MASTERING GRAPHICS ON THE MACINTOSH

DAN McNEILL

The one-stop guide to *MacDraw*, *MacPaint*, and *HyperCard* graphics. Covers business and presentation graphics, as well as desktop publishing.

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To Mike and Sue Elwell

Contents

Foreword

How many of us have suffered through a presentation or desktop publication created with more enthusiasm than skill? Wouldn't it be great if there were a guide to help people avoid the pitfalls of poor balance and poor choice of type and layout? But even better, what if there were a guide somewhere that helped beginners not merely to avoid the sinkholes and morasses, but went on to inform them on injecting style, energy, and good, old-fashioned pizzazz into their presentation or desktop publishing?

This is it. Author Dan McNeill has provided the secrets necessary to create attractive, interesting, and energetic Macintosh Graphics in his latest COMPUTE! book, *Mastering Graphics on the Macintosh.*

Starting with an introduction to the Macintosh as a graphics platform, McNeill introduces you to graphics software and the standard graphics formats. Then he turns to the use of the specific software packages *MacPaint, MacDraw,* and *HyperCard.* Learn about the tools available and how to use them to the limits of their power. Learn about perspective, shadow, and texture, capturing reality, and using color.

Learn how to import art into the Macintosh by manual copying, or using clip art and digitizers.

When you master the software and hardware that help you create art on the Macintosh, put your skills to work creating vivid, powerful presentations complete with script, charts, visuals, diagrams, and illustrations—all presented via overhead transparencies, slides, computer screen images, and handouts.

If you're interested in using your Macintosh graphics in the desktop publishing world, you're in luck. Desktop publishing is covered in full, including explanations of the best use of typography, trademarks, logos, and page design. Learn how to take control of the reader's eye with layout and white space.

Should your text be laid out in columns? What can you do to improve readability? What's the best alignment for your work—ragged right or fully justified? What's the proper use of borders, lists, subheads, readouts?

What about printers? When it comes time to put your work on paper, what kind of computer printer will make the best original? What kind of printing should you use when you want to distribute your work to the masses?

If you know the answers to these questions and follow the simple rules provided in this book, your readers will be able to tell; and the credibility of your creation will be enhanced.

Let Dan MacNeill help you create your graphics; then print, present, and distribute them with class. It's all here for you in one book.

Preface

The Macintosh was the first graphics computer for the desktop, but in recent years its power has bloomed—and more like fireworks than a flower. Yet it's one thing to have the power to create wonderful graphics and another to understand how to use it. In fact, the Macintosh is rather deceptive. It makes creating graphics so easy we think we can do it all, and all by ourselves. In fact, you can do a remarkable amount very easily, but you do need some guidelines, especially at first.

This book focuses more on design than specific software. New versions of the Macintosh are emerging fairly rapidly. Likewise, the software surges ahead in power, and novel programs are still appearing. Thus, hints and caveats about specific software have a way of becoming quaint very rapidly. Moreover, Mac graphics programs have grown from a handful to an abundance, and universally accepted standards are becoming harder to find in any field. Most successful programs have some features its rivals lack.

Hence, this book addresses the end more than the means of getting there, result more than technique. Nonetheless, the *modi operandi* in certain kinds of software are similar and relatively stable, so we can guide you through a program like *MacPaint* without worrying that the description will have the lifespan of a mayfly.

Finally, this book more or less covers the gamut. Though it omits some fields, it also covers more topics than most readers may need to know about. So please feel free to skip around. This is a guidebook, not an assignment.

Acknowledgments

No doubt some readers view an acknowledgments section as a kind of preliminary cough, where the author grudgingly concedes his debt to others before hastening on to crow about himself. However, like most writers, I have always found the truth to be very different, and it is a pleasure for me to tip the hat to those who have sustained me from first outline to final patch-up. They include:

Paul Freiberger, high-tech reporter for the *San Francisco Examiner,* who offered invaluable insights and assistance along the way.

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At COMPUTE!, Editor in Chief Stephen Levy, who oversaw this endeavor with keen and helpful eye, and Project Editor Robert Bixby, who intelligently combed the book for ambiguities and discordances.

And finally, my wife Rosalind Gold, who buoyed me throughout with serene and nimble spirit.

About the Author

Dan McNeill has written five books and numerous articles about personal computers, and has also consulted on graphic design and *HyperCard* development. He lives in Los Angeles.

Part 1
The Digital Canvas

1
A Graphics Primer

Graphics are as old as the human race. Scholars think they began with bodily ornament—smearing the face, scarifying the arms, tattooing the chest. Virtually all primitive tribes show a proud array of these adornments, even ones who lack all other pictures. Unfortunately, illustrations on the skin do not survive the death of their owners, so we cannot tell when they originated.

True art emerged only within the last 100,000 years, and cave paintings of aurochs, horses, and other beasts survive in Europe and Africa from as early as 35,000 B.C. Not all this work is impressive or even competent, but some is memorable. A picture of a bison charging full bore across a limestone wall, head down and hooves aloft, puts you right there, a witness to angry mass in motion.

Since then, graphics have always exploited new technology. For instance, factory-produced oil paints in tubes made possible the *plein air* works of the Impressionists—sunny picnics on grass, poplars at Arles—since they obviated the need to prepare paints in the studio. Graphic designers quickly embraced lithography and photography, and modern artists and sculptors have exulted in steel I-beams, glass, burlap, and like materials.

The computer is the latest advance in graphics, and by far the most dramatic.

Every graphics medium has some advantages and some drawbacks. For instance, charcoal is quick and erasable, but lacks color and requires fixative. Watercolor easily renders depth and a certain pale dreaminess, but demands rapid fresco-pace execution. Computers too have up sides and down. Let's look first at their advantages:

Precision. The machine works in dots, and they can be exceptionally small. Laser printers render images at 300 dots per inch (90,000 dots per square inch), and phototypesetters like the Linotronic yield of up to 2540 dots per inch. Of course, mediums like oil achieve a dotless saturation, but the computer lets you

control each dot directly. Hence, you gain extraordinary power over detail.

Palette. On the Mac II, you can choose among about 16.8 million different colors for each dot, a staggering sum. Moreover—onscreen, at least—you work in pure light, without the bother of pigments.

Erasures. The computer bestows a magical forgiveness. If you make a mistake in charcoal, say, you must make an effort to eradicate it, and rubbing may even remove paper. But the computer erases cleanly, instantly, and forever. Only when you are finished do you print out and generate a hard copy.

Special effects. The computer supplies an array of instant tools. For instance, you can pull out a circle or rectangle on the screen automatically. You can fill space with patterns, create mirror images, trace edges, eliminate "noise," move figures about, and duplicate them onscreen. You can carry out a host of other functions—indeed, so many that we'll spend most of this book describing them and still won't reach an end.

Range. The computer lends itself to every kind of art: not just drawings, but charts, diagrams, fonts, and page layouts. It's a total graphics machine.

Absorption. The computer is a graphics sponge. It can easily read in printed graphics and display them onscreen where you can alter them. It also accepts video signals, so you can take photographs through a video camera or copy frames from a videotape.

Variations. The computer can replicate electronic files in a snap, usually with a command or two. Hence you can rapidly vary your work. For instance, if you are drawing a series of comprehensives *(comps)* for a client's inspection, you can do one, duplicate it, alter the new file, duplicate it again, alter that, and so on. This process saves a fantastic amount of time and labor.

Copies. As in lithography, the computer can print out as many copies of your work as you want. Hence, though originals won't fetch auction-block prices, you can distribute them far more easily.

Finally, the computer adds a whole new phase to graphics: a waystation on the road to output. Its screen presents a vision of the final image which you manipulate at will, adding, erasing, and retouching until you're satisfied. Only then do you make the hard copy. It's almost like developing and refining the picture in your

mind, except you view it in faultless detail and the machine executes the final vision automatically.

Of course, the computer too has drawbacks, though few are inherent:

Price. It costs far more than most art materials, and is less portable—though portable machines are certainly available.

Color reproduction. More important than the price of the machine, direct color printout remains either inferior or expensive, and hues on the screen may not match those on hard copy.

Size. The machine may also limit hardcopy size, usually to the width of the printer. Film sidesteps some of these obstacles, but final copies still lack the range of expressiveness of traditional art media.

Yet the computer has tremendous powers. As a graphics tool, it's not merely legitimate, it's impressive and powerful.

The Macintosh

Most computer books are about software, not computers, and this one is no exception. You don't have to know how a computer works to use it, but it's important to know a few hardware traits to grasp what the software can do. So lets tarry a moment on the Macintosh, the pedestal supporting all else. I'll try to make it as painless as possible, but if you find technical talk insufferable or know the material already, please jump ahead.

Personal computers debuted commercially in 1975, but they were feeble by today's standards. Though they grew rapidly in power, for years they displayed an inaccurate image of printout. In some cases, distortion was perhaps desirable; for instance, word processors could show a whole page of text by compressing lines together. But such displays hamstrung graphics.

In January 1984, Apple Computer announced the Macintosh. The Mac was the first personal computer with a graphics orientation, and hence the first desktop machine for serious artists.

What does *graphics orientation* mean? In fact, it's a catch-all term for several qualities. Most basically, it means the Macintosh has a set of software routines called *QuickDraw* that place text and other images on the screen more or less exactly as they will look at printout, a trait called *WYSIWYG* (pronounced WIZZY-wig, for *What*

You See Is What You Get). Instead of guessing output, you can see it at a glance.

This approach has proved so popular it has spread to virtually all personal computers that can handle it. At the same time, the Macintosh has evolved into two lines, the original and the Mac II, which have quite different ramifications for graphics.

Original Line

The basic line includes the Mac, Mac Plus, Mac XL, Mac SE, and Mac SE/30. These are sometimes called the *portable line,* because they come in fairly small size with the screen inside the box as part of the in-store purchase. It's a happy arrangement, in some ways: It greatly reduces buyer confusion. The machine has attractive contours, and its black-and-white screen boasts high resolution.

However, this package exacts a toll: lack of choice. You are essentially compelled to use the Mac monitor unless you want to rewire the computer. Also, the display is small and solely black-and-white.

The first three computers mentioned—the Mac, Mac Plus, and Mac SE—are based on the Motorola 68000 microprocessor. This central device comprising the brains of the Mac is a 16/32 bit chip. (A *bit* is one on/off signal in a computer.) It can alter information in chunks of 32 bits but handles data 16 bits at a time in other ways, such as feeding it through channels. These machines are faster and more powerful than pure 16-bit computers like the IBM PC.

The fourth computer in this series, the Mac SE/30, is based on the more powerful 32-bit 68030. Both the SE and the SE/30 have a single slot into which you can insert *cards,* special circuitry boards that give the machine added powers.

