color accuracy.

  Unlike the Nikon scanner, you have to recalibrate the Howtek each time you use it, but the procedure is relatively simple.

- **Microtek ScanMaker 1850.** This 24 and 8 bit color slide scanner sets a new price point for this type of device. You can pick one up mail order for less than $2000.

  All four of these devices scan only the 24 x 36mm (1 x 1.5-inch) image area of a 35mm slide. Once you go past these
dimensions for high resolution scanning of larger color origi­
nals, the $20,000 price tag slide scanners carry seems quite modest by comparison. Expensive scanners of this sort aren’t really intended for desktop publishing. You’ll find them of interest only as an indication of the capabilities that will become available as scanner prices drop even further in the coming decade.

**Color Scanning in Desktop Publishing**

If you’re serious about using color in your desktop publica­
tions, you’ll need to acquire some serious software tools, too. PhotoMac, discussed in Appendix-B, is one of the most flexible color image editing packages available. You can use it to produce color separations for Quark, PageMaker, or Ready, Set, Go documents.

As I noted, this topic requires at least several chapters devoted to the subtleties of working with color on the Mac. I plan to address these points in more detail in a followup to this book. Tentatively entitled The Scanner Toolkit, it should be available by early 1991.

Color separating is an ambitious undertaking by any method. As you can see from the explanations in this chapter, it’s especially challenging for those with desktop scanners. If you’re regularly producing color publications and can justify the investment in equipment and education, color scanning is a viable option for you. I just hope this chapter provided you with a preview of what you’re getting into.

You’ll find that there are a host of programs available to help you. One of the latest on the market is Publisher’s Prism, from Insight Systems. It will produce 4-color process separations from any printable PostScript page description. Many of the color capable image editing programs, such as Canvas can also produce color separations.
Summary

Color scanning is expensive today, but is rapidly dropping in price. Within a few years, nearly everyone will have color capabilities within easy reach. This chapter explained some of the things you need to know to be comfortable with color.

Spot color is the use of one or more colors other than black in specific locations on a page. A logo, for example, may be set off in the company's official color. Spot colors can include any hues you care to have the printer mix for you, and you can have as many different colors as you can afford. Each color requires a separate printing plate. Spot colors usually don't overlap, but cover distinct areas, which are intended to accent the layout.

Process colors use the three primary colors, plus black, to build an image that includes any shade you want. Since process colors do overlap, image registration is more important. We looked at the differences between the primary additive colors of light—red, green, and blue—and the primary subtractive colors, used when printing with pigments—cyan, magenta, and yellow.

While the primary colors can reproduce any shade, including black, printers commonly use black anyway to reduce costs and the complexity of the black-only portions of each page. Because of this, it is possible to reduce the amount of colored ink used through a process called undercolor removal. Equal amounts of all three colors are replaced by an equivalent amount of black ink.

Color separations are individual renditions of a page, each representing the amount of a given color. You can produce separations with your scanner or by using the services of a specialized color separation house.

Several different color models are used to represent the color spectrum. The RGB model is commonly used for video; the CMYK (cyan, magenta, yellow, black) model is applied to
printing technology; the HSB (hue-saturation-brightness) model is often found in graphic design shops; and the Pantone Matching System (PMS) is a convenient way of specifying exact colors that your printer can reproduce by mixing inks to a set formula.

Color scanners and other separation methods use three separate exposures through red, green, and blue filters. By changing the angle of the halftone dots, these images can be printed one on top of another without complete overlap.

The chapter concluded by discussing the various options available for color displays, color scanners, and color printers.
Video scanners provide us with a glimpse of the technology that may be found in all scanners in the future. The flatbed, sheetfed, and overhead scanners that have received the most emphasis in this book all use a linear sensor that reads only a single line of pixels at a time. Video devices, in contrast, use a matrix of sensors to capture an image of an entire subject simultaneously. There are significant advantages and disadvantages to this mode of capture.

First, because a video scanner doesn't need to read a line at a time, there is no need to move the sensor along one dimension of the original or to move the original past the sensor. This significantly reduces the number of moving parts needed in the scanner.

Another advantage is very fast image capture. In fact, video scanners generally use ordinary television cameras, such as camcorders, which can capture images at the rate of 30 separate full frames a second.

For that reason, video capture boards are also called frame grabbers, because they must select and retain one, and only one, video frame at a time (your image capture software may keep four or more of these images in a buffer).

The chief drawback of video scanners is reduced resolution. To produce solid state sensors that are sensitive enough to capture an entire image in a fraction of a second, the surface
area allotted to each pixel must be relatively large. Only in that way can individual sensors receive the light they need.

The best video capture boards may provide you with an image that is no better than 640 x 480 pixels. That may sound good—after all, your display card may be limited to the same resolution. However, if you use a video scanner to capture an image of a 10 x 8-inch subject such as a photograph (which would have roughly the same proportions or aspect ratio as your CRT screen), you are, in effect, scanning that image at only about 64 dpi. You might think that's low resolution indeed. As we'll see, though, there are other factors to consider that are unique to video scanning.

**Apparent Resolution Can Vary**

For example, the apparent resolution of the scan varies widely, depending on how large your subject is. If you move the video camera in closer and confine your field of view to an area about 5 x 6 inches, the effective resolution will increase to about 100 dpi. The number of pixels you're capturing remains the same in each case; you're just allocating them over a smaller area.

Figure 14.1 may show you how this works a little more clearly. Resolution will be discussed again in the section on color video scanning later in this chapter.

With conventional scanners, the distance between the sensors is fixed. The number of pixels you can capture does not change. Your scanning control software determines which pixels are kept (to determine the image area captured) and which pixels will be retained or combined with others (to determine the effective resolution of your scan). For example, with a 300 dpi scanner in 150 dpi mode, the software, in effect, averages the values found in each group of four pixels to provide the final image (this is another type of interpolation).

Video scanners would be more useful for desktop publishing if they had higher resolutions. They don't for one simple reason: at present, the television images which are the pri-
mary application for video devices, after all, are capable of displaying no more than 525 lines.

Those lines define the vertical resolution of the TV image and are fixed by the NTSC (National Television System Committee) specification. The number of pixels per line is called the horizontal resolution. High quality TV sets have horizo-

**Figure 14.1**

Effective video resolution varies with distance. Imagine that each of the small boxes measures 30 x 30 pixels. The light bulb in the top illustration, then, is about 60 pixels wide. In the bottom image, the bulb has been moved closer to the lens. That same width is represented by four boxes, or 120 pixels. The apparent resolution is twice as high.
tal resolutions of more than 500 pixels. Broadcasters must meet a minimum of 330.

A standard TV picture requires a monitor with a bandwidth of at least 15.75 KHz, while a picture with 1280 x 1024 pixels requires a 64 KHz monitor. Such monitors are considerably more expensive to produce. You can see that the cost of producing compatible television/computer monitors goes up significantly as we increase resolution.

As a result, until high definition television systems with higher program source resolutions become prevalent, there is little incentive for electronics manufacturers to produce more advanced video systems.

Higher resolution video systems are rather difficult to design and build from a technological standpoint. Some of the limitations are discussed in more detail in Chapter 15, which looks at possible future applications for video-type sensors in more traditionally configured desktop scanners.

Given the limitation in resolution, total lack of OCR support, and other considerations, are there good reasons to consider a video scanner for desktop publishing? I think so.

Video capture devices are camera and scanner in one. With conventional scanners, to capture a photograph you must already have the photograph in hand. If you suddenly need a shot of a product or your company president an hour before deadline, you may be out of luck. If you’ve installed a frame grabber of some type in one of your computers, the story may have a happier ending.

It’s not even necessary to have the president handy. If you can find a company video that uses the old goat as a talking head for even a few seconds, you should be able to capture a good enough image for a one-column head shot in your newsletter. Or, if absolutely necessary, take a camcorder up to the executive office and shoot a few seconds of tape.

Video capture boards come in several different varieties. The simplest don’t allow you to view the image in real time; you
use your camcorder or television monitor to preview the image. Others let you connect the board to a separate composite monitor and see the image being captured. The very best models provide a series of still images on your display, usually at high enough frame rates to provide a pseudo-motion effect.

**ComputerEyes**

Digital Vision introduced one of the first economical electronic digitizers in 1984 with its ComputerEyes frame grabber. ComputerEyes is currently available in both color and black-and-white versions. Both will scan an image in six seconds, and both work with a variety of standard NTSC video sources.

The color version, for the Mac II, can capture 640 x 480 pixel images, using eight bits per color for 256 different shades per primary color, and 16.7 million individual hues. It requires 2 megabytes of RAM and either an 8-bit or a 24-bit color card and display.

An image preview window provides a view of your image so you can make color capture adjustments, including brightness, contrast, hue, and saturation. The image can be adjusted before or after capture.

The device supports 8-bit and 24-bit PICT2 and TIFF formats and will also capture and display black-and-white images. In that mode you can store in TIFF, PICT, MacPaint, and EPS formats.

The black-and-white version of ComputerEyes uses an external interface that allows it to be used with any Mac from the Mac 512E and MacPlus to the Mac II. You need only 1 megabyte of RAM.

It has two resolutions. At 640 x 480 pixels, a scan takes 24 seconds. You can shorten the scan time to six seconds by reducing resolution to 320 x 240 pixels. Both resolutions
produce 256 gray images. TIFF, PICT, EPS, and MacPaint file formats are supported.

The chief drawback of both these systems is that they don't capture images in real time. That is, you can't view a continuous video image and select the frame you want to grab. ComputerEyes takes a leisurely six seconds to scan an image and thus requires that the camera be mounted on a tripod. For the low price (the black-and-white version costs less than $250) you would expect to give up some capabilities and features. To get the most with ComputerEyes, you really need to use a separate video monitor to preview the image.

Another Option

You can tell that Koala Technologies has been selling frame grabbers for a long time. The little 78-page manual, provided with this product is a model for hardware user guides. It's concise and comprehensive, with everything you need to know to get started.

MacVision, their frame grabber, is no slouch, either. Its specifications read a little like those of ComputerEyes. It will work with any Macintosh containing upgraded ROMs (MacPlus or later) and 1 megabyte of memory. If you have 2 megabytes, you can view four different scans at one time. It produces a 640 x 480 image array with 256 different gray levels. A lower resolution 320 x 240 pixel array is also available.

You can store these images in RIFF, TIFF, and EPS formats (but not MacPaint). For the latter two formats, you can choose the TIFF or EPS format particular to either the Mac or IBM computers, so it's possible to scan an image with MacVision on a Mac for use with IBM compatibles.

Brightness and contrast controls are cleverly built into the interface box itself as two recessed knobs. Full software controls, including brightness and contrast sliders and a gray
map editor are also provided. Some image processing tools, such as smooth, soften, sharpen, and shadow, are furnished. You can select from ten different dither patterns, including ones with such names as Zebra and Feather.

Like ComputerEyes, MacVision must be used with a tripod-mounted camera. If you can give up real-time image viewing, either of these are excellent values.

Another Quantum Leap

The next step up the frame grabber ladder is a big one. The Neotech Image Grabber costs about $1300-$1500, depending on whether you get the Mac SE or the Mac II model. It provides real-time capture, as it can digitize an image in a thirtieth of a second. This is a monochrome frame grabber only, although color video sources can be accommodated with no problem.

It is furnished with acquisition modules for Image Studio and Digital Darkroom, so you can capture video images directly from within either of those programs. However, the Neotech grabber has its own full set of image manipulation tools which allow you to flip, rotate, invert, and posterize scans. Images may be stored in EPS, TIFF, RIFF, PICT, PICT2, and MacPaint formats.

The Final Frontier

If you can spend $2000 or more (a lot more) for your video capture equipment you can add 256 gray levels (or full 24-bit color), additional input options, and a wealth of special effects.

Data Translation, of Marlboro, Massachusetts, is one of the leaders in this technology for both IBM PC-PS/2 systems and the Macintosh.

The company markets a $3000 ColorCapture version for full-color images. It can be connected to any video source you can imagine, including a professional RGB camera or PAL
(European) system. This frame grabber features a phase-locked loop circuit for jitter-free image capture from VCRs. Some of the other frame grabbers I tried worked fine when connected to cameras, but produced images that were ragged and difficult to capture from VCRs. That doesn’t happen with this board.

It has an advanced capability called genlock (for generator locking device), which allows the board to synchronize to external sources. Genlock essentially locks one set of sync signals while it accepts a feed from another source. The board is equipped with the QuickCapture Application Interface, which is menu-driven software for capturing, displaying, saving, and restoring images. Files with up to 256 levels of gray can be saved in TIFF or PICT2 format.

The video display capability of this device allows you to mix live video with regular Macintosh applications; you can cut, copy, paste, and crop images. In addition, this board will output to NTSC or RGB videotape recorders and/or external monitors, so you can use your Mac to produce video presentations with some sophistication.

Overall, Data Translation’s offerings provide top-notch quality and all the features you could want. If you’re serious about video capture for desktop publishing or other uses, check them out carefully.

A True Vision

Data Translation’s chief competitor, Truevision, also markets boards in this price range—and up. The NuVista 1M combines 32-bit display, capture, and overlay capabilities in one card. Using it with its VIDI/O box, you can videotape standard Mac applications, overlay text and graphics from applications onto live video, and capture frames from standard video sources. I could list a couple dozen applications for this board, ranging from preparing training tapes for Mac applications programs to desktop video productions.
If you’ve got $6500 to spare, Truevision’s NuVista 4M card provides broadcast quality NTSC and PAL video output and image capture. The 1024 x 786-pixel resolution of this card is something to behold.

Using Color Video Images

Most of the video products discussed so far provide monochrome-only images and as I’ve noted before, most of the readers of this book will work primarily with black-and-white images. But color is coming, as surely as the waves inundated old King Canute’s throne around the turn of the last millennium.

My exposure to video production is limited to about 50 articles, based on interviews at four dozen of the leading television stations in the United States, which I wrote some years back. I learned then that the real experts are the people who work with a given technology every day. That’s why I asked for help from Tobin Koch at Data Translation for this next section. I relied heavily on the material he supplied, a contribution so far above the ordinary call of duty that I’m making a special acknowledgement here. Thanks, Tobin.

Color Resolution

One challenge in capturing color video images for desktop publishing is resolution. As I pointed out earlier in this chapter, video resolution can be a tricky thing to talk about. The resolution in dots-per-inch can vary, depending on how close the camera is to the subject (or the focal length of the lens—it’s the image size that matters).

Other factors include the resolution of the camera itself and the overall clarity of your video signal. I don’t want to overstate the importance of the resolution of the camera, since there are several ways that manufacturers can measure resolution and since even the best resolution when combined with
a poor signal-to-noise ratio (the amount of video information compared to background garbage) won't net you a better frame grab.

Regardless of how the resolution of the camera is measured, it always refers to image clarity rather than the number of discrete lines that can be captured and stored as a pixel array. To put it simply, your best bet is to use a camera that has fairly good resolution (better than 480 lines) and has a good signal-to-noise ratio (better than 55dB). No matter what resolution the manufacturer lists for your video camera, the resolution, signal-to-noise ratio, and a host of other factors all affect the quality of the frame grab.

**NTSC vs. RGB Video**

Both NTSC and RGB can provide fairly high quality video input for a frame grab. The important thing to remember is that it doesn’t matter whether you use NTSC or RGB if the camera produces a noisy image.

If NTSC is used and is input directly from a good quality camera into the frame grabber, you can get an excellent image. One popular camera is the Ikegami ITC-730AP, which has high quality Plumbicon pickup tubes. The disadvantage of an NTSC camera of this type is that you must either use a frame grabber that has an onboard NTSC encoder/decoder or purchase a stand-alone NTSC encoder/decoder box. This special interface, which costs around $1000, translates the image from NTSC to the RGB signal needed by the frame grabber.

An RGB camera can be plugged directly into the RGB input of the video graphics board. This means that the signal does not have to be processed before it can be digitized by the frame grabber board. This type of direct transfer eliminates the possible introduction of video noise that accompanies the encoding and decoding processes.
A great many of the inexpensive RGB cameras on the market can be used for this purpose. It is important to try a sample grab from the camera before you purchase it to ensure that the quality is acceptable, since many of these cameras were not designed specifically for desktop video or color DTP applications.

The level of quality that you achieve at the output stage depends upon the factors already discussed and upon how large the final printed image will be. Video frame grabs are currently being used in color catalog work and many publications. Once you get a good frame grab into the computer, you can use an image editing program to retouch, color correct, and color separate it. It can then be electronically stripped into your page layout.

The chief limiting factor at that point is the size of the pixel array. Ideally, a color separation program should sample four pixels for each dot in the color separation halftone screen. If you create a color separation with a 133 line frequency, you sample from a pixel array of 266 pixels by 266 pixels for each square inch of image. Therefore, an image that will print at 3 inches wide by 2 inches high should sample from a pixel array that is 798 pixels wide by 532 pixels high. Sampling one pixel per dot in most cases does not yield an appreciable quality loss and would require only a 399 pixel by 266 pixel array to create a 3 x 2-inch color separation.

**Tips for Getting Good Video Frame Grabs**

Probably the single most important factor in getting a good video grab is light. You need lots of it. The quality of the light is important, too. Watch for harsh shadows and excessive contrast, especially on a person's face. The examples below assume that you are capturing an image of a person, but the lighting techniques discussed apply equally to any three-dimensional subject. There are two simple ways to light for video:
Cross-key lighting with a single back fill light

A single frontal soft spot.

If you're not a photographer, neither of these recommendations may mean much to you. But, you don't have to be a trained photographer to use the techniques. Here's a brief explanation.