Mac II Line

The newer line includes the Macintosh II and the IIx, substantially different machines from the portable line. Sometimes called *platform machines,* in them the computer forms a shallow dais supporting the monitor, which is detachable from it. This arrangement allows far more flexibility with the monitor: You buy it separately from the computer and can choose among monochrome (black-and-white), grayscale, or color monitors, in numerous levels of resolution. These computers also have slots into which you insert video cards, which let the Mac communicate with a panoply of screens.

These newer Macs are based on full 32-bit microprocessors—the 68020 and the 68030, respectively—which are much faster and more capable than the 68000. In addition, they have math coprocessors, special chips that carry out calculations and speed things up even further.

By the time you read this book, there may well be additional Mac versions.

Stages of Creation

There are six basic elements in the process of creating computer graphics. In rough chronological order, they are:

- Paintbrush: How Is Information Entered?
- Format: How Is It Coded?
- Memory: How Is It Stored?
- Screen: How Is It Shown?
- Program: What Can You Do with It?
- Output: How Do You Make Final Copies?

Most of this book deals with the last two elements, but unless you understand the first four to at least some extent, you'll be at sea with Macintosh graphics. The rest of this chapter deals with them.

Entering Graphics

You can enter graphics into the Mac either piece by piece or full-blown. In other words, you can either create them or copy them.

Creation

Programs like *MacPaint* invite you to exercise your imaginative powers, abetted by a small army of aids. Moreover, a host of less creative programs, like chart software, also take data directly from you and shape it into an image.

Mice. The Mac allows several tools for creating graphics, the best known of which is the mouse. Every Macintosh is sold with one, and the Mac user who doesn't understand it is probably just pulling the styrofoam away from the machine. The mouse is a rectangular item slightly smaller than a deck of cards.

You roll it about your desk, and a pointer or other symbol replicates its movement on the screen. To issue commands, change status, or select an item, you press and release the button on the

mouse. To draw, you press the button and move the mouse, and the pointer/paintbrush trails a line behind on the screen. It's all much simpler than it sounds.

The mouse excels at graphics that don't demand keen neuromuscular precision, such as page layout and chart programs. It does well with freehand graphics too, but since you grasp a block rather than a pen-like stylus, you have less control. A stylus brings the fingertips together at the place of contact with the page and yields greater finesse.

Trackballs. The trackball is even worse. It is a ball in a socket, mounted on or near the keyboard. You place your finger on the ball and rotate it, and the pointer crosses the screen. Proponents claim it surpasses the mouse, since it lets you work without moving your hands away from the keyboard. Whatever its overall merit, it's awkward for freehand graphics since you can't grasp it at all.

Digitizer pads. The freehand champion, this is a flat tablet with a grid on which you move a stylus. This familiar approach not only yields great control, it also permits manual copying. You place an image atop the pad, trace its contours with the stylus, and the picture wends its way into memory. For small images it's a quick and easy process, sidestepping scanners and the other machinery you'll see in a moment.

Creating graphics entails both time and, often, a touch of talent. But there is a faster way: You can copy them.

Copying

The Mac is a kind of flypaper for the graphics of this world. To pick up these images, you merely need to turn light waves or video signals into Macintosh digital code. There are several ways to do this.

Clip art. The most direct kind of copied graphic is clip art, predrawn computer art you buy and feed into the machine as is. Clip art requires no translation, no new hardware, and little extra time. On the other hand, each set of images costs money, and clip art more or less limits you to the fare available on the market.

Scanners. The Mac also accepts images straight from the outside world. For instance, you can use a scanner to read light from a two-dimensional source, such as a photo, and translate it into digital form. The graphic then appears on the Mac screen, where you can alter it as you please.

One common scanner is ThunderScan, which fits right into the

ImageWriter printer. This cartridge device is probably the best to start with, since it is much less expensive than other types. Flatbed scanners resembling office copiers usually cost over a thousand dollars and can copy not only single sheets of paper, like ThunderScan, but pages from books; they also copy much faster and with less effort.

Video digitizers. The Mac also takes video information, letting you snap photos of the world. Set up a video camera and connect it to a translator called a *video digitizer,* which transforms video signals into digital ones. Then you link the video digitizer to the Macintosh and simply start taking pictures. The digitizer also lets you read in video data from a VCR.

Formats: Introduction

Once graphics information enters the machine, you must store it some way. The computer uses special transistors which can be either on or off. A single on/off state is the most basic piece of information in the machine, and we call it a *bit.* A bit can hold one piece of yes/no information, such as whether a light bulb is on or whether a Macintosh pixel is black or white. Likewise, a string of bits can store more complex information, such as the letter *K.*

But how does it work? How do you know the meaning of an on/off series of bits?

You use code, matching the on-off sequence in memory against a set of patterns with specific, predefined meanings. For instance, a string of dots and dashes may be random nonsense, but if encrypted according to the system of Samuel Morse, it has meaning and we can decode it. Three dots, three dashes, and three dots, for instance, is *SOS.* The same symbols in another dot-dash code might have different meaning or none at all. All codes are arbitrary and depend only on prior agreement.

Software uses codes too, and for graphics we call them *formats.* Thus if a program is geared to receive information in one format and actually receives it in another, it won't understand the message.

Most programs such as *SuperPaint* and hardware like ThunderScan have their own format. So, to move graphics back and forth among them, you need a standard format you can translate to and from.

It would be nice if there were just one universal standard, a *lingua franca* to which you could automatically resort, but in fact

there are many. Why? A standard becomes entrenched and, before long, the technology outstrips it. Better machines appear, programmers devise tricks the format can't express, and soon a new format emerges. Yet the old one lingers on serving previous software, for which it may be perfectly adequate. The old standard may even be updated, causing further confusion.

To understand the major formats, you need to know certain hardware concepts that follow, so they'll be bumped to the end of this chapter. If you know the technology already, you can turn ahead; otherwise, read on.

Memory

Memory holds data when the computer isn't working on it, that is, almost all the time. It's crucial to computers, and, as Silicon Valley sages note, "Every computer needs twice as much memory as is currently available."

For graphics, memory has three important aspects: the total amount in the machine, the amount allotted for the screen image, and the manner of storing pictures (by dot or by shape).

Total Memory

Graphics requires more total memory than most applications, because images are more complex. Hence, the amount you have becomes quite important.

For most purposes, computer memory comes in two basic kinds: RAM and storage.

RAM *(random access memory)* refers to the memory chips within the machine that hold data temporarily. When you turn the Mac on and load a program, part of it goes into RAM. The documents you work on go into RAM too, as do changes you make to them.

RAM is measured in *bytes.* One byte equals eight bits and can usually hold a single alphabetic character, number, or other discrete piece of data. It's a molecular amount of memory today, so the standard unit of measure has soared. You normally see RAM described in kilobytes (*K,* or 1024 bytes), megabytes (*MB,* a little over a million bytes), or even gigabytes (about a billion bytes).

The RAM in your Mac holds information for immediate computer access. In this way, RAM may limit the software you can run or the size of documents you can create, and partly define your machine. The first Macs held 128K and ran *MacWrite* and *MacPaint* but little more, since 128K is now considered a narrow slice. Next

came the *Fat Mac*, at 512K. No one calls it the Fat Mac today, since 512K is the lower limit of most Macs. The standard Mac memory now is one megabyte; for graphics, 2MB or even 4MB are better yet.

RAM is transient. Turn the Macintosh off, and you lose all the information in RAM, instantly and forever. Hence you need a more permanent way to save material. This kind of memory is called *storage* (or *mass storage*).

Storage is generally a matter of disks, either normal floppy diskettes you insert or internal hard disk drives. For graphics, a hard disk is almost indispensable; these devices hold a minimum of 10MB, and 20MB is the most common size. You can easily augment a hard disk in increments of 20MB, and for serious graphics work, you may want a hard disk with 100MB or more, though many artists would find 40MB sufficient.

The total amount of memory defines your periphery, your sceptred realm. But all the memory in the world won't help you much if you don't cultivate the part devoted to the screen image.

Screen Memory

One of the more confusing concepts involved in screen memory is *bits-per-pixel.* A *pixel* (short for *picture element*) is a single dot on the screen, the most basic graphics unit. The term *dot* would do as well and is often used, but pixel has a spritely charm missing from much other computer jargon (like the chilling *object-orientation*).

On the original line of Macs, a pixel is either black or white. Since black/white is analogous to off/on, each pixel needs only one bit in memory to describe it. If the bit for a pixel is off, the onscreen pixel is black; if the bit's on, it's white. A black-and-white screen, therefore, is one bit-per-pixel.

Of course, pixels need not be just black or white; they can be any shade of gray and over 16 million different colors. You simply need the right monitor and more than one bit of memory per pixel.

The more versatile the pixel, the more bits it needs. It makes sense: If a pixel can come in 64 different shades of gray, say, it requires 64 different combinations of on and off to describe it. If only 32 are allotted, the computer will understand only 32 states and send only 32 different signals to the screen. As a result, no matter how good the monitor, each pixel would show one of only 32 shades.

Sometimes it's a little hard to grasp the relation between the bits-per-pixel figure and the image on the screen. The number of

possible shades doubles with each new bit-per-pixel, setting up a geometric progression.

Let's look closely at how this works. With two bits for each pixel, you have 2 × 2 possible codes:

on-on
on-off
off-on
off-off

yielding four shades of gray. That's clear. To run through all possible combinations at three bits per pixel, you place an on at the end of each of the four two-bit strings, then an off. You get:

on-on-on
on-off-on
off-on-on
off-off-on
on-on-off
on-off-off
off-on-off
off-off-off

Because you add an on and then an off to each of the four combinations, you double the total to eight. Exactly the same thing happens with a fourth bit. You can attach each of the eight three-bit strings to an on bit, then an off bit. The total doubles again, to 16, and so on.

Therefore, the total number of shades per pixel equals two multiplied by itself for as many "bits per pixel" as we have. In other words, it is 2 to the power of the bits-per-pixel:

4 bits per pixel = 16 shades (2^4, or 2 × 2 × 2 × 2)
5 bits per pixel = 32 (2^5, or 2 × 2 × 2 × 2 × 2)
6 bits per pixel = 64 (2^6)
8 bits per pixel = 256 (2^8)
12 bits per pixel = 4,096 (2^{12})
16 bits per pixel = 65,536 (2^{16})
24 bits per pixel = 16,777,216 (2^{24})

It works the same way with color. If you store eight bits of color information per pixel, as Apple's Macintosh II Video Card does, you get a palette of 2^8, or 256, colors. Internally, the Mac II can hold a maximum of 2^4 bits-per-pixel, so each pixel on the screen can be one of 2^{24}—roughly 16.8 million—colors. The actual range of the palette depends on the bits-per-pixel of the video card.

Bits-per-pixel is the standard measure of screen image quality, often abbreviated to *bit.* When someone refers to "an 8-bit image" or "a 12-bit image," you must either do rapid calculation—not easy—or know the rough equivalent.