**Cross-Key Lighting**

Cross-key lighting typically involves three lights. Two main, or key, lights are positioned in front of and above the subject—one on each side of the subject at about the same distance. Because the lights are above the subject, any shadows cast will fall behind him or her (usually on the floor if you position your subject five to six feet in front of the plain wall or other background you use).

Since the subject is illuminated from both sides, there will be no harsh shadows on the face. The shadows created by one light will be filled in by the other source. Yet, because the illumination comes from the front/sides, there will be enough variation in the light to provide some shape definition. Photographers call this *modeling*.

The third light, the back fill, is positioned above and behind the subject. It helps to define the contours of the subject.

**Frontal Spot**

While cross-key may be the most desirable type of lighting, occasionally, time, money, and logistics conspire to defeat your best attempts to provide good lighting. In this case, a single softly focused spotlight placed fairly close to the camera and in line with (but not obstructing) the camera's view is your best bet.

The price you pay is that your subject will be flatly lit with few, if any, shadows on the face. You won't get the modeling effect that two lights provide, nor quite the differentiation from the background. However, results will be much better
than if you simply relied on whatever light might already be in the room.

**Camera Adjustments**

Videographers typically make several adjustments to a camera before recording. These adjustments are also helpful when the camera is used as an input to a frame grabber board. Not all of them apply to all cameras, however. If you have a very simple camera, or are using a camcorder, you may not have access to all the controls provided on professional-quality cameras.

- 1. If the camera is a three-tube or three-chip camera the beam or chip convergence should be registered. Instructions for registration are included with the camera and vary from brand to brand.
- 2. The lens backfocus should also be adjusted. Instructions for this are also provided by the manufacturer.
- 3. The camera should be white balanced. Many cameras have an auto white balance option. White balancing is extremely important for good picture quality.
- 4. The pedestal should be adjusted if the camera has a control for this adjustment.
- 5. Lens quality is extremely important. One desktop publisher and animator I know has a lens adapter that allows him to use lenses from his 35mm camera on his video camera. The lenses for 35mm cameras are very high quality, are extremely inexpensive, and can serve a dual purpose. If your video camera takes C-Mount lenses, you can probably get an adapter that will let you use Nikon, Olympus, Minolta, Pentax, and other popular lenses.
- 6. Avoid using wide focal angles (short focal lengths) due to the apparent distortion they create, unless you want to use that distortion for a special effect. Objects close to the lens
will appear proportionately much larger than objects only a little farther away. In the worst case, huge noses and tiny ears will result.

7. When lighting your subject, remember that the more light you provide, the more depth of field your image will have. Depth of field is the amount of your subject that is in acceptable focus. More technically, it can be defined as the linear interval along the camera’s line-of-sight within which the image is in focus. A large f-stop—one with a small number (F11 is larger than F16, for example)—will reduce the amount of light you need but will also reduce the depth of field and may leave you with part of your image unfocused.

8. Lighting should be diffused enough that shallow contrast looks natural. A variety of inexpensive spun glass and metal screen filters are available for this purpose. Using a diffusion filter of this type over your light will soften the lighting.

9. Many cameras have what is known as edge or detail enhancement. This creates a slight ghost image along edges where a dramatic change in contrast occurs. A small amount of edge enhancement can work to your advantage. Too much enhancement can introduce unwanted artifacts and ruin an otherwise good frame grab.

10. Avoid shooting intricate patterns such as herringbone tweed. These can result in a red and blue patterning in your image. If you have to shoot this type of pattern, experiment by zooming in and out until the patterning is minimized.

11. No matter how good the frame grab is, increase the contrast and color saturation a little. Image editing software usually provides the tools you need to do this.
Other Video Devices

Still video cameras provide yet another option. If you've looked at the national newsmagazines closely in recent months, you have probably noticed an increasing number of electronic images. The electronic shots are easily discernable from those shot with film cameras; they are the ones with the barely acceptable resolution. The key difference is that electronic stills can be reviewed and edited moments after they're shot, transmitted by phone lines or satellite to the publisher moments later, and printed in Time or Newsweek the next day.

In the consumer marketplace, you're most likely to encounter cameras like the Canon Xapshot, which has a simple fixed lens with separate viewfinder. The Xapshot records 50 color frames on a reusable 2-inch disk, the same used by Zenith in their laptop computer (before Zenith divested itself of its computer business). Canon uses analog format rather than a common digital format. Devices such as the Kodak SV6500 still video recorder can convert these images into a video format that can be captured by your computer. Since you can get a full-motion 8mm video camera that's not much larger than the Xapshot for only a little more, I don't see much application for these devices in desktop publishing at the present time. Their chief value is for photojournalists and others who need instant access to still frames with better image quality than they can get from camcorders.

Summary

Video scanners provide a preview of some of the technology that will be found in all scanners in the future. Since they can capture an entire image in a fraction of a second, they are quicker and more sensitive than anything else available. To date, only the resolution limitations of video scanners prevent their widespread uses.

Scanners and Fax

I was one of those who first saw fax modems as a solution in search of a problem. After all, who would want to use a computer as a $5000 fax machine when stand-alone models
However, video equipment provides a very fast way of capturing some types of images, such as head shots, for rapid integration into desktop publications.

This chapter discussed several different options, including the ComputerEyes and MacVision frame grabbers and more advanced systems available from Data Translation and Truevision. A number of tips for improving your video frame grabs were offered. These included explanations of cross-key and frontal spot lighting, and 11 tips for optimizing your use of a video camera.

were available for $500—and those included a built-in scanner? However, I've come to recognize several distinct advantages of the computer/fax hybrid. And, if you happen to own a scanner, as most of the readers of this book will, some of the disadvantages of fax modems dissipate.

- Receiving a fax with a fax modem allows you to print out the document (if you need a hard copy) using your plain paper printer. Low end dedicated fax machines produce flimsy thermal copies that fade over time. On the downside, though, it can take a lot longer to print with your Mac printer than with a fax machine's built-in thermal printer.

- Fax modems provide needed privacy for sensitive material. There's no need for the recipient to stand watch over the fax machine to make sure a confidential document doesn't fall into the wrong hands. Nor is it necessary for a highly paid manager to feed sheets into a fax machine simply to achieve some privacy. Fax boards allow you to send image-oriented documents directly from your computer. You can scan them in or create them with your software. If a clerical person is asked to send the fax from his or her computer, he or she doesn't have to look at the file to send it, so confidentiality can be maintained.

- A fax modem provides an easy way to get graphics material sent by a person who doesn't happen to have a scanner into your computer. Assume you need to incorporate an image that a colleague in another office has in hardcopy form. You could have the image faxed to you, then scan it. However, you'd lose some quality through the intermediate step. By faxing it directly to your computer, you can eliminate that unneeded scan.

- Documents created, scanned, or manipulated in your computer don't need to be printed out a final time for faxing. That can save time and improve the quality of the image your recipient gets.
Since you can use your own scanner as the capture device for your fax modem, you have a better quality image available as fax standards are improved from their current roughly 200 dpi maximum to higher resolutions. In the near future, fax modems will let you send gray scale and color fax documents at much lower cost than dedicated fax units. That's simply because building gray scale and color scanners into fax machines will be expensive. Why pay twice for this high end technology?

To use a fax modem with your scanner, you must capture images in a format that can be converted into one of the standard fax formats by the board’s software. Many fax modems can convert Mac files to standard fax resolution (198 x 99 dpi) or fine resolution (198 x 198 dpi), while a few can convert incoming faxes back. Usually, you select the fax driver with the Chooser desk accessory and then direct a file to the fax as if it were a printer. A dialog box will let you input a telephone number, page range, image quality and other parameters.

Many Fax Modem Options

There are many different fax modem options available today. Apple, of course, offers the AppleFax, a 9600/4800-baud device that has built-in auto-redial and four fonts (Times, Helvetica, Symbol and Courier). It operates much faster (and in the background) when used with BackFax, software from Solutions International. InterFax, from Abaton, also lets you send and receive faxes in the background, freeing up your computer. You don’t need to use MultiFinder to take advantage of this capability with either BackFax or InterFax.

If you need a pocket-sized fax modem, check out FAXstf. It doesn’t really work in the background, however, and operates at only 4800 baud. The portability comes at a stiff price: it costs the same as the AppleFax unit.
Scanners and Presentations

The images you scan can form important components of presentations and demonstrations. One of the most exciting new tools you can use to integrate motion into these images is MacroMind Director. This is a $695 desktop video application that accepts scanned images and other graphics files in a variety of formats, including MacPaint, PICT, PICT2, and VideoWorks. It has all the features you need to produce color movies that will play back at up to 30 frames a second. If you like, you can print out individual frames to use as handouts or storyboards.

Studio/1 provides some of the same capabilities in a much less expensive package. It handles just 1-bit TIFF images at resolutions up to 300 dpi, but produces animations that can be played back by MacroMind Director, HyperCard, or SuperCard, if you wish.

Both these programs ease the tedium of animation by providing automatic tweening. That’s a process whereby the images needed to produce a smooth transition from one movement to another are created automatically.

Create Your Own Fonts

In an age when a $695 software program can consist of three 3.5-inch disks packaged with a slim manual and five inches of foam, I suppose it’s not too much to ask $195 for a collection of letters. That’s what many of us are paying for a soft font collection for a laser printer.

Economists will tell you that demand, not production costs, is what sets prices. I figured that out on my own the first time I purchased a 250-page computer book for $24.95. Desktop publishing has created a tremendous demand for font sets, and there are seemingly thousands of users willing to pay for them.
Scanner users can create their own downloadable, or soft, fonts at little or no cost, using one of several available utilities and programs. I'll explain what's involved shortly. But before I get into that, I'd like to head off an expected stream of angry cards, letters, telegrams, and telephone calls. Please pay attention:

**Font design is an art and a science.** All the various components of the characters in a given font are carefully chosen for readability, style, and effect. The typographer's skill is what makes one font look modern, another old fashioned, and a third formal. You cannot expect to design fonts with the same professional appearance found in purchased fonts. Most of us lack the experience, knowledge, and eye for that.

With that disclaimer out of the way, I will tell you what you can expect to accomplish with these do-it-yourself font tools.

- You can create special fonts for special effects. You may, for example, want a novel headline font strictly in larger sizes. With a little care, you can create such a font relatively quickly.

- You may want a font to match your company's logo. An entire set of "window blind" characters, like those used in the IBM logo, might be an example. You may be able to edit an existing font to include the distinctive features you want.

- You can create a font that will recreate a scanned signature or other graphic, so it can be included in documents. By going this route, you can add a signature to letters created with word processing software that supports downloadable fonts but not graphics.

- You can reproduce certain fonts for internal use or for proofing. Masters for your publication may be printed by an outside service bureau using a PostScript-compatible typesetter or imagesetter. If you want a rough idea of what the publication will look like, you may want to recreate any special fonts that are available with PostScript that you don't have for your
printer. Because of the amount of work required for building a font from scratch, you'll want to do this only if you need the font frequently and really can't afford to purchase it in bit-mapped form. (A special font may not even be available in some cases.)

**Scanning a Font**

The first step is to scan a sample of the type you want to use. Your original should be as clear as possible and contain all the characters of the set. Use the 300 dpi setting on your scanner. Use the file type that is most conveniently handled by the paint program you'll be using to clean up the scanned samples.

As you work with the bit-mapped files, you can not only clean up any rough edges but modify the characters in the font if you wish. Bold characters can be hollowed out or shadowed. You can modify individual characters, adding a slash to the

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**Figure 15.1**

Fontographer is an advanced PostScript font editing tool. It can import and export PostScript Type 1 and TrueType for both Macs and IBM PCs.
ero, for example. Special punctuation marks, scientific symbols, foreign language characters, and other characters can be added at this step.

Next, you'll need a program to convert your bit-mapped images to fonts.

One of the most popular programs for producing PostScript fonts is Fontographer, from Altsys. With this software, you can do much of the editing you will need to do on a scanned font right in the program itself. It features an autotracing tool that will convert imported PICT bit-mapped font images to outline fonts. You can then adjust the Bezier control points, create kerning tables, and perform other necessary tasks. For example, Fontographer will automatically provide PostScript hints, which enable your printer to provide better renditions of fonts in small sizes.

Fontographer will run on any Macintosh from the Mac Plus on up and requires just 1 megabyte of RAM. It can create bit-mapped screen fonts of any size, including new font (NFNT) format fonts. The program now incorporates a bit map editor for this purpose. That editor is also available as Fontastic Plus for those who want to create bit-mapped fonts for your ImageWriter or LaserWriter IISC. It works with PostScript Type 1 and TrueType fonts for both the Mac and IBM PC.

**CAD Input**

I've been writing about computer assisted drafting and design (CAD/CADD) since the mid-1970's, dating back to the days when CAD systems cost a minimum of $100,000 and ran on dedicated minicomputers. By the mid-1980's, we had decent CAD programs available for personal computers. The first packages I saw in common use were written for the Apple II series and eventually moved over to IBM compatibles when high resolution EGA and VGA graphics became common.
Scanners should become important input devices for Macintosh CAD systems in the very near future. One of the strengths of CAD is that you can revise drawings on-screen and then print out new plans (originally called blueprints, then bluelines as reproduction methods changed). As you probably know, CAD files are object-oriented vector graphics, similar to those produced with draw programs. In fact, some of the earliest microcomputer drawing programs were actually CAD packages unencumbered by the features you really need for computer assisted design.

Since these images are based on outlines, you can zoom in or out to work with various details without losing resolution. The resulting plans can similarly be printed in the large sizes needed for building the design. In more advanced applications, CAD files can actually be used to drive computerized numeric controlled equipment such as lathes, which will produce a part or tool without the need for an intermediate drawing.

Without a scanner, the only way to capture an existing drawing as a CAD file is to trace it, using a digitizing pad. That's a slow process. In contrast, a scanner can create a bit map image of a drawing, which can then be vectorized. That's the sort of application that should be prevalent as Macintosh-based CAD systems become even more widespread. CAD has become a tool of non-engineers, reaching down to the level of the homeowner who wants to design a room addition or landscaping plan.

**Summary**

This chapter has provided a potpourri of applications for scanners, both inside and outside the traditional desktop publishing milieu. We've looked at a broad range of possible uses.

For example, you can scan existing documents and then trace the outlines to produce new business forms in a fraction...
of the time that would be required to lay out the design from scratch.

Scanners can also become the input devices for facsimile machines of the future. With a fax modem and scanner, you have a functional fax machine that is only slightly less useful than a dedicated device. In fact, there are several advantages to this type of fax configuration:

- Access to plain paper printouts without paying a premium for a high end fax machine.
- Extra privacy for transmitting sensitive documents.
- Access to graphics material provided by senders who don’t have their own scanners.
- Improved image quality in some cases.
- Access to special fax formats, including PostScript compatibility.

Scanners also have an important place in producing animations and presentations with tools like Autodesk Animator. You can use your scanner to capture fonts, which can be traced and converted to downloadable PostScript fonts for your printer.

Using a scanner as an input device for a CAD system was the final application discussed in this chapter. Scanned images can be converted to vector format in AutoCAD DXF or other file formats, and then manipulated to produce new designs.

The final chapter of this book will present you with some predictions for the coming decade. I feel confident in making these prognostications, because many of them are already coming true.
Robert A. Heinlein, the greatest storyteller who ever lived, said that if a writer does not entertain his readers, all he is producing is paper dirty on one side. In his 50-year career, Heinlein encouraged his readers to think while he entertained them.

You probably bought this book primarily for information, rather than entertainment. Nevertheless, I've tried to provide you with something extra to get you thinking. I hope that all the how-to stuff you were looking for has been included in the previous chapters. I suspect that there's probably been more technical detail here than you ever hoped to see in a book written by someone without a degree in engineering. Along with all that, I've tried to include a little "So what does it all mean?" with each discussion.

Learning how to work with scanners isn't enough. To really get the most from these important tools, you should give some thought to how they fit into your working life. That kind of reflection will help generate the kind of new ideas that will let your scanner truly be useful to you.

To that end, I'd like to conclude with some ideas on how scanners might be used in the future. Most of these concepts are already at work today: I'm hardly a futurist on the order of an Isaac Asimov, nor a philosopher like John Dvorak.

Every time I doubt this, I dig up some predictions I made around 1980 in one of the leading computer journals of the time. Before the decade was out, I said, several Space Shuttles
would be engaged full time in a communications satellite pick-up and delivery service. The skies would be full of geosynchronous satellites and every business would be linked to every other through roof-top dishes. This didn't seem too farfetched at the time, even considering the number of satellites that would be required.

Corporations Use Satellite Communications

Actually, I wasn't too far off. Today, large corporations, including the parent of the Holiday Inn chain, use very small aperture terminal (VSAT) satellite networks to link its 1800 nationwide sites. As I write this, the shuttle Columbia is performing a satellite rescue mission.

However, I didn't foresee the advances that would be made in fiber optics, nor anticipate digital networks like ISDN. These technologies are both vastly superior to the conventional telephone line systems that I didn't think would survive the decade.

It has been said that the only value in predicting the future lies in the amusement it provides for our descendants. Further, it's never been difficult to predict advances in technology. Seers have always had more trouble foreseeing the effects of those innovations. Any number of forecasters predicted the automobile; no one saw the possibility of traffic jams, smog, or drive-in theaters until they appeared. Even Robert Heinlein was wrong about the future as often as he was right. Nevertheless, I'm going to offer some comments on the future of scanners. I'm being less than daring, because all the technologies and trends are already at work today. We may, however, have some surprises in store for us in the directions they take. The scenario that follows may not be as impractical as it might appear on first reading.
The Future of Scanners

The Scanner of the Future

Scott Nolan Hollerith is a fictitious typical desktop publisher in the year 1995. He’s currently putting together a newsletter for one of his clients using PageMaker 6.0 and decides to incorporate several color photographs in a center spread.

Scott places the first photograph face up on his desk to the right of his Mac IIci keyboard. He slides it up and to the left so the photo is snug against two positioning stops. Then, he marks off the area to be scanned with his mouse.

The mouse is one of those cordless models, with a transparent X cursor out front where a mammalian mouse’s nose would be. As he slides the mouse over the surface of the color print, Scott positions the X at one corner of the area he wants to define and double-clicks the left mouse button. Then, he swiftly moves to the opposite corner and double-clicks again. A piezoelectric crystal in the mouse emits a sound that is picked up by a pair of sensors built into the desk surface. The computer uses the difference in sounds to triangulate the exact position of the X cursor to within .03 inch.

Although the system seems like science fiction mumbo jumbo to Scott, it’s actually exactly similar to the technique used by some high volume photocopiers in the late 1980’s to define image areas for spot color. The same mouse also can transmit conventional directional/movement information to the computer through infrared signals. Some software doesn’t need to know the exact relative position of the mouse—only the direction and speed of its movement.

A Built-In Scanner

With the area to be scanned defined, Scott turns the photograph face down, aligning it against the same stops on his desktop. Although the shiny surface looks opaque, that’s just a trick of the lighting and the special hard and slippery coating on the desktop. The area to Scott’s right is actually the platen for a flatbed scanner housed within the desk itself.
At the press of a key, the scanner digitizes the color photograph three times in rapid succession, forming three color separation images. Scott doesn't feel any vibration because there are no moving parts to the scanner when it's used in flatbed mode. A single 6600 x 10,200-pixel charge-coupled device captures an entire image—up to an 11 x 17-inch original—in a fraction of a second. Scott is always surprised that he doesn't see a flash during the exposure, but suspects that this scanner uses a non-visible wavelength of light. He's glad that users don't have to understand the technology to work with these desktop publishing tools.

Scott is only scanning an 8 x 10-inch color image, so the 84 megabytes of 24-bit color information (at 600 dpi) are stored temporarily on a 5 gigabyte erasable optical disk. If he decides to save the image, it will be compressed and directed to one of the larger erasable disks Scott uses to store files for longer periods.

Several of the other images Scott wants to scan are more complex. One is a color bar chart on the front page of a brochure. Scott also would like to reuse some of the text. He decides to scan this graphic along with a new batch of text, so he drops the stack of sheets into a hopper at the side of his desk. One by one the sheets are fed into the alternate intake slot of the scanner.

**Automatic Text/Color/Font Detection**

There's no need for Scott to define areas to scan on these sheets. The scanner software differentiates between text and graphics and photographs, and handles each differently. All the columns, formatting, colors, fonts, and other information are noted in the file. Scott will later be able to select any component for re-use or discard portions he doesn't want.

Within a few seconds, images start appearing on his high resolution color monitor. Scott has been coveting those new models with the 27 x 20-inch screen. They can display two 11 x 17 documents full-size side by side, with room left over for a
small Finder window and a couple cable television channels. The best Scott could afford was a 22-inch monitor with 5100 x 3300-pixel resolution. Still, that allows him to display two 8.5 x 11-inch pages side by side at 300 dpi. He thinks that's a lot more resolution than he really needs. Heck, the old 1024 x 768 monitors looked sharp to him.

The color photograph needs some touching up. Before he goes to the trouble, Scott decides to check with the client to make sure the illustration is one he will approve. He punches a couple more buttons on his keyboard to send the image directly to the client's fax machine.

When he has finished laying out the newsletter, Scott prints out a color proof copy. At 1200 dpi, his printer produces pretty good color and black-and-white halftones. However, Scott still prefers to send his files by modem to the local printer for old-fashioned offset printing. It's cheaper and faster to produce long runs using conventional methods.

Scott likes his scanner a lot. He's heard that there are new versions being introduced that are built right into a mouse, something like the hand scanners that were popular five years ago. Even so, Scott is becoming a bit set in his ways and thinks he'll stick with his current configuration for a couple more years, until long after it has become dreadfully obsolete.

**Dropping the Barriers**

Only a few of the innovations described in the preceding few paragraphs are wildly impractical today.

A few years ago, Bill Joy, a co-founder of Sun Microsystems, predicted that by the year 2000, Sun workstations would have monitors capable of 4000 x 6000 pixel resolution with 24-bit color that would be able to display 24 frames a second—in 3-D! He also predicted workstation performance in the range of 100,000 MIPs (million instructions per second: that's 100
billion operations per second, or 10 to 15 thousand times better than the fastest computers today).

The $6600 \times 10,200$-pixel charge-coupled device I described contains more than 16 times as many individual sensors as the highest resolution solid state device available today. That $2024 \times 2024$ sensor is extremely costly at this writing and can be justified only in equipment costing tens of thousands of dollars.

The reason for that is the high degree of perfection demanded of image sensors. The latest 4 megabit memory chips contain a number of spare cells that can be substituted for any that prove defective during manufacture. As a result, the yields—the number of good chips that can be sold from each batch produced—are high enough to make four megabit chips fairly economical.

The chip fabrication techniques used to produce charge-coupled device sensors are similar to those used for memory chips. However, there is no way to swap in a sensor from another location if one proves to be bad. What you get, instead, is a blank spot in the image.

**Denser Sensors Cause Problems**

Fortunately, as sensor density increases, the relative size of the defective pixels decreases. You certainly wouldn't notice a few missing pixels from an image that is scanned at 600 dpi. The big problem comes from clusters of bad pixels, which are large enough to be seen by the eye.

Here, the power of the computer can come to our rescue. By averaging the values of the surrounding pixels, the processor can make some fairly good guesses about the missing information. So, while high density sensors are less forgiving of manufacturing errors than memory chips, we won't need the 100 percent perfection that would keep prices high.

Another constraint comes from our ability to produce solid state components with ever-smaller geometries (the basic units used to measure the size of the microscopic components).
The Future of Scanners

We may be reaching the limits on the fineness of detail that can be etched into a flat surface. Future chip designs will rely more on three-dimensional layouts, using hills and valleys to increase the component density. How does this affect solid state scanners, which must be flat?

A sensor doesn't need to be a three-dimensional array that can capture an entire document at once, of course. Current scanners use a linear array that progressively scans each line on the page. However, linear scanners require moving parts, which can limit their speed and reliability. If the cost of high resolution solid state matrix sensors can be kept low enough, future scanners will have no moving parts other than the optional sheet feeding mechanism. It may take more than five years.

Are 5100 x 3300-pixel monitors on the horizon? Bill Joy expected such displays before the year 2000. They could come much sooner. Research into high definition television may help pave the way.

Scanners in the Paperless Office

The predictions of the late 1970's about the coming paperless office have been forgotten or ignored for the most part. There are things you can do with printed material that become laughably clumsy when you try to coerce an electronic gadget to do the same thing.

Many of these activities suffer from what I call the Computerized Checkbook Syndrome. For most individuals, a checkbook register and a cardboard file with dividers labeled January, February, etc. work just fine. Computer programs to track personal accounts invariably take you two or three times as long to enter the information, and provide you with all sorts of interesting reports and summaries that you'll never, ever use.

If your affairs are sufficiently complex that you need a computer program to itemize personal expenses, you probably
would be better off with an accountant who can also provide you with an informed tax strategy. (I'm fully aware that Quicken for the Macintosh, a computerized checkbook program, was the number one selling software application in the United States when 1990 opened. Some times you use a computer for something because it is fun to do so, not because you need to.)

Some of the things you can do with scanners today don't really require computer technology, either. Traditional methods still work just fine.

Magazine Database?

For example, I receive more than 100 magazines every month, a situation that is probably unusual if you don't make your living writing for or cribbing from those publications. To keep from being buried in periodicals, I keep four or five handy at all times and read them during free moments. Some articles are read and absorbed on the spot. Memorable articles are torn out, stapled, and filed away for future reference. The Bill Joy material earlier in this chapter, for example, came from a file labeled "Far Out Predictions."

At this point, my manual filing system does the job. In the future, though, it may make more sense to scan the articles I want to retain. A really fast OCR program could capture a page of text in a few seconds. A neural network with the artificial intelligence to learn which things are important to me could automatically catalog the article by key words and then find that text again when I queried my information database days or weeks later.

Wouldn't it make more sense to receive these magazines in electronic form each month? Or better yet, arrange for access to a full text retrieval database with all available magazines, not just the 100 I like most?

Not to me, who needs to carry along a few of those 100 magazines where ever he goes and can snatch a few minutes for reading whenever possible. A really fast OCR system would
make that unnecessary. A great many of my magazines hold only a few articles of interest to me.

There is already an experimental system that will do everything I've outlined. It's called the system for conceptual information summarization, organization, and retrieval (SCISOR). It scans articles and uses artificial intelligence to draw conclusions and explain them to you. The system can already accumulate text from 500 stories and includes a dictionary of 10,000 financial words.

**OCR for Data Compression**

Here's an aspect of OCR you might not have thought of. OCR is a highly effective means of data compression. The transmission of digital images is costly and wastes time. This is particularly true when long distance telephone lines are used to convey the data.

Some data compression is built into fax transceivers—with good reason. If an entire 8.5 x 11-inch page (about 3.7 million bits of data) were transmitted bit-by-bit, each page would take more than six minutes. Instead, special techniques, including transmitting the white spaces between lines of text as a code rather than as a bit image, are used. So, a typical page may take only 25 seconds or less to send.

If that page consists only of text, it may contain no more than about 2000 characters. At 9600 bps, it could take less than two seconds to transmit all that ASCII data. That's a 12:1 data compression ratio without even using one of the available text compression algorithms. If only the graphics information is transmitted in bit-mapped form, while the text and formatting data are transmitted as codes, a very effective form of data compression results.

So, capture systems with intelligent OCR/scanner capabilities may become key time and cost savers when document images must be shared over wide area networks or local area...
networks. If you're transmitting documents that will be used in desktop publications, OCR systems will be able to include font and type size information as well as formatting data. These files will still be significantly smaller than bit-mapped images.

Keep in mind that such data compression also translates into reduced space on storage media. This is particularly important in the case of more costly magnetic media, but can be valuable for data stored on optical disk as well.

Summary

There are many more applications for scanners within the desktop publishing field. For example, scanners coupled with voice synthesis equipment can make your publications available to the blind. It's conceivable that publications for specialized interests, such as musicians or home workshop enthusiasts, could include pages designed for scanning. A page might include a set of bar codes or, quite possibly, actual sheet music that could be scanned and played through a home synthesizer. A woodworking journal might include plans that could be scanned and translated into CAD files for numerically controlled home shop equipment.

As I mentioned at the beginning of this chapter, all these applications are already here in some form. As the cost of scanners drops and the technology improves, we should see new uses that no one has dreamed of. Scanners may not change your life, but they will certainly change the way you work with computers. The 500-year-old war between technology and images launched by Gutenberg is coming to a peaceful conclusion.
Appendix A

Scanner Capsules

This section will describe some of the leading scanners on the market to provide you with an idea of what’s available. As I noted in the introduction, you’ll probably want to check one of the in-depth reviews and roundups in a publication like MacUser magazine before narrowing your choices down to a few models to test drive. If a model discussed here has been replaced by a later version, most of my favorable comments probably still apply. The new scanner will generally be an enhanced model with added features.

Flatbed Scanners

Flatbed scanners and their lower-cost cousins, the sheetfed scanners, are the workhorses of the desktop publishing field, because they have the most flexibility. Equipped with a sheet feeder, a flatbed can function like a roller-transport scanner for high volume applications like OCR. You can also scan from books or large sheets, which can be moved around on the glass platen. The flat side of any three-dimensional object is also fodder for these devices. Sheetfed scanners also can be equipped with feeders, albeit with lower capacities, in the 10 to 20 page range.

Several scanners use a common engine manufactured by Canon, while others rely on proprietary designs. The software provided with flatbed scanners may be less important than that provided with hand scanners.

In this section, I’m lumping color and gray-scale scanners together since, during the useful life of this book, I expect that gray scale-only devices will be strictly entry-level machines, or may vanish entirely. I’m not kidding.
Color scanners look a lot like monochrome models, but they generally use three fluorescent tubes—in red, green, and, blue hues—instead of one. All these scanners can also function as monochrome, 256 gray level scanners through the simple expedient of scanning just one of the primary colors (usually green). This may present a problem if you want a gray scale-only scan of a color image. Green shades will appear lighter, while red and blue will seem darker in such scans. Your best bet may be to go ahead with a full color scan and then “dial out” the colors using your image editing software.

Since color scanners are basically gray scale scanners that perform three scans instead of one, capturing an image takes three times as long. In practice, you’ll spend a great deal longer than three times scanning color originals, since it will frequently take several tries to get a scan that captures all three colors the way you want them.

You’ll obviously need a color Macintosh for any of these scanners. Some, like the Sharp JX-450 or Howtek Scanmaster, require a Mac II with at least 2 megabytes of RAM. These two also use a special IEEE-488 general purpose interface bus (GPIB).

**Abaton Scan 300/GS**

This is a 300 dpi, 8-bit scanner that offers 256 gray levels. Documents up to 8.5 x 14 inches can be scanned. There are 255 brightness and contrast settings to choose from to compensate for light or dark originals.

The supplied Abaton Scan DA desk accessory lets you scan images without leaving your current application.
Apple Scanner

Apple One Scanner

As you might expect, the original Apple Scanner was solid, dependable, and neither the lowest priced nor most advanced scanner available for the Macintosh. It was a 4-bit machine, with only 16 different gray levels available; however Abaton markets an upgrade board you can use to add full 16-bit capabilities.

The Apple One Scanner, in contrast, is a new full-function machine. Like other SCSI scanners, you can daisy chain up to six other SCSCI devices, including hard disk drives and video capture interfaces. Variable scanning resolution is provided with 75, 100, 150, 200, and 300 dpi choices.

The Apple Scanner's HyperScan software will store images in virtual memory, so you can scan images that are larger than available RAM (important if you have a 1-megabyte machine). The scanner can produce PICT, TIFF and MacPaint files.

Also included is Ofoto, which is used for high resolution scanning.

AVR 8000/GSX/CLX
AVR 3000/GSX/CLX
AVR 1000

If you want an 800 dpi scanner, the AVR 8000 series is the place to start. The company offers both gray-scale (GSX) and color (CLX) models for less than $2000 each. Of course, true resolution of either model is no higher than 400 dpi. AVR uses a proprietary Resolution Engine that interpolates 300 and 400 dpi to 600 and 800 dpi respectively.

The 3000/GSX and 3000/CLX are 300 dpi versions of the high-end models. The AVR scanners are furnished with plug-in modules for PhotoShop and ColorStudio, and EasyScan, which is System 7.0 compatible. An optional 100 page automatic document feeder is available for $795.

The gray-scale models are field-upgradable to color, and any of them can be used on both Macintoshes and PCs, so those of
you who plan to upgrade or switch platforms won't find your investments worthless sooner than you expected.

The AVR 1000 is a combination hand scanner and sheetfed unit (the hand scanner portion fits in a cradle that feeds the documents through. It has 400 dpi resolution, but only 64 shades of gray. You can often find this unit for $500 or so, which makes it a bargain if you need an automatic document feeder that can handle only 10 pages. You'd generally pay that much for the ADF alone.

**Epson ES-300C**

If the Microtek MSF-300Z started a revolution in low cost color scanners, Epson fired the second shot with its lower-priced, more advanced, more compact model, the ES-300C. The Epson’s glass document table measures 8.5 x 11.7 inches, including a very small non-scannable margin around the four edges, which varies from .08 inches (2 mm) at the right side to .24 inches (6 mm) at the bottom. The top cover is easily removable, so you can scan thick books and other unwieldy material.

Output resolution can be selected by your software from 19 different settings, ranging from 50 to 600 dots per inch. Everything over 300 dpi is interpolated from the 300 dpi information. You can specify the horizontal and vertical scanning resolution independently.

As noted above, the Epson scanner offers a single-pass color mode, in which each line is scanned three times during a single pass. Three colored gas fluorescent lamps are used alternately. The scanner also has a three-pass sequence that scans the entire image in triplicate—once for each primary color. While the single-pass mode is faster, the three-pass method is thought to produce more accurate colors and a sharper scan, since there are fewer stops and starts within each pass.

The Epson scanner can automatically provide some image manipulation and correction for you. Three different halftoning methods can be chosen. It also has five gamma correction
curves that can compensate for the idiosyncrasies of specific types of printers and displays. You can choose one gamma correction for 24-pin and laser printers and another for 9-pin and inkjet printers. A third set of corrections offers enhanced contrast and definition when you are scanning images that contain both pictures and text.

The feature, other than the low price, that makes the Epson ES-300C so attractive is its connection flexibility. Like several other scanners, it can be used with both IBM and Macintosh computers in the same session (but not at the same time, of course.)

It can also connect to a limited number of color printers for direct printing of scanned images. This allows you to have a color copier for a fraction of what you might expect to pay. At this writing, the scanner works with an Epson LQ-2500, LQ-2550, or LQ-860 printer with a color ribbon, an HP PaintJet color inkjet printer, or an HP 3630 color graphics printer with a parallel interface. The system won't work with a PaintJet equipped with an HP-IB or RS-232C interface.

The Epson scanner is furnished with LetraSet ColorStudio, ImageStudio, and ScanDo.