Since most Mac II screens display about 780,000 total pixels, you can show a maximum of 780,000 different colors at any one time. That's a reasonable palette, since to scan color photos accurately or shade three-dimensional objects, most professional workstations display more than 1,000,000 colors at once.

Programs for your Mac have two manners of memorizing graphics: by dot, or individual pixel; or by overall shape. The first method is called bitmapping; the second, object-orientation.

Bitmapping. Bitmapping is a simple concept, but sometimes it's ramifications seem unclear. Essentially, it is plain rote memory of pixels on the screen. The computer makes a map in memory to correspond to the pixels, and each pixel has its own site. When you print a bitmapped image on an ImageWriter, the Mac simply sends this information to the device, bit by bit.

Bitmapping makes precise work easy. Since you control each pixel independently of all others, you can make it whatever you want and gain crisp detail. We generally call bitmapped graphics software *paint programs,* after *MacPaint,* which started it all.

Object-orientation. The Macintosh *QuickDraw* routine uses bitmapping to display the screen, but your software need not employ this tactic if it can "understand" the relation between the pixels.

Imagine a circle on the screen. Memory can record it in one of two ways: A bitmapped program simply notes the location of each pixel, with no information about the overall shape. An object-oriented program, on the other hand, expresses the overall shape as a formula and places it at a particular site.

At first glance, this approach may seem clumsy. By working with objects, you forsake the splendid detail of bitmapping. You lose such charming features as FatBits, which lets you manipulate individual pixels. Usually it also takes longer to get accustomed to object-oriented software. You can sit down with a bitmapped program and create pictures at once, as if you're sitting at an easel. Object-oriented software is more like playing with blocks, and demands more patience.

However, the payoff might be worth it. Object-orientation lets you work with clearly demarcated objects—hence its name. Since the machine stores each object separately, you can pile them atop each other in layers and later easily detach them, an invaluable power for drafting. With bitmapping, there is only one "layer," so once you fuse two shapes, they stay fused; it's like pouring apple juice into pear juice.

But object-orientation goes further. Since it defines shapes, not pixels, it can readapt the shapes to new circumstances. For instance, if you expand a bitmapped circle, the program magnifies the image literally, and tiny steps swell into great blocks. The software has no choice, since it knows only pixels. An object-oriented program, however, regenerates the circle in larger size and rounds out the curves; it, too, has no choice, but here you benefit.

Text also profits from this compulsive tidiness. Expand a bitmapped *A* and you get an Aztec pyramid. Expand an object-oriented *A* and you get a smoothly-sloping *A*. The software cleans up the contours, so you can resize almost any type you want.

This capacity has proved fantastically useful with laser printers, because it enables greater resolution. If you can resize your work, you can take advantage of more precise printing techniques, and that's what the laser printers and phototypesetters offer. Most laser printers print at 300 dpi (dots per inch); the Macintosh screen has only 72 dpi. If you send bitmapped characters to a laser printer with no mediation, they stay more or less as they are. If you send object-oriented characters via *Laser Prep* and *PostScript*, the printer can round them off and sharpen them substantially. The effect is like expanding the image dramatically, smoothing it out, and reducing it to original size. Object-orientation offers crisp, attractive graphics and text, and so has become immensely popular.

Object-oriented software programs are generally called *draw programs*, after *MacDraw*.

The Screen

The monitor is the part of the computer you deal with most frequently. It provides the ongoing status of your work, the arena for issuing commands, and the center for messages from the computer itself.

Macintosh pixels are square, a fact that affects the appearance of graphics on the screen. Since squares have 90-degree angles, they tend to give graphics a sharper appearance. Had the pixels been circular, as on TVs, the screen would look softer.

The pixels form a tilework on the screen. Therefore, you don't really work pointillistically like Georges Seurat, who placed dots wherever he wanted: You are confined to a grid. However, the finesse of such machines as laser printers and phototypesetters is making this fact much less significant.

The screen also has a number of other basic characteristics, such as size, resolution, and the relative presence or absence of color.

Size

There are two ways to measure a computer screen: by grid size and by absolute size. These methods are very different.

All graphics software works from a basic concept: the grid. It sets up vertical and horizontal axes, somewhat like those in analytical geometry, and places a pixel at each intersection. *Grid size* is the number of pixels across and down. The grid size of the Mac, Mac Plus, and Mac SE is 512 by 342 pixels, or almost exactly 3 to 2. Grid size of screens for the Mac II varies according to the manufacturer. Apple's monochrome and color monitors are 640 by 480, or precisely 4 to 3.

The *absolute size* of a screen is the figure you get by applying a tape measure to it. The screen of the original Mac line is very small: 9 inches across diagonally, or 7.11 inches horizontally by 4.75 vertically. The absolute size of Mac II screens also varies but is almost always larger. Apple's color RGB monitor is 13 inches diagonally, and its monochrome is 12 inches.

Resolution

You combine these two ways of determining size to get *resolution,* perhaps the most important figure of all. Resolution measures your

perception of the screen's finesse, and it's expressed by the number of dots per inch, or *dpi* (sometimes called *dot pitch*). You can easily derive dpi by dividing the inches in one direction by the number of pixels. The screen of the original Mac has 72 dpi, which makes fine resolution.

Resolution matters because of the basic optical illusion behind the screen. As pixels dwindle, they tend to fuse together, like the flowers in an arboretum bed spelling out "Welcome Shriners." But for this trick to work, the pixels must be relatively dense. Some computers have offered screens with about the same number of pixels as the Mac but spread over a wider area, which looks grainy and diminishes your pleasure at the machine.

Resolution explains the small absolute size of the screen in the original line of Macs. If you increased its size, the pixels would become more evident and the screen would appear granulated.

Full-page screens. The nine-inch screen means you have tunnel vision on your work. You see only part of the page at any time, and must shuttle up and down between its sections. It's a real irritation for desktop publishing, and an almost insuperable obstacle for full-page images.

The solution is a full-page screen, which displays the entire page or, more often, two pages before your eyes. Some "false" large screens simply blow up the small Macintosh display, increasing the absolute size of the screen without increasing the grid size. These screens may be useful for presentations, but otherwise they solve very little.

The true full-page screen increases the number of pixels as well as absolute screen size, and lets you peruse many more of them. It comes in two types: *portrait* and *landscape*. Portrait screens generally show one page and are slightly longer vertically. Landscape screens show two pages side by side and are longer horizontally. As the difference in price between the two is small, the latter have come to dominate the market.

Chromaticity

The Mac II lifts the Macintosh out of the realm of black-and-white, affording new opportunities for the graphic artist. Its monitors come in three kinds: monochrome, grayscale, and color.

Monochrome. The first Macintosh, and all models before the Mac II, worked almost entirely in black and white. This fact did not

encumber writers or individuals making charts, diagrams, or page layouts. Nor did it hinder people making line art.

Moreover, monochrome monitors can render gray through a trick called *dithering*. This interesting word refers to strewing black dots out in patterns. The eye sees a sparse array of dots as light gray, a denser cluster as dark gray. Dithering can't replace true gray, for the resolution on the Mac screen is far too coarse, and dithered black-and-white lacks the sleek appeal of genuine grayscale.

Why buy a monochrome monitor for a Mac II? It has several advantages: It is much cheaper. Moreover, since it needs only one bit per pixel, it saves memory and lets the computer redraw the screen faster. In addition, much early software was written for monochrome screens, and some programs still run better on it, though software authors are rewriting most popular programs and this disability should not linger.

Grayscale. A grayscale monitor gives true gray, since it has individual pixels in shades between black and white. It's rather like the way photography works, except photos achieve different levels of gray by varying the amount of chemical reaction on the negative or print. Since photographs show a near-infinite range of grays, they are called *continuous-tone images*. Grayscale monitors are digital and show only a certain range of gray tones.

On the screen, the difference between grayscale and monochrome is instantly obvious. Grayscale looks much sharper, as though an array of sub-pixels, all black-and-white, make up each pixel. To achieve this crispness by dithering black and white, the screen would need exceptional resolution. Grayscale pixels yield precise, pleasant images, and with image processing software, you can manipulate and improve them with much greater freedom.

Color. The Macintosh 512K, Mac Plus, and Mac SE can actually print in color, as the original *QuickDraw* provides for seven colors: blue, cyan, green, yellow, magenta, red, and black. However, the process is laborious: Since the screen is black-and-white, with the nonblack colors appearing as white, you must tag colors separately. (The SE has a slot, so it can also display eight or even 16 colors with a ColorVue SE card from Orchid Technology and a color monitor.)

The Mac II is able to support this old scheme. However, it displays glorious color on its own and is plainly the machine for color output, even though it's also more expensive than the others.

The predominant color displays are *RGB* (red-green-blue) monitors. On these, each pixel is actually composed of three tiny phosphor dots, one red, one green, and one blue. (These roughly match the three kinds of cones in the retina that sense color.) The electron gun of the monitor stimulates the phosphor dots in different degrees and, because they are so small and tightly packed, the eye welds them into a single color. For instance, blue plus green yields cyan (turquoise), red plus green gives yellow, and red plus blue yields magenta.

Graphics Software

The computer lends itself to any kind of art. To perform art, you need software, which basically transforms the computer from a universal machine into a specific tool. Numerous categories of software have sprung up to reflect the needs in the marketplace; the main ones are discussed here.

Paint. Paint programs turn the screen into a freehand canvas. They use bitmapping, as you've seen, and specialize in complex, irregular pictures, like trees.

Draw. Draw programs began as software for engineers and architects, and replicate the drawing board and its special tools, like the protractor. They are object-oriented, reducing every line and figure to a formula.

Clip art. Clip art is the predrawn art that lets you leapfrog the creative process.

Image processors. Image processors provide an array of tools for sprucing up whole images. Originally designed for scanned material, which often needs extra work, they confer great power and flexibility with many kinds of images.

Chart. Chart programs convert numerical tables into illustrative charts. They can generate pie, bar, line, plus many other kinds of charts. They are almost indispensable for reports and have also come into vogue for desktop presentations.

Page layout. If you're publishing a newsletter, book, or even a flier, you need to organize its elements on the page. This artform is called *page layout,* and the programs that accomplish it are page layout programs. Desktop publishing has brought these items to the fore, and they remain among the most rapidly growing segments of the industry.

Desk accessories. Desk accessories like graphics viewers can be handy for browsing through pictures. There are also full-blown

paint and draw programs that come as desk accessories, such as *DeskPaint* and *DeskDraw.*

Output

Final copies are, of course, vital for graphics—they make the difference between smear and scintillation. The Macintosh gives you numerous options.

For black-and-white output, laser printers have generally become the machine of choice. They yield 300 dpi and higher, which approaches professional quality. For proofs and less important printout, dot-matrix machines like the ImageWriter are satisfactory. You can also feed clear plastic sheets into these printers and produce transparencies for use with overhead projectors. If you want professional level resolution, up to 2540 dpi, you can send a file to a phototypesetter such as a Linotronic.