Fujitsu M3191-Mac
Fujitsu M3096E
Fujitsu M 3296

The M3191-Mac is a low cost (under $1800) gray scale scanner that offers 64 levels of gray and reportedly scans at 75 to 1200 dpi. It's furnished with a SCSI interface. The M3096E is a more advanced gray scale unit that can handle large size 11.5 x 17-inch documents. The high-speed unit can scan up to 20 letter size pages per minute at 200 dpi.

The M3296 is a color scanner that can be fitted with a 50-page automatic document feeder or color transparency adapter. It offers resolutions from 200 to 400 dpi.
HP ScanJet IIc

There was no ScanJet I, unless you count the original ScanJet. HP's second model was the ScanJet Plus. Their third model is called the ScanJet IIc (the c stands for color), and if that doesn't make sense to you, check out the nomenclature for the company's first, second, and third in the basic LaserJet line.

Introduced at $2195, the ScanJet IIc was a little late coming to the color scanner party, but the wait was worth it. It does have some significant advantages over the competition.

Not the least of these is the Hewlett Packard name. HP was gray scale scanning for quite a long while, and has always boasted the top performing model, as voted by editors at PC Magazine and other publications.

The IIc is a 400 dpi color model (with interpolation to 800 dpi. It uses a single scan head with two fluorescent lamps and a three-stripe CCD sensor that allows single-pass scanning. Unlike most of the scanners for the IBM PC, it uses a SCSI interface.

Even so, it captures images faster than most computers can process them, so the IIc scans in stops and starts to give the CPU time to catch up. It will actually continue to move the scan head after actual scanning has stopped, then backtrack to an earlier point in the scan and start up again before resuming the scan. In that way, the stops and starts are "invisible" to the software. The scan head moves smoothly and continuously during the periods in which actual scanning is underway.

The ScanJet IIc costs the same as the ScanJet Plus only a short while ago, so you get a much better device for the same money.

Hewlett-Packard ScanJet Plus

The only thing wrong with the HP ScanJet Plus is that you can't upgrade the old ScanJet to add its capabilities. I'd had
Appendix A

my ScanJet for more than a year when the Plus was announced, but I still felt farther behind than the owner of a shiny new Packard when I checked out the features of the Plus. The industry leader was made even better in 1989 with this significant upgrade.

The best news is that the Plus costs only $100 more than the venerable ScanJet it replaces. The new scanner has 300 dpi resolution, although higher resolutions can be interpolated from the 300 dpi information (from 12 to 1500 dpi can be specified in single dots-per-inch increments). This lets you adjust the effective resolution of the scanner to match most typesetters and imagesetters. This HP offering was one of the first moderately priced scanners to provide full 8-bit gray scales—as many as 256 different shades.

Where the earlier scanner had three-position contrast control, the ScanJet Plus has continuous control along its whole range. A new dial enables you to lighten or darken the image. An optional 8.5 x 14-inch automatic document feeder with a 20-sheet capacity is available for about $600.

Because it is an industry standard, you'll find that most software packages, including Caere's OmniPage support the ScanJet Plus. The new ScanJet is smaller and lighter than its predecessor, weighing about 16.5 pounds compared to 22 for the older model. It's also 3.5 inches shallower at 18.9 inches. Heavy scanner users will be pleased to learn that you can now replace the lamp bulb yourself instead of hauling the device in to your local service center.

In addition to interfaces for Mac Plus, SE, and II systems, you can also get a version for XT/AT-bus computers and the PS/2 Micro Channel models, if you want to use a single ScanJet Plus with both types.

The material to be scanned must be positioned in the upper right-hand corner and not the lower right as with the earlier ScanJet. You may find this a convenience, since it's not neces-
sary to turn the original upside down to scan in the correct orientation.

**Hitachi HS-700**

This is a 400 dpi color scanner with an 8.5 x 11-inch scanning area and SCSI interface. It carries a hefty price tag (about $5000) but is a rugged model for professional applications.

**Howtek Scanmaster II**

**Howtek Personal Color Scanner**

The Scanmaster II is basically the Sharp JX-300 repackaged and sold as a Howtek offering. However, the packaging, as such, deserves special mention. It is furnished with MacScan-It software, which has an unusually wide range of color controls. It allows scanning at fixed resolutions of 75, 100, 150, 200, and 300 dpi, or variable resolutions. While MacScan-It operates under MultiFinder, it monopolizes the CPU enough to severely limit background processing. It has a preview mode for looking at the image before the final scan.

The Howtek Personal Color Scanner is the low end 24-bit, 300 dpi color scanner in the Howtek line. During 1991 it was advertised for $1295 direct from Howtek—and that price included Adobe PhotoShop. At that time, that was roughly what you could expect to pay for a gray-scale-only ScanJet Plus. As you might expect, it was quite a deal and attracted some deserved attention to Howtek.

**HSD Scan-X Color**

This 24-bit color scanner is furnished with proprietary Spectrum Enhancement technology, which helps produce 600 dpi resolution. PRiced at less than $3000, the same scanner can also be used with Next computers.

**La Cie 911 Color Scanner**

This is another low cost color flatbed scanner, with a discounted price that is even lower than that of the Microtek 300Z. Even so, it’s a 24-bit, 300 dpi printer that can capture
16.8 million different colors. It will also function as a 256-gray scale or single-bit black-and-white scanner.

I didn't get a chance to test this relatively new scanner, but it certainly merits consideration for its low price if nothing else.

Microtek MSF-300G
Microtek MSF-300Q
Microtek MSF-400G
Microtek MSF-300ZS
Microtek ScanMaker 600ZS
Microtek MS-II

The Microtek MSF-300ZS is the low cost winner in the flatbed color scanner race, while the ScanMaker 600ZS ups the resolution stakes to 600 dpi.

While I wrote the first edition of this book, the 300Z scanner was scarcer than happy OS/2 users. Microtek was selling every one they could assemble and ship, without benefit of more than cursory reviews in the computer press. Now that's a hot product.

The 300Z is your basic do-everything scanner. It will handle black-and-white (1-bit), 256-gray shade (8-bit) scanning and full color (24-bit) work. It comes bundled with all the basic software you may need: Digital Darkroom and PhotoMac

You can get interface cards separately for both IBM and Macintosh computers, so the same scanner can be used with both machines.

Microtek claims the first scanner for desktop publishing (in 1985) and the first 256 gray level scanner (in 1987). One thing is certain, these scanners, along with those from HP, have become the standards by which all other desktop scanners are judged.

Microtek Lab literally offers a scanner for everyone, including its latest 600 dpi color scanner. These scanners are quite
easily among the most popular and advanced available at reasonable prices for desktop publishing applications.

The MSF-300Q is a 300 dpi scanner that can capture up to 64 different levels of gray. The MSF-300G is Microtek's answer to the ScanJet Plus: a 300 dpi, 256 gray level scanner. The MSF-400G is similar, but offers slightly better 400 dpi resolution. The MS-II scanner is a 64 gray level unit with a built-in 50-page document feeder. It is targeted at OCR applications.

These scanners are furnished with bundled software, including Digital Darkroom. This bundle makes the Microtek scanners an excellent value: you receive software that you might pay $600 to $1000 for otherwise. The scanning software allows you to set resolution, brightness, contrast, scale, and scanning mode. Dithering can include 12 different halftone patterns, or you can customize your own.

You can select from 14 brightness and 14 contrast settings to compensate for less-than-perfect originals.

**Phovos 400C**

This color scanner is a full-size, 400 dpi device that uses a single pass scan design that minimizes the need to recalibrate the device. It's built like a tank (but fortunately doesn't smell or sound like one) with a rugged metal case. The omnipresent Micrografx Picture Publisher is furnished at no charge by the vendor, Prime Option, Inc., of Torrance.

**Sharp JX-450**

This scanner is the only one of the seven that handles originals up to 11 x 17 inches. It's also expensive (about $7000) and commands 22 x 21 inches of your desktop—for starters. This scanner uses a moving table rather than a moving scanning element to capture images. That is, the platen holding your original moves in front of the scanner's CCD sensor and fluorescent tubes. This movement adds an extra 18 inches to either side of the scanner.
The JX-450 handles reflective artwork (opaque documents that all desktop scanners work with) and transparencies up to 8.5 x 11 inches. In the latter mode, you replace the cover with an optional mirror that directs light back through the image for capture. You can also scan books, provided they are not too large and heavy (more than 11 pounds).

This scanner is a good performer, and its $7000 price may drop under pressure from newer, lower-cost color capture devices. However, even at its current price, the JX-450 is an excellent buy if you need full-color scanning of large originals and transparencies. The larger size also pays off for black-and-white-only scans of bigger originals.

It is supplied with PixelScan software.

**Sharp JX-300**

This scanner is a more conventional-looking flatbed scanner with 300 dpi resolution and the ability to capture 64 different shades per color for a total palette of 262,144 hues. With this model, your original remains stationary on a glass platen, while the CCD scanner and fluorescent tube travel on a track below.

Resolution, scanning window, scaling and color/monochrome settings are all controlled through software. Resolution can be varied from 30 to 300 dpi. At around $5000, this scanner represents a lower-cost entry into color scanning.

**Dest Scan 3000**

It's good to see Dest back in the market after its financial reorganization in 1989. The new Scan 3000 Series is a flatbed 300 dpi scanner that can capture 256 levels of gray scale information.

**Canon IX-30F**

The Canon IX-30F captures 256 levels of gray. An optional document feeder accepts up to 20 letter or legal sized documents at one time. This scanner is unusual from the stand-
point that it uses a SCSI interface for both Macintosh and IBM versions. That makes it particularly easy to swap the machine back and forth between the two systems (if you have a SCSI host adapter board installed on your PC). Up to six additional SCSI devices can be daisy-chained at once.

**UMAX UC630**

**UMAX UG-80**

**UMAX UF32**

The UC630 is a 600 dpi color scanner that uses a single-pass technology like that found in the Epson ES-300C to capture full color images without the need for three separate scans. The company claims true 600 dpi resolution, rather than interpolation. When this book went to press, this scanner was provided with Adobe PhotoShop.

UMAX also markets the UG-80, a 256-gray scale scanner, and The UF-32, a low-end 145 gray scale device (don’t ask me how they came up with that odd-ball number.)

**Xerox Datacopy GS Plus**

This is an upgraded version of Xerox’s 730GS, which provided only 64 different gray levels. The new version, for the Mac SE and II is one of the fastest flatbed scanners on the market, suitable for high production needs.

Resolution is adjustable between 75 and 300 dpi in 1-dpi increments. The MacImage control software lets you choose from among 16 brightness controls, four contrast settings, and a whole brace of dithering options for halftoning. The included ImageTune software supports 14 popular file formats. The Image Copy desk accessory allows you to scan images directly into your favorite desktop publishing or graphics programs.

The GS Plus is one of the smallest flatbed scanners available—scarcely larger than its platen at about 11.5 by 19 inches, and 15 pounds. The tradeoff is that document size is limited to 8.5 x 11 inches.
XRS 6c OmniMedia

The X-Ray Scanner Corp. offers this 600 dpi, 24-bit color scanner, which is an enhanced version of the Microtek ScanMaker 600ZS. Its main advantage is a specialized backlighting arm that allows it to capture transparencies from 35 mm to 8 x 10 inches. It's a three-pass scanner with built-in SCSI port. It is furnished with Adobe PhotoShop.

Present Microtek scanner owners can upgrade their models for about $1000 using a kit offered by XRS. The upgrade includes transparency scanning capabilities.

Hand Scanners

If most hand scanners look a lot alike to you, there's a good reason. Many models that are sold under different names are built by a single Japanese company for other vendors. So, the physical resemblance between, say, Lighting Scan and the Logitech ScanMan hand scanners is more than accidental which is not to imply that these scanners are identical. Each is built to the specifications of the U.S. importer and can include some important differences. One might use a reddish illumination source that will ignore some important facial details when scanning color photographs of people. (You can scan color pictures in black-and-white, after all.) Another may use a yellowish light source.

Logitech ScanMan Model 32

The Logitech ScanMan is a 100/200/300/400 dpi hand scanner with some valuable extras. The latest version has improved software that allows capturing 32 gray levels. It boasts true 400 dpi resolution and has a speed indicator light that can help you compensate for variations in hand movement. The feedback the light provides can help you reduce scanning speed before you lose image information.
Lightning Scan
Lightning Scan Pro 256
Lightning Scan Compact

The basic model is a twin of the Logitech ScanMan is nevertheless different in several important areas. Lightning Scan was the first handheld scanner for the Macintosh. This scanner can scan images about 4 inches wide at 100 to 400 dpi resolution. Both application and desk accessory scanner drivers are furnished.

The capabilities differ slightly between them. For example, desk accessory can fit, flip, or rotate images, while the application software cannot. The application, however, provides adjustments for brightness, contrast, inversion, gray map editing and other capabilities.

The application can store captured images as MacPaint documents or PICT, EPS, or TIFF files. The desk accessory can store images in MacPaint, TIFF, and Scan Image formats.

The Pro 256 model is a 256 gray scale hand scanner with built in memory that permits faster scans. The Compact model is an oddball device that connects to the floppy disk port of the Mac Classic, SE/30 and Portable. It draws its power from the drive port, and so needs neither an external power supply nor a SCSI connection. It uses dithering to simulate gray.

Mouse Systems Page Brush
Page Brush Professional
Page Brush Color

The $795 Page Brush hand scanner is the first to tackle the problem of scanning larger images in a really new way. Instead of the mirrors and lenses found in most hand scanners, the Page Brush uses a contact sensor. The sensor reads light reflected from an overlay pad which provides a reference point. The scanning software is able to “stitch” an image together on-screen as you scan.
The Page Brush Professional adds some unique features. You can scan images in any direction at resolutions from 75 to 300 dpi with 64 gray levels. It will automatically stitch the images together even if you change directions. The device doubles as an optical mouse.

The Page Brush Color is a 12-bit color scanner that can capture 4096 colors at 100 to 200 dpi, or gray scale images at 100 to 400 dpi. It is furnished with VideoPaint.

**Complete Hand Scanner/400**

**Complete Half Page Scanner**

The CHS/400 is one of the new breed of hand scanner that provides 200, 300, and 400 dpi resolutions. The SmartScan software allows you to resize, scale, rotate, crop and edit your picture. It will scan images up to 2.5 inches wide and 14 inches long. You can scale from 10 percent to 20 percent of original size, and 16 gray levels are simulated with three different dithering schemes.

The Complete Half Page Scanner can handle a larger 4-inch wide path at a resolution of 200 dpi. It will store files in MacPaint, PICT, PICT2, TIFF, and EPS formats.

**Niscan ClearScan Color**

This hand scanner is a 256-color single pass device that will handle any image that will fit in its narrow 2.5 inch window. This is a low cost device suitable for those who want to experiment with color scanning, but who aren’t ready to spring for a full-featured scanner.

**Sharp JX-100**

The Sharp JX-100 is a large, hand held scanner that provides full color capabilities for less than $1000. The most striking aspect of the scanner is its viewfinder, which allows you to see the actual image being scanned. In use, the scanner is placed over the original and left there while the scan takes place. That provides you with hands-free operation and is necessary to produce the three separate color scans.
The JX-100 has only 200 dpi resolution, but that's about all you need for color scanning anyway, given the limitations imposed by the large file sizes.

**Sheetfed Scanners**

There's no denying the convenience of sheetfed scanners for OCR operations. You can load a set of pages and then let your computer grind through the tedious number crunching required to translate each bit map into text. In fact, while sheetfed scanners usually function as graphics-only devices, organizations with heavy OCR workloads are advised to dedicate one of these scanners to that task and purchase a second graphics-only model for artwork.

Sheetfed scanners range from the compact to the huge, so you may want to measure the available space on your desktop before making a decision.

**The Complete Page Scanner**

This compact (9.5 x 13 x 3 inches) scanner has both 200 and 300 dpi resolutions. Up to 16 gray levels are simulated through dithering. The SmartScan software included allows you to resize images, scale from 10 percent to 200 percent, and merge multiple images. As with the Complete Hand Scanner, you can print directly to 100 different laser and dot matrix printers

**ThunderScan**

How far we've come! Half a decade ago when I purchased my first ThunderScan scanner, it seemed like a miracle. I replaced my ImageWriter ribbon with the ThunderScan cartridge mechanism, rolled an 8 x 10 inch photograph into the platen of the printer, and 20 minutes later I had a complete dithered image on the screen of my Fat Mac. Since the image
appeared a line at a time on the screen, the suspense was almost unbearable.

Today, I can generate better scans in ten seconds using a flatbed model (that costs ten times as much). Therein lies the rationale for ThunderScan’s continued success. For a $180 street price, you can purchase a scanner that will generate scans with more gray levels and not much less resolution than you get with the Apple Scanner.

ThunderScan’s software has been upgraded considerably over the past five years. You can capture 32 different gray levels and save your files in ThunderScan or EPS file format.

This scanner competes directly with hand scanners. It can capture larger images at a single pass than hand-operated models, even though that pass takes a bit longer. You’re also limited to scanning artwork that can be fed through the ImageWriter. If you’ve got more time than money, ThunderScan can give you big scanner results for a small price.

**Overhead Scanners**

**Chinon DS-3000**
**Chinon DS-4000**

As I noted in Chapter 2, I don’t understand why there aren’t more scanners configured like the 300 dpi Chinon color and gray scale scanners. Certainly, they are limited in what they can do (gray scales have to be simulated through dithering, in the DS-3000, for example). However, it costs one half to one third of what the typical flatbed model goes for. If you don’t need to manipulate gray scale information, this scanner has a lot going for it.