For grayscale printout, you might be able to tolerate a 300 dpi laser printout, but you'd do best with a phototypesetter.

Color printing is a bit more problematic. Some emerging color printers seem to hold promise, but the best are still very expensive. Film recorders yield high-quality slides and even photos direct from the Mac screen, but they, too, remain somewhat costly. In many cases, you may simply want to take color separations down to an offset printer for a four-color process job, which can look resplendent.

Formats: Specifics

We return at last to formats. Here are the major standards:

Paint. Paint was the initial standard format, derived from the original *MacPaint.* Paint files can be only 8 × 10 inches large, and its images are 72 dots per inch. This format prints well on an ImageWriter but produces jagged images on laser printers. Paint files are compatible with most programs. The main drawback of Paint, of course, is that it addresses only paint software.

PICT. PICT began with *MacDraw,* the first object-oriented program on the Mac. Apple devised it to deal with *MacDraw*'s different nature. PICT files can be larger than 8 × 10 inches and can store information both as bitmaps and as objects. However, PICT itself soon began to creak. With the advent of the LaserWriter and the *PostScript* page-formatting language, software writers could achieve effects like hairlines and graduated fills that PICT could

not adequately express. Soon programs like *CricketDraw* were adding little extensions to PICT, and these addenda differed from company to company. Software writers also found that PICT could not render color or shades of gray, or compress files to save memory.

RIFF. The first format to deal with these problems was RIFF (Raster Image File Format), created by developer Mark Zimmer, who also wrote *GreyPaint*, the program that evolved into *ImageStudio.*

TIFF. The next was TIFF (Tag-based Interchange File Format), developed by Microsoft and Aldus, the maker of *PageMaker.* At this time, scanners were becoming popular, and TIFF remains the standard for scanned images, partly because it allows great compression of large files. It can contain grayscale or color information, and resolution from 72 to 2450 dpi. Unfortunately, for a standard, it comes in several versions. But TIFF doesn't handle *PostScript* directly.

EPSF. For some time after the appearance of the LaserWriter, most programs used the *QuickDraw* routines in the Macintosh ROM for screen display and the Laser Prep file to translate into *PostScript* for the laser printer. Adobe Illustrator switched that around. It built graphics with *PostScript* and conducted an ongoing internal translation for the screen. Soon EPSF (Encapsulated *PostScript* File) emerged, a format with two main parts: 1) *PostScript* commands for the printer, and 2) a bitmap image for display on the screen. That is, EPSF really contains two formats: *PostScript* plus a second type, such as PICT or TIFF. Hence, it's *encapsulated.* EPSF boosts the speed of printing, since it sends data straight to the printer without translation. It also allows finer effects, such as precise positioning of text. However, because its bitmap subformat can differ from program to program, EPSF is not completely compatible across the field. Though most programs which read it can place images for printing, they can't always open an EPSF file created by another program or let you modify it.

PICT II. PICT II arose with the Mac II, which had color and thus had outgrown the original PICT. PICT II handles color up to eight-bits-per-pixel, a level which already seems inadequate, so a new version of PICT is undoubtedly on the way. Most Mac draw programs are now oriented around PICT II.

GIF. GIF was invented by CompuServe, the large information utility. CompuServe deals with users of all kinds of personal com-

puters, and needed a way to transfer graphics among many machines; their solution was GIF.

The formats will probably continue to grow in number and power, but for now, let's go back to the beginning. Let's look at the world of paint.

Part 2
Paint and Draw

2
Secrets of Paint

The ancient Asian game of Go is amazingly deceptive. It has about two or three rules, which you can learn in a few minutes, yet mastering the strategy may take a lifetime. Anyone can play Go, but very few play it well.

In a sense, paint programs resemble Go. *MacPaint,* the best known, is so easy you can start painting in a matter of seconds. Yet beneath its splendid and obvious features lies a trove of little secrets, often unsuspected by happy users.

Paint is the granddaddy of Macintosh graphics, *MacPaint* debuted with the computer itself in 1984, and gives ample evidence of its capacities. These are the most flexible of all graphics programs. Since the software understands each pixel as an atom unto itself, rather than as part of a larger entity, you can manipulate the pixels with delightful ease, as well as shift portions of images about and copy them, alter shapes, and generally act as a wizard of screen detail.

Let's examine paint programs in general through the medium of *MacPaint,* still a good example of the breed.

The Tools

MacPaint tools are the items that determine how you interact with the screen. They usually change the pointer from an arrow to another figure, like a bucket, and they're the key to the whole program.

In the early versions of *MacPaint,* the tools lay constantly available in a set of icons on the left side of the screen. *MacPaint* 2.0, *HyperCard,* and many other programs now place them in tear-off menus. You can use them as normal pull-downs, or you can rip them off and deposit them anywhere on the screen for instant access. Since you can move them about, tear-offs let you use the whole screen.

To tear off the Tools or Patterns menu, drag the mouse across it and continue going below. A shimmering outline follows, and the menu springs into being when you release the button. To shift the menu elsewhere on the screen, place the pointer on the dotted

area at its top, press, and drag. To retire the menu, click the tiny square in the upper left.

If you wish to use *MacPaint* in fifth gear, you should definitely take advantage of the tear-off capacity. Many shortcuts involve double-clicking an icon on the Tools menu, an impossible act while it hangs from the menu bar.

MacPaint's tools are important not only for themselves but because they often introduce these other features of the program:

- Paintbrush
- Spraycan
- Pencil
- Eraser
- Straight Line
- Paint Bucket
- Shapes (various)
- Text
- Grabber
- Lasso
- Marquee

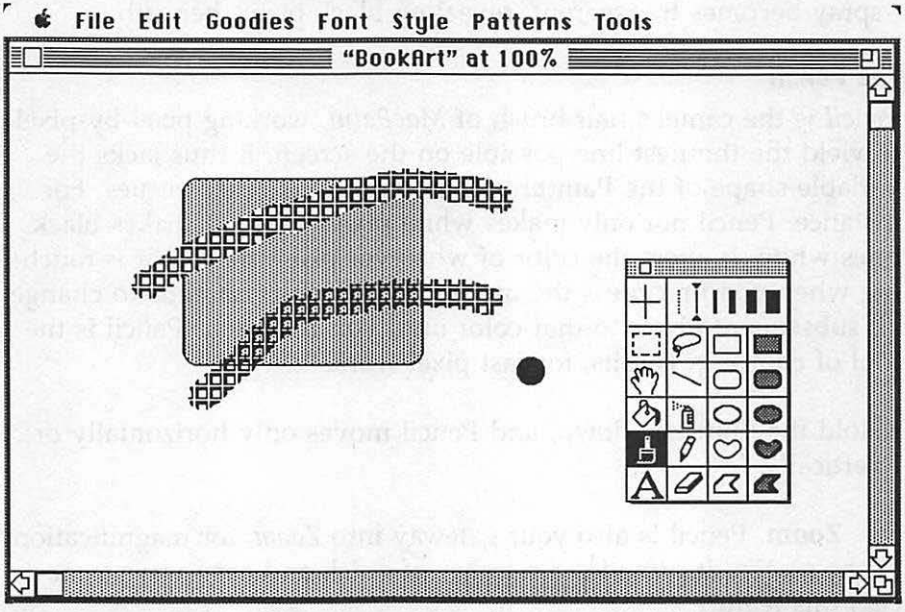
The Paintbrush

Here is the tool that named the genre. The *Paintbrush* cursor forms a shape on the screen; as you drag it along with the mouse, it changes the pixels it crosses to the pattern or color you've selected. You have several options for working with this tool.

Traditional artists use brushes of many sizes, but paint programs allow different shapes as well. You choose Brush Shape under the Goodies menu and a dialog box appears offering squares, spheres, and vertical, slanting, horizontal, or dotted lines. You select one by clicking it.

- Double-click the Paintbrush icon and the brush-shape box appears; click a selection and it vanishes.
- Hold the Shift key down and draw, and you *restrain* the brush—that is, it only paints vertical or horizontal lines, so it works like a T-square you can't rotate. The Shift key has this effect on many other tools.
- Hold the Command key down and draw, and the white in your patterns becomes transparent, allowing whatever you paint over to show through. In effect, the pattern merges with the one below, rather than replacing it (see Figure 2-1).

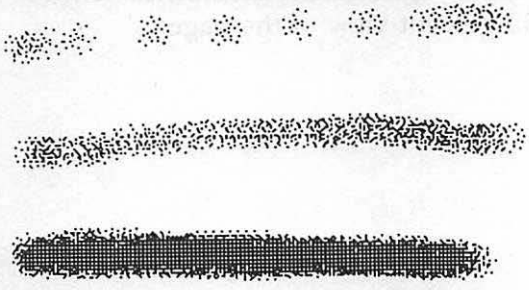
Figure 2-1. The Paintbrush: Opaque and Transparent



The Spraycan

The *Spraycan* resembles the Paintbrush, except it sieves out most of the paint before applying it. With a single pass you get a scattering of dots that becomes denser with every subsequent pass, until finally the pattern stands plain and solid. The Spraycan works in bursts, so if you pull it quickly across the screen, you'll see a series of dots in a disklike form. Pull more slowly, and you'll get a steady trail (see Figure 2-2).

Figure 2-2. The Spraycan: Fast, Slow, and Repeated



- Hold the Shift button down as you pull the Spraycan, and you restrain it to vertical or horizontal lines.

- Hold the Command key down and spray, and the white in the spray becomes transparent, revealing black pixels beneath.

The Pencil

Pencil is the camel's hair brush of *MacPaint,* working pixel-by-pixel to yield the thinnest line possible on the screen. It thus lacks the variable shape of the Paintbrush, though it has other virtues. For instance, Pencil not only makes white pixels black, it makes black ones white. It alters the color of whatever pixel the cursor is touching when you first press the mouse button, and proceeds to change all subsequent pixels to that color until you release it. Pencil is the tool of choice in FatBits, for fast pixel work.

- Hold the Shift key down, and Pencil moves only horizontally or vertically.

Zoom. Pencil is also your gateway into *Zoom,* for magnification of the screen. It provides a number of quick and easy ways to access this feature.

- Double-click the Pencil icon on the menu, and you jump into 800-percent Zoom; double-click again to return to 100 percent. (Clicking on the window that appears in Zoom also returns you to 100 percent.)
- Hold the Command key down and click the screen to magnify the image one stage at a time. The first click yields 200 percent, the second 400 percent, the third 800 percent, all from the point where you click (see Figures 2-3, 2-4, 2-5, and 2-6).
- Hold the Shift and Command keys down and click the screen, and you go the other way—the magnification diminishes. Click from 100 percent to get a 50-percent view of the page.

Figure 2-3. Normal Magnification

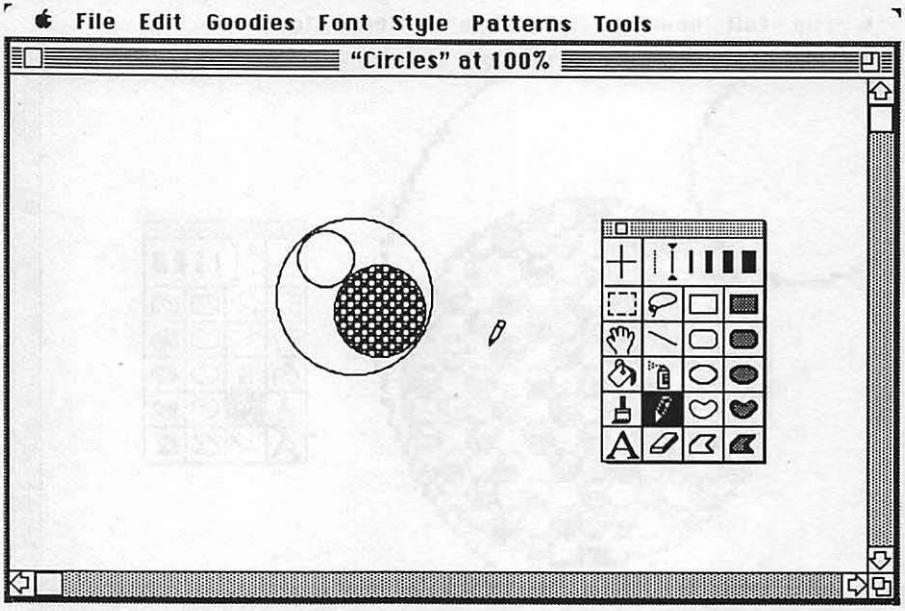


Figure 2-4. 200 Percent Magnification

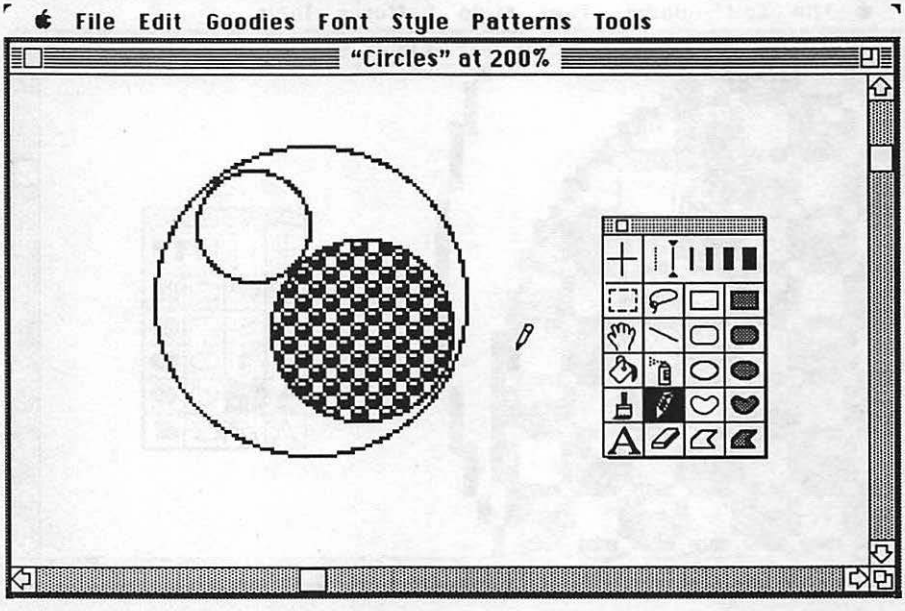


Figure 2-5. 400 Percent Magnification

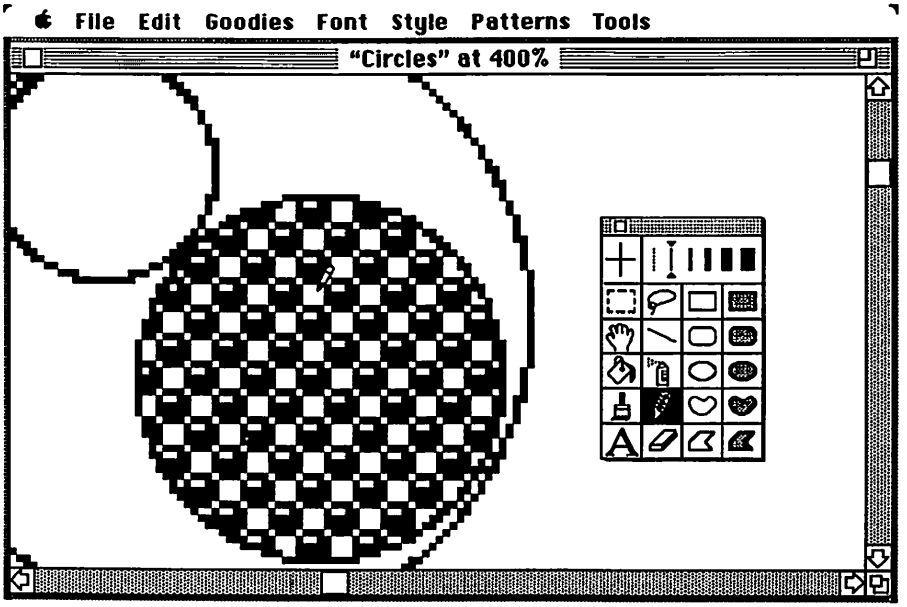
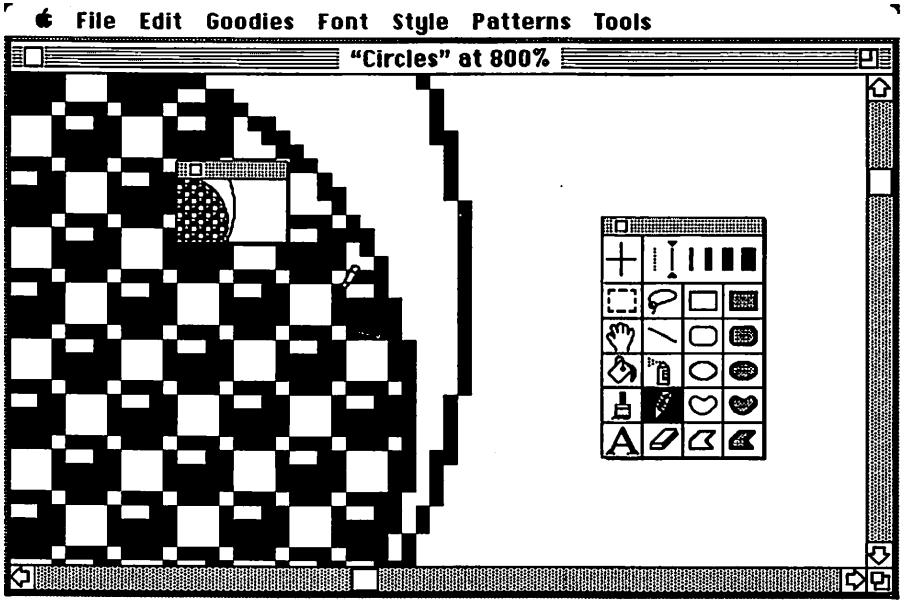


Figure 2-6. 800 Percent Magnification



The Eraser

The *Eraser* tool is just a white Paintbrush shaped like a square that turns each pixel it touches white. The Eraser allows a fair amount of control, even in 100 percent, since it goes to work only when you press the mouse button. You can easily erase pixels that touch lines you want to retain: Move the Eraser up against the line until it and one side of the pointer form a doubled line and click. If erasing gets delicate, don't hesitate to go into Zoom—it can save time and tension.

The Eraser seems to be a pretty simple tool, but beyond its plain facade lies a host of little secrets:

- Double-click the Eraser icon to erase the whole screen, often a very gratifying power.
- Hold the Shift key down and double-click the Eraser icon to erase the whole page.
- Hold the Shift key down and pull the Eraser, and it erases only vertically or horizontally. Why have this feature? It's very handy, for removing those irritating black pixels that often touch a straight line. You place the Eraser beside the line, press Shift, and pull it along without fear of taking bites out of the line.

Snapshot. Like the Pencil, the Eraser opens into another realm, this time of the *Snapshot.* The Snapshot is a fall-back position in devising graphics, an image of the screen you can always return to if you make a mistake or find yourself in a blind alley. It is not the same as Save, since you might want to Save fairly often, even with material you're not sure about. *MacPaint* automatically takes a Snapshot every time you quit; otherwise you issue this command by choosing Take Snapshot from the File menu.

- Press Command and an animated pyrotechnic appears within the Eraser, signaling its new powers. Each stroke of the Eraser now resurrects part of the screen as it was the last time you took a Snapshot.
- Hold the Command key down and double-click the Eraser icon to fully restore the last Snapshot. This is equivalent to choosing Revert to Snapshot from the Edit menu.

Note that Revert to Saved in the File menu, which takes you back to the last image saved, is also a fall-back; but issuing this

command also takes a new Snapshot, killing access to an earlier one. Intriguingly, if you return to a Snapshot that took place prior to the last Save and choose Return to Saved, you restore graphics.

Other means of erasing. There are a number of ways to erase in *MacPaint* without using the Eraser:

- Press the tilde key at the upper left of the keyboard (Mac 512K and Plus), or just left of the spacebar (Mac SE and II), or choose Undo from the Edit menu. Of course, this erases only if your last act created something, and then it erases only that.
- Select the Paintbrush and paint with the white pattern. The squareness of the Eraser helps in cleaning out corners, but the Paintbrush gives you a range of other shapes.
- Lasso or Marquee an item and press backspace. This is a very fast way to erase large items.
- Fill a black shape or line with white from the Paint Bucket.
- Pull out a borderless white rectangle or other shape.

The Straight Line

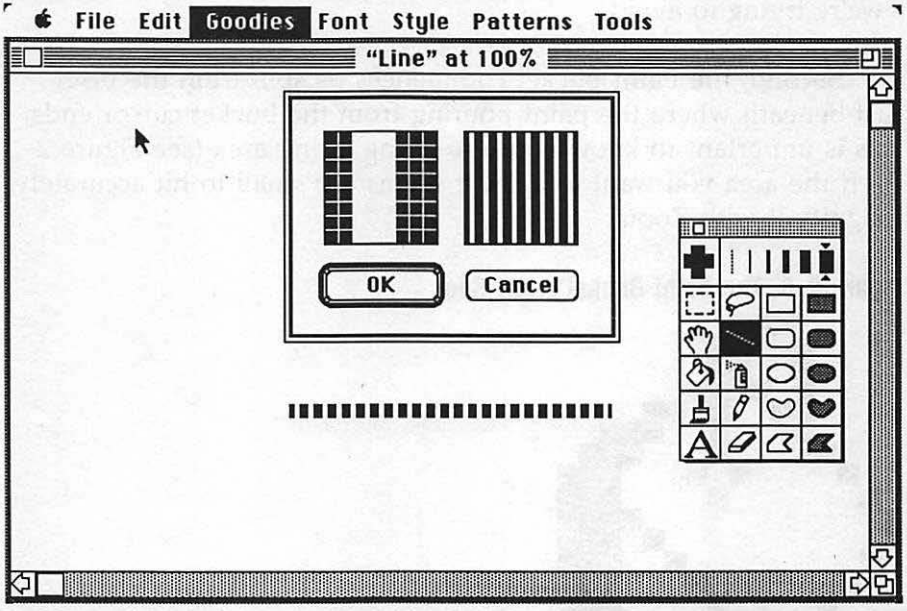
Of course, not every image in paint is complex. Often you deal with straight lines, and in such cases, the *Straight Line* tool is invaluable.