For one thing, it’s almost as portable as the typical hand scanner and at six pounds weighs a third to a fourth of what most flatbed models weigh. Its base is about 12 x 13 inches, and it stands only 13 inches high.
The Chinon DS-3000 is connected to the Mac through a SCSI interface. The same scanner can be used with IBM PCs through parallel or serial connection, which makes it easy to move the unit from Mac to IBM computer; there's no need to pull an interface board and reinstall it in another system. Seven resolutions are available, ranging from 75 to 300 dpi. Settings can be made without resorting to software: DIP switches along the edge of the baseboard provide access to key parameters.

A faster dedicated parallel interface board is also available for those who will be using the system primarily with one computer.

In a neat touch, Chinon also lets you connect the scanner directly to a parallel printer. You can, in effect, use it as a photocopier to immediately print out hard copies of the image you scan. No computer system must be involved. There's a button on the front to initiate a scan without a signal from a CPU.

Brightness control is automatic, and a dial on the unit or the included scanner control software enables you to adjust contrast.
Appendix B

Bit Map Image/Paint Software Capsules

This appendix includes discussions of some of the leading image editing software packages and utilities not covered in the main body of the book. As mentioned before, these capsules aren't intended to be a feature-by-feature comparison. I worked with dozens of programs in writing this book, and I wanted to share with you some impressions of the software I liked most.

Image editing software for the Macintosh is so advanced that the distinctions between the different categories is blurred and sometimes confusing. Paint programs modeled on the original MacPaint have grown in sophistication. They now can work with images up to 2540 dpi and may have Bezier curve tools like those once found only in draw programs. The most sophisticated paint programs can handle up to 32-bit color.

Similarly, draw programs now provide many features previously found in sophisticated CAD packages. There are even programs like Canvas that allow you to create both raster and vector images with the same software, in the same file. At the high end, gray scale and color editors handle scanned continuous tone images to do tasks that once required an expensive workstation.

I've done the best I could in this appendix to sort the best available image editing software into appropriate categories. We'll look at leading paint programs first. Draw programs will be covered in Appendix C.

In the Macintosh world, gray scale and color editors are just different flavors of the same basic software. Many programs
can handle both. In some cases, a vendor will supply both a
gray scale and a color version of each (Letraset's ImageStudio
and ColorStudio, for example.)

The hardware requirements are much the same for both.
You'll need a color card (8-bit or 24-bit, preferably) and either
a monochrome gray scale monitor or color monitor. In this
appendix, I'll describe the best features of some of the leading
continuous tone editing packages.

**Adobe Photoshop 2.0**

Photoshop gives you everything you need to manipulate both
gray scale and color images. It isn't fussy about file formats
and can open just about any standard Mac format to which you
might have converted your scanned image to. A total of 14
different file formats is supported. These include EPS, PICT,
Amiga, TIFF, PIXAR, PixelPaint, Scitex, and Targa formats.
Adobe is obviously serious about this program.

Photoshop is actually an enhanced version of the XP image-
editing software that has been sold with the Barneyscan color
scanner for several years.

The usual electronic photographic retouching tools are pro-
vided. You can lighten shadows, change colors or patterns, or
cut objects from one photograph and paste them down in
another.

Everything is made easier by flexible selection tools. You can
use both rectangular and elliptical marquees as well as a lasso.
A magic wand can be used to select all adjacent pixels with
similar colors. That way you can grab only part of an image,
such as the background.

You can also draw directly on your image. Pencil, paintbrush
and adjustable airbrush are all available. You can smudge,
blur, or sharpen images. The common eyedropper tool is pro-
vided to pick up a color you want to paint with.

One unique feature is the "rubber stamp," which lets you
pick up a small portion of an image and stamp copies on other
parts. Make a mistake? Photoshop has a magic eraser you can use to undo a portion of an image. You can restore that section to the state it was in before the file was last saved.

Photoshop has its own sharpen, blur, diffusion and edge enhancement filters. But you can also use those from other programs, such as Digital Darkroom. How’s that for open architecture?

In the color realm, Photoshop lets you use both RGB and HSB color models. You can adjust these colors for a full image or just part of it. You can create and print CMYK separators or create an image that can be printed directly by an Agfa Compugraphic 9600 imagesetter. It can also handle QuickDraw printers, Tektronix thermal color printers, and the Apple LaserWriter. Clearly, Photoshop is intended for professional level applications.

Color Studio

Color Studio is more than a full-color version of Letraset’s popular Image Studio product. This program has both a standard color layer and a monochrome mask layer. The latter is useful for adding overlays or floating images/text on top of your image. Its new Shapes module lets you work with vector graphics in many creative ways.

A full range of tools is provided: pencil, paintbrush, charcoal, and airbrush. You can use a water drop to blend tones or a fingertip to smear them. As with many other programs, you can pick up part of an image and use it as a paintbrush.

The standard sharpen, blur, soften, and diffusion filters, along with an unusual star filter are available. Gradated fills are provided, along with support for the Pantone system. You can even calibrate your monitor to more closely match the colors you’re using with this program.

The latest version of Color Studio added support for Photoshop plug-ins, so you can draw from the vast reservoir of drivers and filters created for the Adobe product.
Color Studio will output directly to high end color image processors such as the Crosfield Studio system.

**Image Studio**

Image Studio is a powerful gray scale painting program that has recently been upgraded to offer even more features. The original support for 64 gray levels has been increased to 256 different tones. On Mac Plus and SE screens, the program will display 64 dithered shades, plus white. On a Macintosh II with at least an 8-bit color card, you can view up to 102 different grays on the screen at once.

The program now has virtual memory routines to allow handling files larger than available RAM (which you are likely to have with 256 tones and 300 dpi resolution). Scanners and frame grabbers can be controlled directly from the program. You can scan directly to Letraset's RIFF format. Image Studio will also open and save files in PICT2 format (if you have a Mac II).

This program has the intelligent selection tools that are so important in image editing packages. For example, the lasso can be constrained to move in a straight line, so you can use it to select polygons such as triangles.

The usual brush and paint tools are provided. Very useful is a new Match on Close Shades option for the paint bucket, which lets you fill all contiguous pixels that are the same or within 16 shades as the pixel you click on. This lets you paint subtle gradations of tone with a new shade.

Image Studio is furnished with some special effects modules. These include Halftone Preview, which expands the program's range of PostScript halftone capabilities to include specialized screens such as mezzotints. The Design Effects module provides incremental rotation and scaling, transparency, and automatic drop shadow creation.
Digital Darkroom 2.0

Aldus's purchase of Silicon Beach early in 1990 brought it a number of complementary software packages that fit in nicely with PageMaker and Freehand. One of the most notable of these is Digital Darkroom, a pioneering gray scale editing program.

Digital Darkroom runs on every Mac from the Plus on up, and will display dithered images if you don't have a gray scale display. If you do, images can be viewed in either 16-level or 256-level renditions.

The program reads and saves images in TIFF, PICT2, ThunderScan, and Archive formats. It will export files as EPS, PICT, MacPaint, and 1-bit TIFF files.

Before you open any of these files, Digital Darkroom can display a preview of the image. If the image is too large for RAM, you can select a portion of the image and import only that at full resolution. Alternatively, you may choose to import the full image at a reduced resolution.

A full tool set is provided. A selection rectangle, polygon, oval, and lasso are available, as well as a magic wand for selecting continuous gray values within a specified range. Filters are furnished for blur, sharpen, despeckle, posterize and invert. The 32 different brush shapes can be set for modes including texture, stamp, smudge, blur, sharpen, lighten, and darken.

An autotrace mode allows you to trace the outlines of bitmapped images, either black-and-white or gray scale. You can adjust sensitivity.

Digital Darkroom includes an advanced halftone option that produces better image quality on 300 dpi printers, whether they use PostScript or QuickDraw.

This program is ubiquitous, since it is bundled with gray scale scanners from Apple, Microtek, Abaton, Siemens, and New Image Technology. I liked its plug-in technology, which
allows you to add filters and other new modules simply by placing them in the folder with the application.

**Picture Publisher**

Sometimes you have to stretch a few rules. Picture Publisher is supposed to be available for the Macintosh by the time you read this. The early information I have is sketchy. However, the program has enough going for it that I decided to include it here with one caution: I used and liked Picture Publisher in its IBM PC version. I'm hoping that it will be as pleasing in its Mac incarnation.

Astral Development will be staking its reputation on this followup to the PC version of Picture Publisher, an extremely sophisticated gray scale editor, indeed.

As with all gray scale editors, you can adjust contrast, brightness, gray map, and other parameters, and edit the image on a pixel-by-pixel basis. Image processing choices let you sharpen, blur, or posterize the image.

The Mac version of Picture Publisher should have some enhancements. It will support a larger number of scanners directly. The program now offers smart sizing interpolation, which helps you scale images more accurately. It has automasking and selective Paint and Paste, determined by gray scale value, which allows you to superimpose images while blending them smoothly. Added retouching features like dodge and burn, which allow you to lighten and darken portions of an image selectively, and smear are provided. Images can now be rotated in 1 percent increments.

A PostScript driver provides better control over screen ruling and angle. You can import bit maps from the Clipboard and export EPS files. Picture Publisher supports TIFF 5.0 files and includes file compression for gray scale images.
PhotoMac

Talk about ambition. Avalon Development doesn't just position PhotoMac as a color/gray scale editor. These folks are convinced that the package has everything you need for electronic page layout and color stripping with desktop publishing programs like QuarkXPress, RSG, and PageMaker. They speak from experience, too, since all the dazzling full-color brochures, ads, and other sales promotion materials you see from this company are produced entirely with their products. Well, some of the photos are scanned conventionally, but Avalon's sister company, Data Translation makes video color capture boards that are used to grab some of the color images you see in their material.

This isn't a color paint program, although PhotoMac does offer tools like the marquee, lasso, paintbrush, airbrush, eraser, and eyedropper. What you don't get are the tools required to make squares, circles, and text. PhotoMac is designed for manipulating and color separating scanned images.

The program features many powerful separation controls. You can set screen rulings, screen angles, and separation dimensions. You can make adjustments for paper type, gray component enhancement, and gray balance. Like all programs that generate color separations, PhotoMac produces four separate versions of your page. However, when used with programs like QuarkXPress, four negatives that include both text and color separations are generated. With PageMaker and Ready, Set, Go five negatives are produced: four for the color separations and a fifth for text and line art. Negatives are output to a PostScript compatible imagesetter or to one of a number of 35 mm film recorders (to produce color slides suitable for presentations). You can also produce color proofs on printers like the Kodak SV6510 video printer.

PhotoMac works with full 24-bit color images. It uses a proprietary virtual memory system that allows you to open files up to 74 megabytes in size. This scheme also allows
manipulating 24-bit color on standard 8-bit displays. It will optimize an image for display on monitors with only 8-bit displays.

PhotoMac can import color TIFF, PICT2, and Targa files, as well as input from color slide scanners, flatbed color scanners, and Data Translation's ColorCapture board for the Mac II.

The program is actually quite easy to use to produce separations for QuarkXPress. Once you have manipulated the image in PhotoMac to your heart's content, you simply pull down the File menu and select Separate Colors. One of the options is QuarkXPress EPS format. When you click on Save, four files are created. Four of these contain separate 24-bit information for the cyan, magenta, yellow, and black separations. The fifth, marked Main, contains an 8-bit full-color representation of the image.

You use Quark's Get Picture facility to place the Main image in your document. It may be scaled and cropped normally. You may also incorporate color images produced by other programs such as Adobe Illustrator 88 or Aldus Freehand in your layout. When you're ready to produce files for the imagesetter, follow the directions for making a PostScript file presented earlier in Chapter 12. However, check the Make Separations box in the Print dialog box. That's all there is to it.

**Enhance**

This powerful image processing software is intended for Mac II users who need maximum flexibility for filtering images with various special effects. More than 75 different filters are provided with the package, and you can create your own masks for additional effects. Any of the filters can be applied or blended with the original image in one percent increments.

Enhance lets you create and save custom color palettes, and boasts all the standard paint tools, such as air brush, smudging, gradient fills, rotation, and distortion. This package is
often discounted from its $495 list price to about the $375 level, which makes it a good buy.

**MacPaint**

What’s MacPaint doing here? Where’s your sense of history? I should have put MacPaint first because it was first. The original version was one of two applications available for the Mac when it was introduced. When I trotted down to my local computer store to order one after the press conference, the salesman was demonstrating the concept of Fat Bits to a horde of enraptured customers. None of us had ever seen anything like that before.

Within a few years, we had a horde of programs named BLANK-Paint or Mac-BLANK. There was even spillover into the IBM PC compatible world with products like PC Paint. Everyone tried to mimic, or improve on, MacPaint.

Today, a new version of MacPaint is marketed by Claris, that was spun off from Apple Computer as a separate company. No longer provided free with each Mac, MacPaint continues to compete with its imitators ever since.

Scanner users are likely to own some version of MacPaint. Despite its limitations, you’ll find it a handy tool for touching up scanned images. The strong suit of MacPaint is that millions of Mac owners have it, and nearly everyone knows how to use it. It’s been improved by the addition of some handy tear-off menus, more sophisticated zooming, and the ability to open up to nine files at once.

MacPaint is still limited to working with its own files, at 72 dpi. Large, high resolution scanner files can’t be manipulated. You must convert files to MacPaint format, in any case. If you want a simple tool for occasional touch up of scanned images, consider MacPaint. If you need a more sophisticated program and are willing to make the investment in learning how to use it, look to one of the packages described below.
PixelPaint Professional

This was the first color paint program for the Macintosh and is still considered one of the very best paint programs available. It is now offered in two versions: PixelPaint 2.0 is an 8-bit program, while PixelPaint Professional adds 16-, 24-, and 32-bit modes.

The first few paragraphs in this capsule describe features common to both. Each has a full selection of pens, brushes, and line and shape tools. Only marquee and lasso selection tools are provided. However, you can choose from several intelligent selection modes.

For example, as you might expect, the lasso shrinks to select a specified area. You can tell the lasso to select only one color, or you can define a depth of color range. The lasso will automatically slip to ignore colors it passes over that are outside that range. This feature is useful for selecting part of a scanned image.

The marquee and lasso allow you to perform many transformations on the selected area. You can flip an image, trace edges, distort, change perspective, rotate, and warp the selection.

PixelPaint supports both Bezier and spline curves, but can't see the curves themselves until you have laid down all the control points.

This SuperMac Technology product provides very good color management tools. A wide range of palettes are available, including Rainbow, Fleshtones, Gray scale, PaintJet (corresponding to the colors available with the HP PaintJet printer), and System. The program imports MacPaint, PICT, PICT2, TIFF, EPS and Startup Screen files. It exports PICT, PICT2, Startup Screens, PixelPaint Stationery (a proprietary format), gray scale and color EPS files. Only gray scale TIFF files can be exported.

As befits a full-color bit map-oriented program, PixelPaint is furnished with a color scanning program, PixelScan. At this
writing, the software works only with Sharp and Howtek 24-bit color scanners.

While PixelPaint can handle only one document at a time, PixelPaint Professional allows you to open as many as you have memory for. The pro version lets you work with four 256-color palettes at a time or one in 8-bit mode.

If you want to make your own color separations, you can choose one of the most common models, CYMK, HSV, RGB and Pantone. In the Pantone window, an entire page of 49 swatches is on view at once. You simply type in a PMS number to choose a color. The standard Apple Color Picker wheel is also available. You choose a color by clicking on it in the wheel, and then control intensity or brightness with slider controls.

The program also has a color mixer that lets you create colors the same way oils are mixed. You can use the alpha channel (32-bit mode) for specialized transparent masking techniques. For example, drop shadows can be created to allow the base image to show through.

The latest version of PixelPaint Professional introduced support for System 7, including Publish and Subscribe features, and TrueType fonts.

It's now one of the most powerful 24-bit color programs on the market. It adds powerful Bezier curve editing capabilities, as well as new painting implements, which include charcoal, pastel, and rubber stamp. A new magic wand and better cropping techniques are also welcome additions.

Bundled with the program is PixelPaper, a collection of nine texture templates.

The original split-screen Zoom of earlier versions of PixelPaint has been replaced with a full-screen Zoom, and the program now uses virtual memory to let you handle much larger images, up to 4000 x 4000 pixels.
PixelPaint Professional 2.0 added new color separation capabilities, and can output to Scitex CT format for linking with high-end color prepress devices.

Canvas 3.0

Can’t decide between draw and paint programs? Canvas is arguably the best of a breed of programs that don’t require you to choose. They let you work with both bit-mapped and object-oriented images in the same file. Given the $399 price—about half that of some programs with fewer features—the choice may be fairly easy.

With Canvas, you gain the best of both worlds. Outline drawings which don’t lose resolution as you resize them for printing can be created. You can add bit map painting enhancements to these drawings and then print out the combined image. Of course, the bit map component of the image will change as you size or scale the drawing, so you should add these details last.

Canvas 3.0 was one of the first applications to provide System 7 support, including Publish and Subscribe. Its text handling has been improved to the point that it now includes a 100,000 word spelling dictionary (how many image programs can boast that?)

You can now use tool managers to customize each of the tools you use, and select from among them with a ToolPicker that can load, save, and delete sets of customized tools as they are needed.

What else is different about Canvas from Deneba Software? Most drawing programs allow you to import and work with bit map images. However, the goal in most cases is to trace the bit map to convert it to an object-oriented drawing. While Canvas does have autotrace features, you really don’t have to convert your scanned images to use them. It raster and vector images in separate layers. With an unlimited number of layers available, you can easily combine both types of images.
As a drawing program, Canvas has few equals. It supports full Bezier curves, cutting and joining of polygons, skewing, perspective, and distortion. You can use autodimensioning to resize images as you move them from document to document.