It works very simply: Choose the desired line width from the offerings atop the Tools menu, and the crosshairs at the left change to display it. Then you select the Straight Line icon, press the mouse button, drag across the screen, and release.

The cursor is two crossed lines, and when you move it over an existing line, the matching part of the cursor turns white. You can place it fairly precisely, and create perpendiculars or regenerate broken lines without blind guesswork.

- Hold the Shift key down as you pull to restrain the line to a vertical, horizontal, or 45-degree diagonal—an important power.
- For a patterned line, select the pattern, hold the Command key down, and pull out the line. To get a dotted or dashed line, you may have to create your own pattern, with the Edit Pattern. . . command under the Goodies menu—more on this below (see Figure 2-7).

Figure 2-7. Making a Pattern for Dashed Lines



The Paint Bucket

The Paint Bucket fills the area you click with a pattern. It is a sweeping command, and there are a few things to note about it.

First, it fills solid white or solid black areas only, so Paint Bucket doesn't replace prior patterns with new ones. Instead, it either fills an enclosed part of the old pattern, if one exists, or completely merges with the old one, creating a new (and usually ugly) pattern.

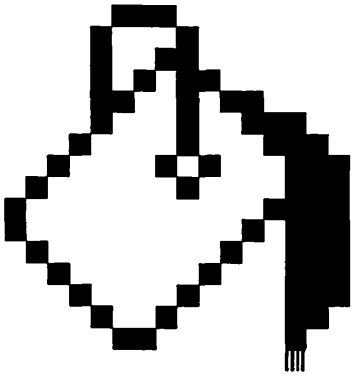
So how do you replace a pattern? There are three methods, all somewhat flawed:

- You can resort to the Fill command, which fills out to the border of the selection no matter what pattern is there. You choose a pattern, select an item with the Lasso, and choose Fill from the Edit menu. However, not only does this act eliminate the border, but you can't Fill effectively again unless you provide a new border.
- If the shape is regular, such as a rectangle, you can choose the new pattern and pull out a filled borderless rectangle within the prior one. It's a delicate act, but it works. You can also simply select the white pattern, effectively erasing the contents of the rectangle, and then use the Paint Bucket again.

- You can erase a pattern with the Eraser tool, but this is what we're trying to avoid.

Second, the Paint Bucket commences its spill from the pixel just beneath where the paint pouring from the bucket cursor ends; this is important to know if you're filling a tiny area (see Figure 2-8). If the area you want to fill just seems too small to hit accurately, magnify it with Zoom.

Figure 2-8. The Paint Bucket's Hot Spot



Third, it's easy to make apparently catastrophic mistakes with the Paint Bucket. Misplace the cursor slightly or pour into a shape with a one-pixel gap—most often an Oval or a shape with an angled line—and a startling pattern fills the screen. When this happens, the very next thing to do is to click the Undo command from the Edit menu or press the tilde key in the upper left.

Undo acts on only the last act committed, so if you issue some other command, the flood remains.

- Normally, if you click the bucket on open space, it fills the screen only. If you hold the Shift key down and click, however, it fills the entire page.

Shapes

There are ten tools that allow you to create forms. Five yield unfilled shapes, and the other five, shapes filled with the preselected pattern. The shapes are the

- Rectangle
- Rounded Rectangle
- Oval
- Polygon
- Freehand tool

All yield forms with a black border as wide as the sample line atop the Tools menu. If you pick the thin dotted line, filled shapes appear as borderless patterns and unfilled shapes don't appear at all.

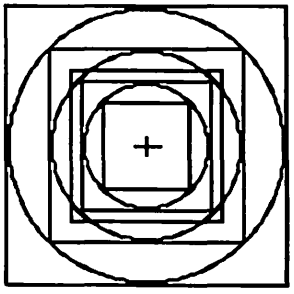
- Hold the Command key down and pull out an unfilled shape, and the border appears in pattern rather than black (see Figure 2-9). This nifty trick lets you quickly surround a screen or page with a customized border.
- For a filled borderless shape, hold the Command key down and pull out a filled shape. Basically, you are making both border and fill the same pattern here. The act replicates picking the dotted line in the Tools menu and pulling out a filled shape.

Figure 2-9. Pattern Border

Regular shapes. The *Rectangle, Rounded Rectangle,* and *Oval* are regular shapes, and when you pull them out, they grow from the corner where you begin to its opposite corner where you end. This approach is called *Draw from Edge,* and it gives you more control over where the shape starts and finishes.

Double-click any of these icons, however, and a cross appears in its heart and the method changes. Now the shape grows away from the center and twice as fast. You pull in one direction, and the shape expands both in that direction and in the opposite direction. This method is called *Draw from Center,* and it's invaluable if you want to surround a point with a shape, like a circle. It also lets you square a circle, by commencing both from the same center (see Figure 2-10). (Draw from Center is available on the Goodies menu as well.)

Figure 2-10. Concentric Figures Made with Draw from Center



- To paint a square, rounded square, or circle, hold the Shift key down and pull out the Rectangle, Rounded Rectangle, and Oval, respectively. It's analogous to restraining a line.
- Though *MacPaint* has no Arc tool, like *MacDraw,* you can get an arc by drawing a circle or oval, selecting part of it with the Lasso, and pulling it away.

Irregular shapes. The two remaining shapes—Polygon and Freehand—are irregular and hence work a bit differently. With the *Polygon,* you pull out a line, click to end it, pull in a different direction, click to end that line, and so on until finally you double-click and complete the polygon. With the *Filled Polygon,* you need not actually return to the starting point. You can double-click with the shape still open, and the software draws a straight line to the point of origin and fills the shape.

- Hold the Shift key down and you get vertical, horizontal, and diagonal lines only.

The *Freehand* tool lets you create any form you like. You just draw and release when finished. It's not particularly useful unfilled, since you can draw as easily with the Pencil or Paintbrush. However, the filled shape saves you the trouble of resorting to the Paint Bucket and, like the Polygon, it automatically closes an open form with a straight line.

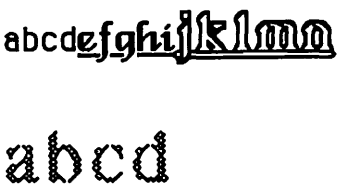
Text

The *Text* tool lets you write on the screen. It acts as a very crude word processor, and you must proceed with some caution. Text be-

gins wherever you first click the cursor. You can move down another line (by pressing Return), select fonts and sizes, and choose left, center, or right alignment. However, once you leave the text, it becomes pure paint. You can type over it, but the software no longer recognizes the text as characters. If you need to do complex formatting, you may want to use a real word processor, Copy to the Clipboard, and Paste.

- Normally, if you change font, style, or size while in text, all previous text changes. To mix modes in the same stretch of text, press Enter before changing font, style, or size (see Figure 2-11). Note: This act seals off the prior text, so you can no longer backspace into it.

Figure 2-11. Mixed Text and Patterned Text



- To set the method of writing over graphics, choose Preferences. . . from the Goodies menu. The options are:
  Normal, which clears a swath of white for the text
  Overlay, which fuses text with graphics so letters disappear
  Inverted, which puts white letters on black and vice versa
- To adjust line spacing, press Option/Command and the less-than key (<) or greater-than (>) key (actually, the comma or period). This power lets you shift the lines together or apart in minute increments, and you can even fuse lines so tightly that they overlap and obscure each other.
- For patterned text, the best approach is to select a large font size and change the letters one by one with the Paint Bucket (which fills solid black as well as white—see Figure 2-11). Patterned letters look better large anyway, but if you do want them small, Zoom before pouring. You could also choose a pattern, Lasso the whole text, and choose Fill from the Edit menu; unfortunately, this command also fills the spaces in such letters as *o* and *b*.

- To alter font size, press Command plus the less-than key or the greater-than key. To change font, press Command-Shift and the less than key or the greater-than key. Of course, you can perform these feats from the menus also.
- For instant little pictures, add Zapf Dingbats to your System fonts. You are then able to access them with Text.

The Grabber

The *Grabber,* a grasping hand, appears onscreen when you press Option with most tools. The Grabber moves the screen before your eyes and is especially useful for fast screen adjustments in Zoom. You can of course also move the window with the scroll bars on the bottom and right.

- Double-click the Grabber icon and you see the whole page. Double-click again and you return to 100-percent magnification.

The Lasso and the Marquee

The *Lasso* and *Marquee* both select parts of a drawing for further action. The difference between them is that the Marquee selects a rectangle and everything within, including the white space, while the Lasso selects only the contents within a loop you draw. The Lasso works more precisely, but the Marquee deploys faster and provides the open sesame to the Trace Edges, Flip Vertical, Flip Horizontal, and Rotate commands in the Edit menu, and Scale Selection. . . in the Goodies menu.

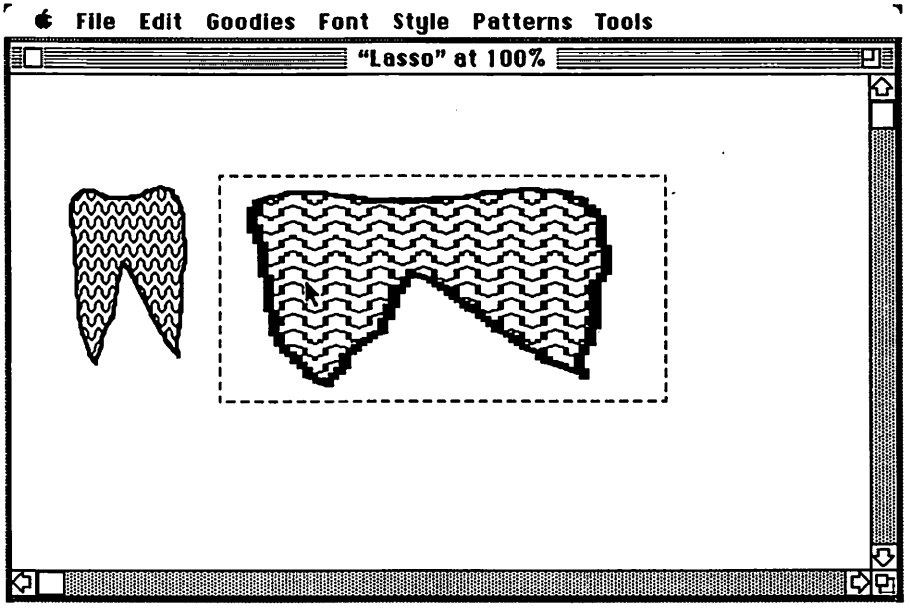
You need not totally close the Lasso loop. *MacPaint* does so for you and, if you've enclosed at least three sides of the item you want, you're set. This feature is especially helpful in those Scylla and Charybdis situations where you would otherwise have to pull the Lasso through a slender strait of white. If you begin and end at the right places, the Lasso runs the narrows by itself.