Its painting features are similarly powerful. Canvas will create and edit bit maps at resolutions up to 2540 dpi, so you won't lose any quality when working with scanned images.

Canvas is a full 24-bit color program, but you don't necessarily need a color Mac to produce color images. Macs equipped with black-and-white screens can still produce complex color images in a round-about way. On a Mac Plus, for example, you can work with multiple binary bit maps, each assigned a different color value. Only the eight colors supported by QuickDraw can be specified: red, green, blue, cyan, magenta, yellow, black, and white.

Since Canvas has an unlimited number of layers available, you can stack them to produce the color images you want. You won’t be able to view the color effects on-screen, but your efforts can be transferred to a color Mac and viewed or printed out.

For those with color Macintoshes, Canvas is supplied with a Canvas Separator utility. You can create CMYK separations from any Canvas illustration. The utility will print directly to PostScript typesetters and output film compatible with four-color process printing. Precise adjustments are available to control line screen frequency percentage enlargement/reduction and screen angles.

Other color models are supported, including RGB, HSL, and HSV. Canvas can import and export color TIFF, MacPaint, PICT and PICT2 files. Canvas has added EPS export to allow creating images for PageMaker and Xpress without loss of precision. Four EPS formats are available: regular, Adobe Illustrator 1.1, PICT EPS and Clipboard EPS. The latter two formats allow using EPS images within applications that don’t normally support PostScript files.
DeskPaint

Although it isn't as sophisticated as most of the other paint programs described in this appendix, I'm including DeskPaint for a simple reason. It works as a desk accessory. While desk accessories will see less use as MultiFinder and System 7.0 take hold, I recognize that many users still work with tried-and-true 512K or 1 megabyte Macs.

DeskPaint, marketed by Zedcor, makes paint features available to you without the need to exit your current application. So, if you need to touch up an image from within PageMaker, you can pull down the DeskPaint accessory, load the image, and then save the modified version a few minutes later. DeskPaint imports and exports both MacPaint and TIFF files.

SuperPaint

SuperPaint was the first combination paint/draw program. It's not terribly fast, but it will operate on any Mac from the Plus up. Unlike some paint programs, it will work with resolutions higher than 300 dpi.

This Silicon Beach (now part of Aldus) program has an autotracer feature and allows you to create smooth Bezier curves. SuperPaint is usually available at a low price. You might want to check it out if your needs are modest, but you would like the idea of having both paint and draw capabilities in a single program.

The latest version (3.0) adds 24-bit color support, and new controls for adjusting brightness, contrast, and color balance. The masking, smudge, diffusion, lighten, darken, and invert controls have also been revamped. At under $200, SuperPaint 3.0 is a bargain, when you consider all it can do.

Modern Artist

This is a sophisticated program with capabilities that will satisfy even professional illustrators. In fact, the Computer Friends software has both a Standard mode and an Expert mode built in.
In standard mode you can work with a palette of 92 colors, chosen from a 256-color palette. Smooth color transitions required by gradient fills and other shading are simulated by dithering.

In Expert mode, you can choose from 128 different colors to provide smoother gradients. Modern Artist offers some interesting tools. For example, your brush can be set to operate in a wet canvas mode in which the paint gradually runs out as the stroke proceeds. This makes for realistic blending of colors. The stain tool will recolor only the pixels of a specific hue, leaving the others alone, even when they are mixed.

Modern Artist's selection tools operate with surgical precision. The lasso can be used to select an area while including or excluding certain colors. You could, for example, grab an object of a certain color from amid others.

While the program can work with only one file at a time, you can select from several formats. PICT2, MacPaint, and Modern Artist's proprietary file formats are available. You can store EPS files with a preview header, so the images can be viewed when placed in PageMaker documents.

Modern Artist is furnished with ColorSep, a utility for producing CYMK separations.

UltraPaint

This is another program that offers black-and-white painting, color painting, gray scale image processing, and object drawing all in one. It runs on everything from the Mac Plus to the Mac IIfx, with the obvious limitations on display of gray scale or color images on lower end machines.

UltraPaint allows up to eight layers for its paint/draw images. You work with 600 dpi precision, so none of the resolution available in your original scan is lost.

For color painting, UltraPaint supports 256 colors and can apply these hues to blended fills and its multicolor airbrush (three distribution patterns are available for the latter). Cus-
tomized color palettes are available, and you can create a variety of custom brush shapes.

Gray scale images can be merged using powerful selection tools that let you merge and blend scanned images. The lasso, for example, is editable. A water droplet tool can be used to soften sharp edges. The usual gray scale tools for blurring, smearing, adding charcoal effects, and masking are available. Images can be rotated in one degree increments. The airbrush has three different distribution patterns, and you can create custom brushes.

UltraPaint, another Deneba offering, also includes all the standard object-oriented tools, including autotrace, both freeform and Bezier curves and scaling.

It reads and saves in MacPaint, PICT, PICT2, TIFF, Startup Screen, and MacDraw I formats. It has an open architecture design which allows new tools effects and filters to be integrated.

**Cachet**

This is a new basic package designed to let business users edit and correct the color of scanned images, especially if they don't want to learn complex software like Adobe PhotoShop. It's aimed specifically at audiences other than graphic designers and artists.

Don't get the wrong idea, though. This $1000 package has sophisticated controls, including color calibration. The intelligence is built in, rather than in the user (if you get my drift.)

**Photon Paint**

Photon Paint is a paint program intended for Macintosh II systems equipped with a color card. The program has some strengths, such as its multiwindow capability. You can work with as many files as your available RAM permits.

Photon Paint also has an excellent curve tool. After end points are set, you can pull the line into the desired curve
shape. Color support is average, providing only RGB and HSL models. You won’t be able to create CYMK color separations with the program without some hard work. Custom colors can be selected with an eyedropper tool, which is a time-saver.

The MicroIllusions software also is limited to 14 pen shapes and sizes. Changing the size affects all the tools, including the airbrush. That’s a bother, since you must repeatedly switch pen size if you want to use another tool in a different size.

For scanner users, the big limitation of Photon Paint is its file format support. You can work only with PICT files. You’ll need to convert your scanned TIFF images to PICT before you can work with them using Photon Paint.

**Studio/8**

**Studio/32**

Studio/8 and Studio/32, from Electronic Arts, are the color paint applications for the Mac II you’ll most often see used by professionals. These bit-mapped color painting programs have a very complete set of tools. Studio/8 lacks only a spray can. That’s not really an oversight, since Studio/8 gives you something much better: a programmable airbrush that works like the real thing. That is, you can adjust the flow rate and dissipation of the paint.

The normal polygon tool is provided, along with a variable side polygon tool that lets you create triangles, octagons, and so forth. The Bezier tool features fully adjustable control points.

The selection tools are more flexible than most. The lasso and marquee are available, along with a poligonal selector. This option is especially useful if you wish to select a regularly shaped object that’s not a square or rectangle. Instead of tracing the lines with the lasso, you can form a polygon that tightly fits the desired object.

Compared with the mere 14 brush sizes and shapes furnished with some paint programs, Studio/8 supplies an em-
barrassment of riches. Many different brush shapes can be selected. In addition, any selected area of your image can be specified and turned into a brush. Brush shapes can be stored on disk and reloaded as needed. A brush editing dialog box shows the last eight custom brushes you worked with.

Further modifications can be made with the tool modifiers. These alter the way individual tools function. Modifiers can control transparency, fatbits modes, grids, and other features.

Line weights can be adjusted independently in the vertical and horizontal directions. Zoom sizes are provided for 100%, 200%, 400%, 600%, and 800% ratios.

Studio/8 lets you work with the Apple System palette and 256 color/gray shades, or create a custom color palette. If you don't have a 24-bit video card, it will work with 4 to 16-bit systems. If you have only an 8-bit color card, for example, it will optimize 24-bit color files for display on the screen.

A color mixer window lets you smear various colors together to create new shades. An eye dropper tool lets you select a color on the screen and make that the current foreground or painting color. Gradients can have a texture. The program also works with 4-16 bit video cards.

Studio/8 boasts an unusual color finding capability. When you click on a color in the color palette, all occurrences of that color in your image flash.

Sophisticated masking can limit your painting to within or outside the area masked. Studio/8 will work with PICT2, MacPaint, and color TIFF files.

Studio/32 is the 24-bit upgrade, with a large group of enhanced features. For example, you can use this program to edit 24-bit color images even while in 8-bit mode.

It also includes an antialias modifier, which softens the outlines of bitmapped type and geometric shapes.
Studio/32 has a special layer for text, so you can always come back and edit the type at any time. Both PostScript and TrueType fonts are supported.

The program supports the Pantone Matching System, as well as traditional color models.

Studio/1

Although the name might lead you to believe that Studio/1 is just a less functional version of Studio/8, it is an unusual, full-featured program in its own right.

For example, Studio/1 allows you to do rather sophisticated animation of your scanned images. It will do automatic "tweening" (creating the appropriate images for the frames between those you already have). Transitions, fades and distortions also add to the animation capabilities of this program. Digitized sound, speech, and music can be added to your productions. The program includes a disk of animations and a HyperCard stack, which can be used as templates.

Studio/1 is geared toward high quality black-and-white painting. Editing can be done at up to 300 dpi, and the separate text layer supports PostScript quality.

The program can control the Apple Scanner directly. Once you've captured an image, you can enhance it with sophisticated sizing and distortion tools. Create a 3D perspective. Edit bezier curves. If you need a close-up look, choose one of eight magnification levels.

Studio/1 works with PICT, MacPaint, TIFF, EPSF, PICS, and S1AN (EA's compressed animation format.)

VideoPaint/VideoPaint 32

Those with Apple, Microtek or Sharp scanners will be interested in VideoPaint, a new offering from Olduvai which can drive these capture devices directly. It's a strong 8-bit color painting program with color separation capabilities.
VideoPaint 32 is a professional 32-bit color painting and retouching application.

VideoPaint is touted for its 40 sophisticated special effects, including spherization, fractals, custom shadings and the usual blur, smudge and diffusion tools. CAD users will be familiar with the 3-D wire frame creation and rendering capabilities. You get full control over the apparent light sources and shading used to portray 3-D images.

All three of the most common color models (RGB, CMYK and HLS) are supported. VideoPaint can import MacPaint, PICT, PICT2, PixelPaint, Color TIFF and compressed LZW format files. It can export standard EPS files, gray-scale PostScript and color PostScript files.

VideoPaint is an enhanced version of GraphistPaint, a French creation marketed in the United States previously by Aba Software.

VideoPaint 32 is basically the same program, with enhanced color capabilities, color separation facilities and more advanced file import/export features.
Appendix C

Object-Oriented Software

Vector-based drawing programs are fast becoming a valued tool for art directors and artists. Even the non-artist can learn to use these packages effectively. For scanned art, programs that work with outlines and objects must have some facility for tracing the bit map. All the top packages have this facility, and you can even get autotracing with stand-alone programs like Adobe Streamline.

Each draw program has its own idiosyncrasies and strengths. I'll mention some of these in the capsules which follow.

Adobe Illustrator 3.0

Adobe Illustrator was the second drawing program I used on the Mac after MacDraw, and the transition was a bit breathtaking. This program is indeed a complex, full-featured object-oriented program that can do everything from simple line drawings to full color separations.

I'll concentrate on the features of most interest to scanner users. Adobe Illustrator can import your TIFF files with ease, especially since it has one of the best autotrace facilities of any vector-oriented program. It will also accept images created by Aldus FreeHand, Cricket Draw/Stylist, ImageStudio, PixelPaint and other packages. The converted or manipulated images can be stored in EPS format for use by PageMaker, Quark or Ready, Set, Go. An extra program called DrawOver will convert MacDraw files to Illustrator format.

The latest version added the ability to see EPS files in working mode. You simply click on Show placed images in the Preferences dialog box of the Edit Menu to view PostScript files in both Artwork and Preview modes.
Illustrator lets you use custom colors in one of two ways. You can specify colors with the Pantone Matching System or use colors that you mix and create yourself.

Illustrator is furnished with Adobe Separator, a stand-alone application that can produce color separations of Illustrator and some other PostScript files. Included is a bound color guide that explains the use of PMS colors and the Separator. If you use the PMS colors, the program will produce a separate piece of film for each Pantone color. It will convert the values to CYMK equivalents for process color. The chief limitation of this program are the skimpy collection of options provided for changing screen angles and frequencies.

Aldus FreeHand 3.0

It's hard to choose between FreeHand and Illustrator. Both are professional level tools that will satisfy artists, art directors, and others with the most stringent requirements.

FreeHand imports all the graphics you might capture or manipulate with your scanner. These include TIFF images, MacPaint graphics, PICT files, and EPS illustrations. It will convert Illustrator images to FreeHand format, so you can edit and modify individual elements. However, EPS images are not converted. You can edit the graphic as a unit, but not its individual parts. Nor can you add color to EPS graphics.

You can control the lightness, contrast and halftone screen used to reproduce bit-mapped images. You can even modify the gray scale using a built-in Gray Map (like the one found in PageMaker) and use special effects such as posterization. Color can be added to bit-mapped images with FreeHand.

The program's autotrace function will place control points around the borders of your scanned images to convert them to vector format. As with all autotracing functions, the feature works best with high contrast images. Aldus recommends posterizing or converting an image to black-and-white before autotracing.
FreeHand has extremely sophisticated color separation features, which, as you might expect, integrate well with PageMaker. FreeHand offers Pantone, RGB, and CYMK palettes and will generate color separations for outputting with an imagesetter.

The latest version added three new palettes—Layers, Colors and Styles—and an on screen palette of colors that can be accessed at any time.

FreeHand now has 100 levels of undo. A blend command lets you interpolate shapes and colors and the latest version includes expanded text commands.

It seems like a small point, but I really liked FreeHand's little guidebook, Aldus FreeHand and Commercial Printing. Only 28 pages long, it explains color separations, screens, and things like traps and overprinting (a way of compensating for any errors in misregistering multiple images) in an easily understood way. All in all, FreeHand was a little easier than Illustrator to learn. On a feature-by-feature basis, though, they compare well.

Version 3.0 also added the ability to display, separate, and print 32-bit TIFF images, and create color EPS files compatible with OPI (Open Prepress Interface) also used by high-end scanners.

CA-Cricket Stylist

There are at least two companies who liked Cricket software so much they bought the company. A while back, Xerox Corporation purchased the rights to Cricket Presents. That program has since been taken over by Computer Associates, which took on the rest of the Cricket product line.

So, CA-Cricket Stylist is nothing more than an enhanced version of Cricket Draw, a popular object-oriented drawing program for PostScript compatible devices. The latest edition was released in July, 1990, as part of a revamped CA-Cricket product line. It works with any Mac from a Plus on up,
although you'll need a color Macintosh to use all the features of the package.

Stylist may be easier to use for those who aren't accustomed to working with Bezier curves and their associated control points. Instead, you can create drawings using the familiar Line, Rectangle, and Oval tools. These objects can then be converted to Bezier paths using Stylist's conversion facility.

The program offers black-and-white, gray scale and full color support, including 32-bit color QuickDraw. It has a special color table that can hold an unlimited number of user-defined custom colors. A new color window lets you preview colors interactively on the screen.

A full set of drawing tools is provided, including a novel starburst tool to create starburst objects. A path clipping command lets you apply stencil-like effects to objects. As with many drawing programs, your Mac screen can be a window onto a much larger document that you can print out in sections. In the case of Stylist, the virtual document may be up to 55 x 55 inches.

Stylist imports files in PICT, PICT2, EPS and MacPaint formats. You can export files in PICT, PICT2, PICT with embedded PostScript, EPS, or as PostScript text files.
Appendix D

Glossary

This appendix provides you with definitions for some of the words in this book that might not be familiar to you. I tried to explain key terms in the chapters in which they first appear. Some were defined several times in the book, as I thought appropriate. Readers who are very new to desktop publishing and scanning may want to refer to the appendix often as they read this book. I've also included some common computer terms not used in this book that you'll encounter in your use of desktop publishing and scanners.

Antialiasing: A process which can be used to remove jaggies or stair-stepping in an image. Antialiasing smooths out diagonal lines.

Applications program: Software, such as a word processing program, spreadsheet, or database manager that performs useful work not directly related to the maintenance or operation of the computer. Quark XPress and PageMaker are applications programs.

Archive: To store files that are no longer active. Programs like Stuffit combine and compress files into an archive file for more compact, easier storage.

Aspect ratio: The relative proportions of the length and width of an image. For example, if you scan an original that measures 4 x 6 inches, it will have an aspect ratio of 4:6 or 2:3. To keep the same proportions, you would place it in your desktop publishing document with dimensions that follow the
same ratio. That is, it could be sized at 2 x 3 inches, 1.5 x 2.25 inches, etc. CRT screens and printers also have aspect ratios.

**Asynchronous:** A communications method under which exact timing of the signals is not critical: the next set of information is sent whenever a confirmation signal is received. This is the opposite of synchronous communications, which send out data within an exact block of time. Macintosh computers most commonly use asynchronous communications, such as with modems, to exchange data over distances of more than a few feet. Some scanners communicate with your computer in this way.

**Autotrace:** A feature found in many object-oriented image editing programs to allow you to trace a bit map image and convert it to an outline or vector format.

**Backup:** To make a copy of computer data as a safeguard against accidental loss. The copy that is made is also called the backup.

**Baud:** A data transmission rate of 1 bit per second, used to measure asynchronous communications speed.

**Bezier curve:** A cubic polynomial in mathematical terms or, simply, a way of representing a curve that allows great flexibility in manipulating the curve. Bezier curves are adjusted using endpoints and anchor points. The control points are the four direction points at the ends of the two direction lines that are tangent to the curve. Named after Pierre Bezier, who presumably understood all that.

**Bilevel:** In scanning, a binary scan that stores only the information that tells whether a given pixel should be represented as black or white.

**Binary:** Base-two arithmetic, which uses only 1's and 0's to represent numbers. 0001 represents 1 decimal, 0010 represents 2 decimal, 0011 represents 3 decimal, etc. In scanning, a black-and-white image.
Bit: A binary digit, either a 1 or a 0. Scanners typically use multiple bits to represent information about each pixel of an image. A 1-bit scan can store only black or white information about a pixel. A 2-bit scan can include four different gray levels or values: 00, 01, 10, or 11. Other values include:

- 4 bits 16 gray levels
- 5 bits 32 gray levels
- 6 bits 64 gray levels
- 7 bits 128 gray levels
- 8 bits 256 gray levels

Bit map: A representation of an image in row and column format in which each individual pixel is represented by a number. A single bit or up to as many as 32 can be used with each increment representing a larger amount of gray or color information about the pixel.

Bounding Box: A box shown on the screen in place of a graphic, as when an EPS file without an image header representation of the image is loaded into PageMaker.

Brightness: The balance of light and dark shades in an image.

Buffer: An area of computer memory set aside to store information meant for some sort of I/O, such as printing or writing to disk. This allows the device supplying the information to feed it into memory faster, if necessary, than the device meant to accept it can handle it. A printer buffer, for example, allows an applications program to quickly dump a document for printing and then go on to something else. The buffer can then feed the information to the printer at a slower rate. In scanning, buffers are often used to store images awaiting processing.

Bug: An error in a program that results in some unintended action.

Byte: Eight bits, which can represent any number from 00000000 to 11111111 binary (0 to 255 decimal).
Cache: A memory buffer used to store information read from disk to allow the operating system to access it more quickly. Cache programs use various schemes to make sure that the most frequently accessed sectors, as well as the most recently accessed sectors, remain in the buffer as long as possible.


Camera ready: Art work that is printed in hardcopy form and ready for photography to produce negatives or plates for printing.

CD-ROM: Compact Disk-Read Only Memory. An optical disk mass storage device that, like all optical disks, uses pits written on the disk by laser to convey information. CD-ROMs are encoded with information during manufacture and cannot be written to by the user. They provide a means of distributing large databases on a compact medium.

Character: An alphanumeric character, punctuation mark, or other symbol available from the Mac keyboard.

CCD: Charge-Coupled Device. A type of solid state sensor used in scanners and video capture devices. Compared to older imaging devices, including video tubes, CCD’s are more sensitive and less prone to memory problems that can cause blurring of images.

Clip art: Artwork that is purchased or otherwise available for scanning or other uses in desktop publishing with few restrictions.

Clipboard: A memory buffer in the Macintosh that can hold images and text so they can be freely interchanged within and between applications.

CYMK Color Model: A model that defines all possible colors in percentages of cyan, magenta, yellow, and black.
Color separation: Four representations of an image such that each color is given individually. Color separations are used to produce printing plates that will reproduce a color image on a printing press.

Concatenate: To add together.

Contrast: The range between the lightest and darkest tones in an image.

Control character: A nonprinting character used to send information to a device, such as the control characters used to communicate special formatting commands to a printer.

Contiguous: In reference to hard disks, contiguous sectors are those that are arranged consecutively on the disk. DOS tries to allocate sectors to a file contiguously so that the disk drive can read as many sectors of a file as it can with a minimum of read/write head movement. However, as a hard disk fills, the unallocated sectors gradually become spread out and fragmented, forcing the operating system to choose more and more noncontiguous sectors. Fragmented files can be much slower to access.

Coprocessor: An additional microprocessor used in tandem with the main processor. A Macintosh can include a math coprocessor designed to offload number crunching tasks from the main microprocessor, producing much faster operation for applications involving much computation, such as autotracing.

Crop: To trim an image or page by adjusting the side, top, or bottom boundaries.

Crop mark: Marks placed on a page that is larger than the finished page to show where the page should be trimmed to final size.

Cursor: A symbol that indicates the point at which the next action the user takes—text entry, line drawing, deletion, etc.—will begin; the current screen display position.
**Default:** A preset option or value that is used unless you specify otherwise.

**Diffusion:** The random distribution of gray tones in an area of an image, often used to produce a mezzotint effect.

**Digitize:** To convert information, usually analog information, such as that found in continuous tone images (or music), to a numeric format that can be accepted by computers.

**Digitizer:** A device that converts analog data to numeric format. Video cameras are a sort of digitizer. Another type of digitizer would be an input pad that enters coordinates of an image into a computer (usually found in CAD applications).

**DMA:** Direct Memory Access. This term refers to the movement of data directly from memory to some other device, such as the disk drive, without first being loaded into the microprocessor.

**Dithering:** A method of simulating gray tones by grouping the dots shown on your CRT display or produced by your printer into large clusters of varying size. The eye merges these clusters and the surrounding white background into different tones of gray.

**Dot:** A unit used to represent a portion of an image. A dot can correspond to one of the pixels used to capture or show an image on the screen, or groups of pixels can be collected to produce larger printer dots of varying sizes to represent gray.

**Dots per inch:** The resolution of an image, expressed in the number of pixels or printer dots in an inch. Abbreviated dpi.

**Download:** To receive a file from another device. For example, soft fonts are downloaded from your computer to your printer.

**Dummy:** A rough approximation of a publication, used to gauge layout.

**Dynamic RAM:** Type of memory that must be electrically refreshed many times each second, or else the contents will be
lost. The Macintosh uses dynamic RAM to store programs, data, and the operating system.

**Encapsulated PostScript**: An outline-oriented image format that represents graphics and text in terms of descriptions of how to draw them.

**Escape**: A special key that produces the ASCII code 27, which represents the Escape character. Many programs use this code to back out of, or escape from, menus.

**Export**: To transfer text or images from a document to another format.

**File**: A collection of information, usually data or a program.

**Fixed disk**: Another name for a hard disk drive, so-called because such disks are not commonly removed from the computer while in use.

**File-oriented backup**: Any backup system that stores information in files, just as they are stored on the disk. Such a system allows easier access to and restoration of a particular file.

**FPO**: For Position Only. Artwork deemed not good enough for reproduction, used to help gauge how a page layout looks.

**Four-color printing**: Another term for process color, in which cyan, magenta, yellow, and black colors are used to reproduce all the hues of the spectrum.

**Frame grabber**: A device that captures a single field of a video scanner or camera.

**Frequency**: The number of lines per inch in a halftone screen.

**Gigabyte**: A billion bytes of information; a thousand megabytes. Only ten 8.5 x 11-inch full color images scanned at 600 dpi would to fill up a gigabyte of disk space.

**Gray scale**: The spectrum of different gray values an image can have.
Gray Component Enhancement: When a spot in an image has some common amount of gray in the cyan, magenta and yellow separations, that amount of gray can be removed and replaced by black to produce more vivid colors.

Handles: Small squares that appear in the corners (and often at the sides) of squares used to define an area to be scanned or an object in an image editing program. The user can grab the handles with the mouse cursor and resize the area or object.

Halftoning: A method for representing the gray tones of an image by varying the size of the dots used to show the image.

Hardware: The physical components of a computer system, including the CRT, keyboard, microprocessor, memory, and peripherals.

Hexadecimal: The base-16 number system, used with computers to make binary information easier to interpret by humans. The numbers 0 to 16 are represented by the numerals 0 to 9, plus A, B, C, D, E, and F. An 8-bit byte storing a number from 0 to 255 can readily be represented by the hexadecimal values 0 to FF.

Hierarchical: In hard disk terminology, the structuring of directories such that each subdirectory has one parent, but may have several child directories, branching out in a tree-like structure.

Histogram: A bar-like graph which shows the distribution of gray tones in an image.

HPGL: Hewlett-Packard Graphics Language. Used to define images to be printed with plotters.

HSB color model: A model that defines all possible colors by specifying a particular hue and then adding or subtracting percentages of black or white.

Hue: In technical terms, the position a given tone occupies within a spectrum or around a color wheel.
Imagesetter: A high resolution PostScript printer that creates camera-ready pages on paper or film.

Image-oriented backup: Any backup system that creates a mirror image of the disk, without regard to the files themselves. With such a system, the entire disk must be restored from the backup medium to allow access to the files.

Input: Incoming information. Input may be supplied to the computer by the user, or to a program either by the user or a data file.

Interpreter: A program that interprets and carries out each line of another program written in a high level language like BASIC or COBOL. These languages can also be compiled so that the operating system can carry out the commands directly. PostScript interpreters for printers perform the same function with the instructions found in PostScript files.

I/O: Input/Output. Used to describe the process whereby information flows to and from the microprocessor or computer through peripherals such as scanners, disk drives, modems, CRT screens, and printers.

Interrupt: A signal to the microprocessor to stop what it is doing and do something else. An action as simple as pressing a key can generate an interrupt.

Instructions: The basic set of capabilities of a microprocessor, which allows the chip to load information into a register, move it to another register, increment the data, add or subtract data from a register, and so forth.

Intelligent: Having sufficient programming built-in to carry out certain tasks independently. An intelligent disk drive can accept requests from the operating system, locate the data, and deliver it without detailed instructions on how to do the physical I/O.

Interactive: Allowing user input during run-time.
**Jaggies:** Staircasing of lines that are not perfectly horizontal or vertical. Jaggies are produced when the pixels used to portray a slanted line aren't small enough to be invisible.

**K:** Kilobyte. In computer terminology, 1024, so that 16K represents 16,384; 64K equals 65,536; 512K corresponds to 524,288; and so on.

**Landscape:** The orientation of a page in which the longest dimension is horizontal.

**Line art:** Usually, images that consist only of black-and-white lines.

**Line screen:** The resolution or frequency of a halftone screen, expressed in lines per inch. Typical line screens are 53 to 150 lines per inch.

**Lines per inch:** Abbreviated lpi, lines per inch is the yardstick used to measure halftone resolution.

**Lithography:** Another name for offset printing, which is a reproduction process in which sheets or continuous webs of material are printed by impressing them with images from ink applied to a rubber blanket on a rotating cylinder from a metal or plastic plate attached to another cylinder.

**Logical:** Any feature not physically present, but defined anyway for convenience. The physical sectors on a hard disk are arranged contiguously. Logically, they may be arranged in alternating fashion through interleaving.

**Low level formatting:** The most basic formatting done on the hard disk to prepare it for partitioning and high level formatting. This is often done by the manufacturer, which locks out bad sectors at this time.

**Macro:** A series of commands that can be triggered at the press of a key or two.

**Marquee:** A moving dotted line around a selected portion of an image.
Mask: Covering part of an image so it will not be affected by an operation, such as airbrushing.

Mass storage: Permanent storage of computer information, usually on magnetic disk but can also include magnetic tape, optical disk, bubble memory, and other nonvolatile storage media.

Mechanical: Camera-ready copy with text and art already in position for photographing.

Mezzotint: An engraving that is produced by scraping a roughened surface to produce the effect of gray tones. Image editing and processing software can produce this effect with a process called error diffusion.

Microprocessor: The computer-on-a-chip that is the brains of a personal computer.

Millisecond: One-thousandth of a second.

Moire: In scanning, an objectionable pattern caused by the interference of halftone screens. Often produced when you rescan a halftone and a second screen is applied on top of the first.

Mouse: A pointing device used to indicate an area or point on the screen.

Multi-bit: Any scan that uses more than one bit to store information about a pixel.

Multitasking: The ability of a computer system to handle several different chores simultaneously. Since microcomputers have only one main processor, this is usually done by slicing processor time into individual segments and allowing the programs to share the slices in rotation.

Multiuser: The ability of a computer system to handle several different tasks performed by several different users simultaneously. UNIX is the best-known multitasking system among microcomputer users, although it is also available for larger systems.
Object graphics: Vector-oriented graphics, in which mathematical descriptions, rather than bit maps, are used to describe images.

OCR: Optical Character Recognition. The process of converting printed characters into the actual ASCII characters and other attributes of a bit-mapped image of text.

Offset printing: See lithography.

Omnifont: The ability of an OCR program to recognize most fonts without the need to learn that font. Often associated with systems using feature extraction.

Overlay: A sheet laid on top of another to specify spot colors for printing. In programming, a portion of a program that is called into memory as needed, overlaying the previous redundant section of the program. Overlays allow writing programs that are much bigger than those which could fit into memory all at once.

Page description language: A programming language that can be used to tell a printer how to handle a given page. PostScript is the most widely known page description language for computers.

Pantone Matching System: A system for specifying colors. If you tell your printer the PMS number you want, the color can be reproduced exactly by mixing printing inks to a preset formula.

Parameter: A qualifier that defines more precisely what a program such as Quark or PageMaker is to do.

Parallel: To move data several bits at a time, rather than one at a time. Usually, parallel operation involves sending all eight bits of a byte along eight separate data paths at one time. This is faster than serial movement. Most scanners use parallel connections to move image information.

Path: A listing of directory names in an order that defines the location of a particular file.
Peripheral: Any hardware part of a computer system other than the microprocessor itself and its directly accessible memory. We usually think of peripherals as printers, modems, etc.

Phototypesetting: A process used to expose text and/or images onto materials that will later be used to produce printing plates. Phototypesetters generally have much higher resolutions than laser printers.

Physical: A feature that exists in reality.

PICT: A graphic image and file format used by the Macintosh and its Clipboard. PICT2 is an enhanced version, which can be used in both 8-bit and 24-bit formats.

Pixel: A picture element of a screen image; one dot of the collection that makes up an image.

Point: Approximately one seventy-second of an inch, except in the Macintosh world in which a point is exactly one seventy-second of an inch. Points are used by printers to measure things like type.

Port: A channel of the computer used for input or output with a peripheral. The serial and parallel ports of the computer are the most widely used. A scanner interface board includes a special port that the scanner can use to communicate with the computer.

Portrait: The orientation of a page in which the longest dimension is vertical.

Position stat: A copy of a halftone which can be placed on a mechanical to illustrate positioning and cropping of the image.

Posterization: A photographic effect produced by reducing the number of gray tones in an image to a level in which the tones are shown as bands, as on a poster.

PostScript: Developed by Adobe Systems, PostScript is the most widely used page description language for computers. It
provides a way of telling the printer, typesetter, or imagesetter how to generate a given page.

**Printer command language:** As in Hewlett-Packard Printer Command Language (HPCL). The instructions used to drive HP LaserJet printers and compatibles.

**Process camera:** A graphic arts camera which is used to make color separations and photograph original artwork to produce halftones and page negatives, and to perform other photographic enlarging/reducing/duplicating tasks.

**Process colors:** Cyan, magenta, yellow, and black. The basic ink colors used to produce all the other colors in four-color printing.

**Program:** Code that instructs the computer how to perform a function.

**Proof:** A test copy of a printed sheet, which is used as a final check before a long duplication run begins.

**QuickDraw:** A graphics language built into the read-only memory of the Macintosh.

**Raster image:** An image defined as a set of pixels or dots in row and column format.

**Read-Only Memory:** Memory that can be read by the system, but not changed. Abbreviated ROM, read-only memory often contains system programs that help the computer carry out services.

**Registers:** The basic memory locations of a microprocessor, through which all information that is processed pass.

**Register:** To align images, usually different versions of the same page or sheet. Color separation negatives must be precisely registered to one another to insure that colors overlap in the proper places.

**Register marks:** Small marks placed on a page to make it possible to align different versions of the page precisely.
RGB color model: A way of defining all possible colors as percentages of red, green, and blue.

RIP: Raster Image Processor. A device found in printers that converts page images to a format that can be printed by the marking engine of the printer.

RISC: Reduced Instruction Set Computer. A computer system that has a special microprocessor that processes fewer instructions and which, therefore, operates faster. Such systems depend on the software for functions that formerly were handled by the microprocessor.

Saturation: The purity of a color, or the degree to which it is diluted with white or gray. A highly-saturated color is one that contains little white; a less-saturated color looks washed out.

Scale: To change the size of a piece of artwork.

Scanner: A device that captures an image of a piece of artwork and converts it to a bit-mapped image that the computer can handle.

Screen: The halftone dots used to convert a continuous tone image to a black-and-white pattern that printers and printing presses can handle. Even expanses of tone can also be reproduced by using tint screens that consist of dots that are all the same size (measured in percentages: a 100 percent screen is completely black).

Screen angle: The alignment of rows of halftone dots, measured from the horizontal (which would be a zero degree screen angle).

SCSI: Small Computer Systems Interface. An intelligent interface, used for some scanners (particularly in the Macintosh world) and for other devices, like hard disk drives.

Sector: The smallest section of a track, containing 512 bytes of data.
Separations: Film transparencies, each representing one of the primary colors (cyan, magenta, and yellow) plus black, used to produce individual colors of printing plates.

Serial: Passing information one bit at a time in sequential order. Some scanners use serial connections.

Sharpening: A process for increasing the contrast between neighboring colors or tones to boost clarity.

Shell: A program layer designed to simplify things for the user. Often provides menus to replace a cumbersome command-line interface.

Source code: The program code generated by a programmer, which may not be directly executable by the computer. If not, it is translated by an assembler or compiler into machine language object code.

Spot color: Individual colors used on a page. Usually limited to one or two extra colors besides black to accent some part of a publication.