- Double-click on Marquee or Lasso icon and you select the entire window or its contents, respectively. Press Shift and double-click, and you select the page or its contents.
- To minimize the extraneous material the Marquee gobbles up, press Command as you pull it out. The Marquee shrinks to include the least area it can.

Once you select part of the image, you can perform numerous acts on it. For instance, you can move it by waiting till the cursor assumes a pointer shape and dragging the shimmering image along. If you hold the Shift key down, you pull vertically or horizontally only. You can also Copy onto the Clipboard.

Resizing and reshaping. *Resizing* is altering the size of an item while retaining its form. *Reshaping* stretches the form as well. Paint programs are not really made for these tasks and don't excel in them. After either change you may well find patterns distorted, lines doubled, and pixel shapes grossly enlarged (see Figure 2-12). But *MacPaint* can resize and reshape, and that might be enough for you.

Figure 2-12. The Perils of Reshaping



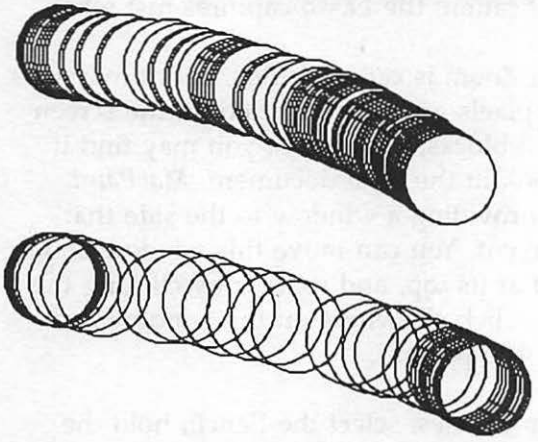
- To resize and reshape an image, pull the Marquee around it, place the pointer at the corner of the quivery rectangle, hold the Command key down, and pull. Everything inside suddenly becomes elastic, and you can stretch it as far as you want from the base of the opposite corner. To resize vertically, pull from a horizontal line. To resize horizontally, pull from a vertical line.
- To resize an image without changing its shape, follow the procedure above but press the Command and the Shift keys. Once again, Shift exerts constraint.

- You can also resize and reshape images you import from the Clipboard by simply pulling out a Marquee rectangle before Pasting. When you Paste, the image adjusts to fit it. Thus, another way to resize and reshape images you already have is to Copy them to the Clipboard, pull out a Marquee, and Paste.
- The Scale Selection. . . command in the Goodies menu also resizes items according to the percentages you type in.

Duplication. The Lasso and Marquee confer special powers to duplicate and to duplicate multiples.

- To duplicate a selection, press the Option key and pull. A new copy emerges from the selected area. This is one of the great powers of paint, since it allows you to build larger shapes from smaller ones or duplicate an image for further, trickier enhancement. If the enhancement doesn't work out, you can delete it and go back to the original.
- To duplicate multiples, press both Option and Command, then pull. A string of images appears in the wake of the cursor, like a shower of coins. The more slowly you pull, the more they overlap.
- If you go all the way and press Option, Command, and Shift, the multiple images aligns horizontally or vertically. This trick works well for generating a stack of items, such as papers or coins for pictorial graphs. You can also make them appear at regular intervals by choosing Turn Grid On from the Goodies menu beforehand, as we'll see below.
- Normally, duplicate images are opaque. White is white rather than no color at all, so if you pull one image atop another, it blocks the bottom image out. However, press the Tab key as you pull and the white areas of the shape become transparent, letting the graphics beneath show through (see Figure 2-13).

Figure 2-13. Opaque and Transparent Strings



Beyond the Tools

As you've seen, the tools provide windows onto numerous capacities of *MacPaint*. However, there are other areas which need to be investigated on their own. Some are initial conditions of painting, such as the level of magnification, and the presence and size of the Grid. Others involve certain menu commands, like Trace Edges.

Zoom

One of the finest aspects of paint programs is *Zoom*, which magnifies the screen so you can see each pixel more distinctly. *MacPaint* 2.0 has three levels of Zoom:

- 200 percent
- 400 percent
- 800 percent

If you've always had problems controlling the pencil or brush, this feature goes far to eliminate them.

All the tools work in Zoom as they do in 100 percent. Their cursors remain the same size, however, so at first you might be startled to see the kind of swath a Paintbrush can cut. The Spraycan and Text also yield gargantuan forms.

The Pencil is the most useful tool in Zoom, because it's adept at selecting individual pixels, but other tools are handy as well. For instance, if you want to Lasso an item separated from another by a narrow, winding band of white, you would need keen neuromuscu-

lar control at 100 percent to avoid roping in parts of the neighboring image. At higher magnification, the Lasso captures just what you want.

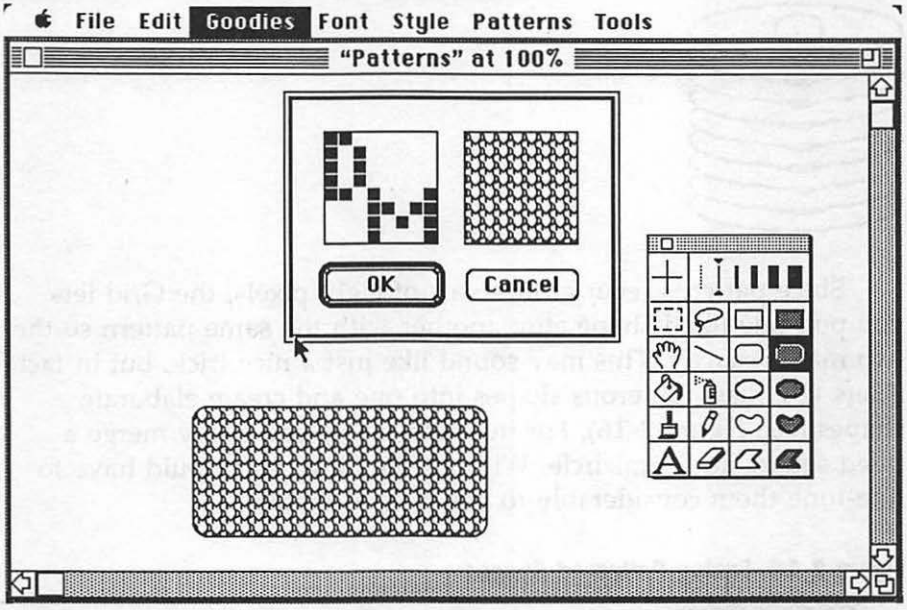
The capacity to paint in Zoom is called *FatBits,* and it may take practice to get used to. The pixels greatly magnified on the screen look like a collection of giant blocks, and at first you may find it hard to grasp how they'll look in the final document. *MacPaint* deals with this problem by providing a window to the side that shows your work in 100 percent. You can move this window about by dragging the dotted field at its top, and retire it by clicking the tiny square in its upper left. Click elsewhere on the window and the whole screen returns to 100 percent.

- To control where the Zoom focuses, select the Pencil, hold the Command key down, and click. It homes in on that spot.

Patterns

A palette of patterns is always available from the Patterns menu, which you can tear off and place on the screen. Patterns often simulate gray and can be essential for your work. Yet you may find the preexisting patterns insufficient. To create your own pattern, choose Edit Pattern. . . from the Goodies menu—or double-click a pattern to bring it up fast—and modify the pattern you've selected. You're now looking at a FatBits version of the pattern along with a 100-percent version of it, which gives you a better idea of what you are creating (see Figure 2-14).

Figure 2-14. Customizing a Monogram Pattern



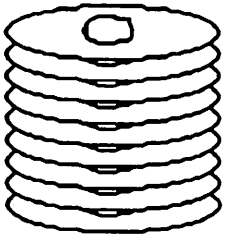
Grid

MacPaint also lets you set up a Grid on the screen by choosing Turn Grid On from the Goodies menu. The Grid is invisible, but if you could see it, it would be a cross-hatching eight pixels wide. You don't notice this Grid when you're drawing on the screen with, say, the Pencil. But pull out a Rectangle or other regular shape and its lines are now made up of eight pixels or their multiples. This fact gives you greater control over their size.

Moreover, if you Lasso a Rectangle and drag, you see it move in eight-pixel increments, essentially lurching across the screen. As a result of this snap-to feature, you can line shapes up with much greater accuracy.

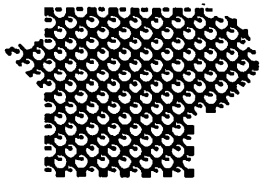
The Grid also allows you to pull out multiple images at evenly spaced intervals. You select a whole item with the Lasso, press Option-Command, and pull out slowly. Duplicates appear only at the Grid interval, and they overlap. Hence, if you draw a coin, select it, and pull it upward in this way, you get a stack of coins (see Figure 2-15).

Figure 2-15. Vertical String at Regular Intervals



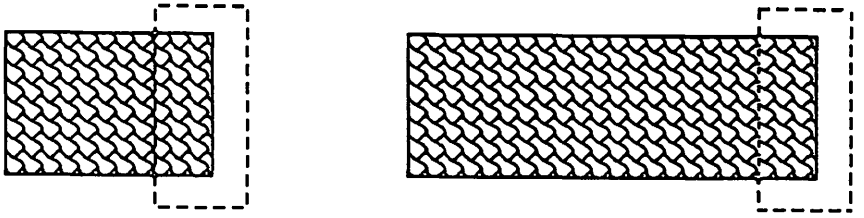
Since patterns recur at intervals of eight pixels, the Grid lets you pull one filled shape atop another with the same pattern so the two match exactly. This may sound like just a nice trick, but in fact it lets you fuse numerous shapes into one and create elaborate shapes (see Figure 2-16). For instance, it lets you easily merge a filled square and semicircle. Without the Grid, you would have to fine-tune them considerably to make them match.

Figure 2-16. Fusing Patterned Shapes



The Grid also lets you stretch patterned shapes. How? If you select the end of a Filled Rectangle, say, with the Lasso or Marquee, hold the Option and Command keys down, and drag with the Grid on, you get a string of copies at eight-pixel intervals. Hence, if you pull slowly, the patterns within overlap exactly, so the copies merge with each other and lose their identity. Only the final copy shows the border at the end of the Rectangle. In effect, you have elongated the item (see Figure 2-17). If you hold Option-Command-Shift, you constrain the image to vertical or horizontal. You can use the same technique to shorten figures but it works better with the Marquee, because the Lasso does not select the outside white space.