Static RAM: Memory that does not need to be refreshed and which, therefore, does not lose its contents when power to the computer is turned off.

String: A series of characters.

Strip: To assemble a finished page by taping or otherwise fastening pieces of film containing halftones, line art, and text together in a complete page negative or positive. The most common format is as a negative, because dirt and other artifacts show up as pinholes which can be easily spotted or opaqued out before the printing plates are made.

System level interface: An interface over which information is passed in logical form.

TARGA: A file format created by Truevision image capture boards, compatible with NTSC standards. TARGA is an acronym for Truevision Advanced Raster Graphics Adapter.

Text file: Usually an ASCII file.
Threshold: A predefined level used by the scanner to determine whether a pixel will be represented as black or white.

TIFF: Tagged Image File Format. A standard graphics file format which can be used to store gray scale and color images.

Toner: A pigmented substance used in page printers (and office copiers) to produce an image on a page.

Unfragmented: A hard disk that has most of its files stored in consecutive sectors rather than spread out over the disk. Such an arrangement allows more efficient reading of data with less time required to move the read/write head to gather the information.

Utility: A program that performs some useful system or maintenance function, as opposed to an applications program.

Vector image: An image defined as a series of straight line vectors. The beginning and ending points of each line are stored and later adjusted as the image is sized.

Virtual disk: An electronic, or RAM, disk created in memory to mimic a real disk drive—only much faster.

WORM: Write Once Read Many (or Mostly). Optical disk technology that allows writing to the disk by the user, although a given section cannot be erased and re-used.

Zoom: To enlarge part of an image so that it fills the screen, making it easier to work with that portion.
Appendix E

Manufacturers' Addresses

OCR Products:

Caere Corp
100 Cooper CT
Los Gatos, CA 95030
OmniPage
One of the leading omnifont OCR packages.

CTA, Inc.
866 Second Ave.
New York, NY 10017
TextPert
An efficient, useful OCR program for the Macintosh.

Datacap, Inc.
Five West Main
Elmsford, N.Y. 10523
Paper Keyboard
One of the newest OCR packages: this one is geared to read hand-writing, for special applications.
Inovatic
1911 N. Fort Meyer Dr. #708
Arlington, VA 22209
**ReadStar II Plus**
OCR software that is reasonably priced.

Olduvai Corp.
7520 Red Rd.
Suite A
South Miami, FL 33143
**Read-It OCR software**
An OCR package available for both IBM computers and Macintoshes, in versions for conventional and hand scanners.

**Monitors:**

Moniterm
5740 Green Circle Dr.
Minnetonka, MN 55343
**Viking monitors**
One of the pioneer full-page monitor vendors. I used the Moniterm Viking G/S extensively to prepare this book. They also have a full line of landscape and portrait monitors without gray scale capabilities, as well as a high resolution large screen color monitor.

Radius Inc.
1710 Fortune Dr.
San Jose, CA 95131
Radius monitors

Sigma Designs, Inc.
46501 Landing Pkwy.
Fremont, CA 94538

*Silverview 21-inch monochrome display system.*
Another two-page monitor. Expensive, but worth it.

Scanners:

Abaton

48431 Milmont Dr.
Fremont, CA 94538

*Abaton scanners*

Barneyscan Corp.
1125 Atlantic Ave.
Oakland, CA 94501

*Barneyscan slide scanner*

Canon USA, Inc.
One Canon Plaza
Lake Success, NY 11042

*Canon scanners*

Canon invented several scanner engines used in a number of well-known scanners, but they're no longer alone in the field.
Chicony America Inc.
1641 W. Collins Ave.
Orange, CA 92667

Chicony IS-8105 Handy Scanner

Chinon America, Inc.
660 Maple Ave.
Torrance, CA 90503

DS-3000 scanner
One of the few low cost overhead scanners, the Chinon line is particularly easy to use and flexible.

CompuScan Inc.
300 Broadacres Dr.
Bloomfield, NJ 07003

CompuScan scanners

Eikonix
32 Wiggins Ave.
Bedford, Ma. 01730

Eikonix 1412 slide scanner
Eikonix 1435 slide scanner

Fujitsu America, Inc.
3055 Orchard Dr.
San Jose, CA 95134

Fujitsu Image Scanner
Hewlett-Packard
19310 Pruneridge Ave.
Cupertino, CA 95014

**HP ScanJet Plus**
The latest edition of the first scanner many desktop publishers ever used. Now scans 256 gray levels and features more flexible operation.

Howtek, Inc.
21 Park Ave.
Hudson, NH 03051

**Scanmaster scanners**
Offers some sophisticated color scanners based on Sharp designs.

KYE International Corp.
769 Pinefalls Ave.
Walnut, CA 91789

**Genius Scanner**
A versatile hand scanner, which comes with software that lets you merge images wider than the scanner can handle alone.

Kyocera Unison, Inc.
1321 Harbor Bay
Alameda, CA 94501

**Kyocera scanners**
Logitech, Inc.
6506 Kaiser Dr.
Fremont, CA 94555

Logitech Hand Scanner
One of the leaders in hand scanner technology. The Logitech hand scanner uses a yellowish light source that isn’t blind to reds like some competitive models.

Microtek Lab, Inc.
680 Knox St.
Torrance, CA 90502

Microtek MSF-300Z scanner
Microtek MSF-300G scanner
The 300G model is indisputably one of the two or three most popular, capable, and feature-rich scanners available. It provides 256 gray levels. The up-and-coming 300Z version was the fastest-selling scanner on the market in the opening months of 1990. It is both a 256 gray-level black-and-white scanner and a color scanner, priced only a little more than a gray scale-only scanner.

Mitsubishi Electronics America Inc.
Computer Peripherals Division
991 Knox St.
Torrance, CA 90502

Mitsubishi Scanners
Appendix E: Manufacturers' Addresses

Nikon, Inc.
Electronic Imaging
623 Stewart Avenue.
Garden City, N.Y. 11530

**Nikon LS-3500 slide scanner**
A flexible, easy to use slide scanner that calibrates itself automatically each time you use it.

NISCA, Inc.
1919 Old Denton Rd.
Carrollton, TX 75006

**Niscan scanner**

Panasonic Industrial CO
Two Panasonic Way
Secaucus, NJ 07094

**Panasonic scanners**

Ricoh Corporation
Peripheral Products Division
3001 Orchard Pkwy.
San Jose, CA 95134

**Ricoh RS320 scanner**

Saba Technologies
9300 S.W. Gemini Dr.
Beaverton, OR 97005

**Saba PageReader**
Sharp Electronics Corp.
Sharp Plaza
Mahwah, NJ 07430

**JX100 Scanner**

**JX-300 Personal Color Scanner**

**JX-450 Professional Color Scanner**

**JX-600 Commercial Color Scanner**

The JX-100 is the first hand-held color scanner for less than $1000. At this writing, the JX100 isn't widely available yet, but it could be a very important product. The other Sharp color scanners are tried-and-true professional quality workhorses.

Thunderware
21 Orinda Way
Orinda, CA 94563

**Lightning Scan**

Thunderscan

Lightning Scan is a nice hand scanner; Thunderscan is a pioneering scanner for the Macintosh Imagewriter. Both are low cost solutions for those who want scanning capabilities, but don’t want to spend a lot.

Truvel Corp.
8943 Fulbright Ave.
Chatsworth, CA 91311

**Truvel scanners**

If you’re looking for a color scanner and have a lot of money, start with this product line.
Xerox Imaging Systems
1215 Perra Bella Ave.
Mountain View, CA 94043
730 G/S Scanner
Becoming one of the standards in gray scale scanning. Available bundled with a variety of OCR and image-editing packages.

Desktop Publishing Software:

Aldus Corp.
411 First Ave. S.
Suite 200
Seattle, WA 98104
PageMaker 4.0
An easy to use publishing package from the folks who started an entire industry. Greatly enhanced in the latest version, with former Color Extension features now built-in.

Quark, Inc.
300 S. Jackson St.
Suite 100
Denver, CO 80209
QuarkXPress 3.0
So sophisticated, it’s scary. Had a virtual monopoly on advanced color separation capabilities in Macintosh desktop publishing world for a long time. A great tool for working with scanned images.
Letraset USA
40 Eisenhower Dr.
Paramus, NJ 07653
Ready, Set, Go
Design Studio
An early desktop publishing program for the Mac. It was my first, abandoned only when the frequent upgrades started to get expensive. Still easy to use. Design Studio is an enhanced program with added color editing and separating capabilities.

Video Capture Tools:

Data Translation
100 Lock Dr.
Marlboro, MA 01752
Video Capture boards
If it involves video capture and image editing for either the Macintosh or IBM, these folks know how to do it. Their product line is too extensive to list here. Color and monochrome versions are available.

Digital Vision, Inc.
66 Eastern Ave.
Dedham, MA 02026
ComputerEyes
A low cost video capture board. You get full gray scale images and some nifty image processing capabilities. In exchange for the low price, you give up real-time capture. Grabbing an image takes about six seconds, so you must place your
BUSINESS ONE IRWIN is dedicated to providing you with the most timely, authoritative, and comprehensive computer guides to meet your personal and professional needs. Our goal is to offer you excellent reference tools written by experienced, highly-qualified authors. Please take a moment to answer the following questions so that we can continue to develop our products based on your needs.

Thank you.

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Name _______________________
Title _______________________
Organization _______________________
Address _______________________
City/State/Zip _______________________
Telephone _______________________

□ Please send a catalog of Business One Irwin books.
video camera on a tripod. Lets you save your images in TIFF formats.

Koala Technologies, Inc.
269 Mt. Hermon Rd.
Scotts Valley, CA 95066

**MacVision**
One of the pioneers of Mac video capture and still one of the most flexible, lowest cost systems.

Orange Micro, Inc.
1400 N. Lakeview Ave.
Anaheim, CA 92807

**Personal Vision**
Low cost video frame grabber system.

Truevision, Inc.
7351 Shadeland Station
Suite 100
Indianapolis, IN 46256

**Targa 16, TIPS Imaging Software**
The inventors of Targa and the place to start if you want Targa-compatible products.
Printers, Printer Enhancements, and Miscellaneous Products:

Abaton
48431 Milmont Dr.
Fremont, CA 94538

**InterFAX 12/48**
Relatively low cost 4800-baud fax modem with built-in 1200-baud Hayes compatible modem. Offers fast conversion and background operation for under $500.

Altsy s Corp
720 Avenue F
Suite 109
Plano, TX 75074

**Fontographer**
Sophisticated tool for making your own PostScript fonts from scanned images or existing fonts.

Broderbund Software, Inc.
17 Paul Dr.
San Rafael, CA 94903

**Typestyler**
Another font creation program at a lower price (less than $200), intended for making special font effects for logos, presentations, and desktop publications.
Custom Applications, Inc.
900 Technology Park Dr.
Bldg. 8
Billerica, MA 01821

**Freedom of Press**

Iomega Corp.
1821 West 4000 South
Roy, UT 84067

**Bernoulli Box II**

Once you start handling large graphics files, a Bernoulli Box becomes almost a necessity. There's almost no alternative; tape drives and removable hard disks don't have the same combination of speed, easy access, and reliability.

Itek Graphix
34 Cellu Dr.
Nashua, NH 03063

**IGX 7000 PS Imagesetter**

A leading typesetter manufacturer.

Lasermax Systems
7150 Shady Oak Rd.
Eden Prairie, MN 55344

**Lasermax 1000 Plain Paper Typesetter**

A relatively low cost high resolution printer.
LaserMaster Corp.
7156 Shady Oak Rd.
Eden Prairie, MN 55344

**LaserMaster printer, and boards**

These products turn your HP LaserJet Series II, or any printer using the same Canon engines, into a 600 dpi output device. Versions are available for AT-bus, Micro Channel, and Macintosh II systems.

Linotype
425 Oser Ave.
Hauppauge, NY 11788

**Linotronic imagesetters**

The standard typesetting device by which others are frequently judged. Your service bureau probably uses a Lino, and you should too if you have enough DTP output to justify the expense.

Pantone Press, Inc.
55 Knickerbocker Rd.
Moonachie, NJ 07074

**Pantone Matching System**

Innovators of a color system used by many DTP packages.

Solutions International
30 Commerce St.
Williston, VT 05495

**BackFAX software**

Replacement software for the AppleFAX modem that provides faster speed and background operation.
STF Technologies
PO Box 247
Higginsville, MO 64037
FAXstf
A pocket-sized fax modem with 4800-baud operation but no polling capabilities.

Varityper
11 Mt. Pleasant Ave.
East Hanover, NJ 07936
VT600, VT600W printers
Another one of the "Big Three."
One of the fastest PostScript interpreters. Works with nearly any printer, including all HP LaserJet compatibles and an impressive list of dot matrix models.

Adobe Systems, Inc.
1585 Charleston Rd.
Mountain View, CA 94039
Adobe PostScript Cartridge
Provides true PostScript compatibility from the folks who invented this page description language.
Studiotronics, Inc.
436 Lakeview Office Park
Building 2
1031 S. Semoran Blvd.
Winter Park, Fl. 32792

**Colorset software**
This product turns just about any gray scale scanner into a color scanner — for less than $400.

**Image Manipulation Software:**

**Aldus**
411 First Ave. S.
Suite 200
Seattle, WA 98104

**Freehand**
A veteran, capable drawing program. Imports EPS, PICT, and TIFF files; exports to Quark XPress and PageMaker.

Adobe Systems, Inc.
1585 Charleston Rd.
Mountain View, CA 94039

**Illustrator, Streamline**
Illustrator is an advanced drawing program available for both PC computers and Macintoshes. It includes an autotrace feature that can also be obtained in Streamline, a stand-alone program.
Appendix E: Manufacturers’ Addresses

Claris Corp.
440 Clyde Ave.
Mountain View CA 94043

**MacPaint II**
This is the latest version of the program that started the image manipulation revolution for the Macintosh. Has some nice features not available with older version of MacPaint, including ability to open and work with more than one file at a time.

Data Translation
100 Lock Dr.
Marlboro, MA 01752

**Photo Mac**
High end color image editing software. You can work with color images and prepare them for color separating with another Mac tool, such as Quark XPress.

Deneba Systems, Inc.
3305 Northwest 74th Ave.
Miami, Fl 33122

**Canvas 3.0**

**UltraPaint**
Two leading packages for working with scanned images. Canvas 2.1 lets you manipulate both bit-mapped and vector graphics, while UltraPaint is a top color painting program for the MacSE/30 and Mac II with color monitors.
Innovative Data Design
2280 Bates Ave., Suite A
Concord, CA 94520

Dreams
This full color drawing program has many CAD-style features. For example, it includes a parallel-lines tool that designers will find useful for drawing HVAC (heating, ventilation, air conditioning) lines, pipes and other similar features.

Letraset USA
40 Eisenhower Dr.
Paramus, N.J. 07653

Image Studio
Sophisticated image-editing software. One of the top two or three programs.

MacroMind, Inc.
410 Townsend St. #408
San Francisco, CA 94107

MacroMind Director
Top-flight color animation programs for Mac users with the CPU and hard disk capacity to handle this stuff.

MicroFrontier, Inc.
7650 Hickman Road
Des Moines, IA 50322

Enhance
A powerful continuous tone image editing package for the Macintosh II. Has more than 75 different filters. You can create your own color palettes. Built-in help is very useful.

Microsystems Engineering Corp.
2400 W. Hassell Rd.
Suite 400
Hoffman Estates, IL 60195

**Mass 11 Draw.**
Good color support for a draw program. Available in versions for Mac and IBM systems.

Olduvai Corp.
7520 Red Rd.
Suite A
South Miami, FL 33143

**VideoPaint**
A new 8-bit color painting program with 40 special effects, built-in color separating capabilities, and drivers for Apple, Microtek, and Sharp scanners.

Paracomp
123 Townsend St.
Suite 310
San Francisco, CA 94104

**Swivel3D**
A three-dimensional animation program you can use to create a world in which objects cast shadows and colored images can be wrapped onto the surface of an object.
Silicon Beach Software, Inc.
9770 Caroll Center Rd. #J
San Diego, CA 92126
Digital Darkroom
SuperPaint
Two top image manipulation packages.

SuperMac Technology
485 Potrero Ave.
Sunnyvale, CA 94086
PixelPaint
PixelPaint Professional

MicroIllusions
17408 Chatsworth St.
Granada Hills, CA 91344
Photon Paint
A color paint program for Mac II systems. Supports only PICT files and doesn’t include the CYMK color model. Allows multiple windows up to RAM limits.

Electronic Arts
1820 Gateway Dr.
San Mateo, CA 94404
Studio/8
Studio/1
Studio/32
Computer Friends, Inc.
14250 N.W. Science Park Dr.
Portland, OR 97229

Modern Artist

Zedcor
4500 E. Speedway
Tucson, AZ 85712

DeskPaint

A good paint program provided as a desk accessory. That allows you to use it from within desktop publishing programs like PageMaker and Ready, Set, Go, even if you aren’t using MultiFinder. DeskPaint imports and exports MacPaint and TIFF images.
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THE COMPLETE SCANNER HANDBOOK FOR DESKTOP PUBLISHING, 1991-1992
Macintosh® Edition
David D. Busch

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About the Author . . .

David D. Busch brings his unique perspective to these topics. A former commercial photographer with extensive experience in creating images, he also was the first two-time winner of "Best Book" honors from the Computer Press Association. His articles have appeared in magazines as diverse as Petersen's PhotoGraphic and The Professional Photographer to Personal Computing. Busch is the author of over 30 computer books, including Inside Secrets of MacWrite, MacPaint, and MacDraw.