Figure 2-17. Stretching a Patterned Shape



If eight pixels seem too large or too small a mesh, you can set the Grid to 2, 4, 16, or 32 by choosing Preferences. . . under the Goodies menu and clicking the corresponding radio button in Autogrid spacing.

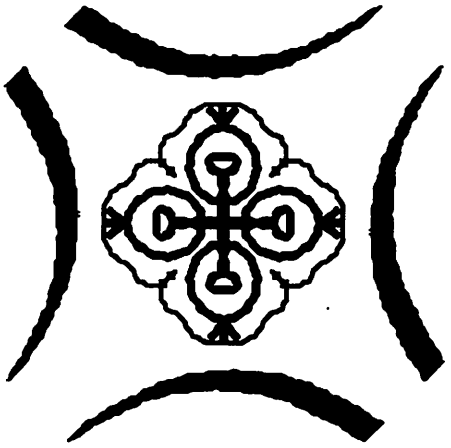
On the Menus

MacPaint has further powers which appear mainly on the menus. Most salient among them are special effects like Brush Mirrors, Invert, Rotate, and Trace Edges.

Brush Mirrors

Brush Mirrors sets up symmetry. You choose the command in the Goodies menu, and a box appears with a vertical, a horizontal, and two diagonal lines crossing each other. These are the *axes of symmetry.* Click on as many as you want up to four, then click OK. (Clicking a second time deselects.) When the main canvas comes back up, you now find that every brush stroke appears in more than one spot (see Figure 2-18). Brush Mirrors works only with the Paintbrush and Spraycan and is an excellent avenue to intriguing work.

Figure 2-18. Brush Mirrors



Invert

Invert is a simple command with a dramatic effect: It turns black pixels white and white ones black. You can select with either the Lasso or the Marquee, but of course the Marquee inverts the whole rectangle. Invert is especially valuable if you wish to paint white on black. It lets you work in the normal way—black on white—and Invert when you're finished.

Trace Edges

Trace Edges is an interesting command with much potential. You select an item with the Marquee—not the Lasso, because you need extra room—and then choose Trace Edges from the Edit menu. It turns the black pixels of each line white and then adds black pixels inside and out. The effect resembles that of the Outline style of Macintosh print. It is thus very useful for creating borders, since you can easily turn a rectangle into a double or triple rectangle. You can also trace the edges of many other items and, if you retrace over and over again, gain pseudo-labyrinth effects.

Trace Edges performs especially well with certain patterns, particularly those that leave a lot of white space inside. If you trace-edge a solid black rectangle, you get an open rectangle two pixels wider. But if you trace-edge a rectangle with a sparse pattern within, you can generate arabesques.

- Hold the Shift key down as you choose Trace Edges and you also get a bit of shadow on all right and bottom edges. It lends a little depth.
- For more condensed text in Outline style, select normal text with the Marquee and choose Trace Edges. For compact text in Outline-plus-Shadow style, select it with the Marquee, hold the Shift key down, and choose Trace Edges.

Rotate

The *Rotate* command in the Edit menu swings an area selected by the Marquee 90 degrees counterclockwise (to the left). Hence, the first time you issue this command, horizontal items stand on end; the second time, they're reversed and upside down.

Flip Horizontal and Vertical

These commands in the Edit menu cause the selected areas to swing about an axis. The first causes one half-swing around a vertical axis, the second around a horizontal one. In other words, *Flip Horizontal* completely reverses the order and left-right shape of pixels, but turns nothing upside-down. *Flip Vertical* turns the image upside-down but has no effect on the left-right order. Issue Flip Horizontal and then Flip Vertical, and you have the same result as if you'd issued Rotate twice.

Color

Mac IIs offer a tremendous array of colors—about 16.8 million in all—and working with color is quite unlike working with black-and-white, or even grayscale. Graphics are made for color. You can achieve intriguing effects with black and white. For instance, the movie *The Third Man* and the photographs of Ansel Adams would be utterly different and diminished in color. Black and white draws you in, induces you to complete the image. It also accentuates shadows and can create a greater sense of austerity and even somberness, as in the work of Rembrandt. But the effect of color in general is so pleasurable and various that it transforms the experience.

Whether you have access to all of the millions of colors or not, you can work with your choice of colors. The System for the Mac II

offers a Color menu, which lets you pick among eight colors—black, brown, blue, light blue, green, orange, pink, and red—for coloring folders or files. This is a handy way to distinguish among files or folders for different purposes.

You can obtain far more colors using the *Color Picker,* which you access by clicking the palette icon in the Control Panel. (Several programs also use it.) The Color Picker defines colors in terms of three technical qualities: hue, saturation, and brightness.

- *Hue* refers to the color itself—red, green, and the other colors across the spectrum. In physics, these are created by different wavelengths of light, and we can describe hue by its wavelength. However, real-life colors are composed of hues as well as white, gray, or black. Hence, we need two more measures.
- *Saturation* refers to how much hue is actually in the color, as opposed to white, gray, or black. A series of various percentages of, say, yellow mixed with a steady gray would differ from each other only in saturation.
- *Brightness* indicates the amount of white in the color and describes the nonhue part of the color. Black, gray, and white have no hue or saturation, and they differ from each other only in brightness. Thus, the hue and saturation of a string of colors could be the same—40-percent magenta—and differ only in the amount of white, gray, or black, that is, in brightness. Pure white would be 60 percent, pure black, 0 percent.

The Color Picker is a circular device that lets you calibrate these three qualities numerically. By combining them in different degrees, you can derive all the colors the Mac II can display.

Color perception is a complex field and abounds with subtleties and limitations. For instance, the color you select in the Color Picker may differ slightly from the color that appears on the screen, for reasons of technology. Color also varies from one monitor to another. The kind of light in the room—solar, fluorescent—can also affect the color on the screen. Our age influences color too, for as we grow older, we tend to lose perception of blue and see the world in yellower tones.

Color brings with it a whole new host of possibilities and potentialities. A few of them include:

Smooth. To ease transition between two colors, some software automatically averages the hues and inserts lines of these colors between them.

Smear. This feature lets you mix two colors at a boundary together, almost as if you were smudging them with your finger. It's good for creating a rough or hazy look, as with clouds.

Cycle Draw. With this feature your brush continually changes color through the current range of colors, so you get brilliant spectrum effects.

Of course, *MacPaint* is not the only paint program. There are many other fine ones, most of which work similarly, including *SuperPaint,* which can both paint and draw. And there is one program that fuses paint powers with a panoply of others: *HyperCard.*

3
HyperCard

After Bill Atkinson wrote *MacPaint,* he went on to write a far more ambitious program called *HyperCard,* which debuted in 1987 to great enthusiasm. *HyperCard* was a true innovation and, initially, hard to describe. Programmers around the world are busy making clones, so such software may soon develop a generic name. For now, perhaps the best description is that it's an interface with special graphics and database powers, which makes buttons, dialog boxes, scroll bars, and other Macintosh features readily available for you to manipulate. Hence, it gives you remarkable control over the machine.

There are many thick *HyperCard* books on the market but, unfortunately, some are almost overwhelming. You can easily get the impression that creating a *HyperCard* stack is an arcane endeavor demanding much sober expertise. In fact, it's simplicity itself. This chapter shows you the basic steps to creating stacks, and it provides some special graphics tips for using this delightful program. *HyperCard* is a world in itself; for more information, you should purchase one of the comprehensive books, which are generally very informative.

The Superficial Elements

HyperCard works quite differently from most other programs. It's like a deck of playing cards, except you can jump around from one card to another with magnificent ease. Here are the major elements, as they appear to a casual user.

Cards. Most programs contemplate printouts on sheets of paper, and hence work with basic units of 8.5 × 11 inches. *HyperCard* is oriented to the computer itself, and thus its basic unit is the size of the original Mac screen, that is, 7.11 × 4.75 inches. Such a screen is called a *card.* (On the Mac II, cards are that size also, but since the screen is larger, they appear as rectangular isles in the center of the monitor.)

Stacks. Cards in *HyperCard* are not isolated entities but appear one atop another, like a ream of paper. Peel one card off and you

see another beneath it. A single pile of cards is called a *stack.* The stack is the basic *HyperCard* document.

Buttons. Buttons are one of the key tricks of *HyperCard.* They make things happen. Click a button and you can move to another card or stack, bring up a dialog box, trigger a sound, and otherwise cause action. The most important buttons are *navigation buttons,* which move you around. They are like instant secret passages, shifting you at once from one locale to another.

Text. Many *HyperCard* cards have special areas where you can type in records or other data.

From the Ground Up

A creator of *HyperCard* stacks sees a picture rather different from the one the casual user sees. That's good. It means *HyperCard* uses a variety of tricks to simplify use. For the stackmaker, the following are the main elements:

Backgrounds. This is a basic, unchanging format provided for a set of cards. A background might, for instance, simply contain a border. Each card using that background would also have that border but could have extra information as well. Backgrounds ease the creation of stacks, since they let you reproduce the same items over and over again. They give the cards a more uniform look, and not incidentally, they save disk space.

Cards. Individual cards are areas where you supply the material particular to that card.

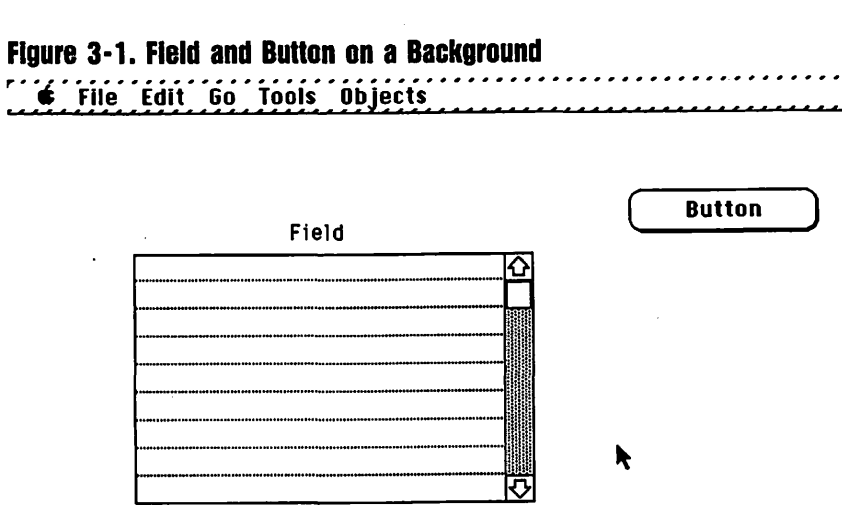
Fields. These are the regions where the user can type in text. Fields may be completely transparent, look plain and rectangular, or have scroll bars; in any case, you must define them. You can put fields on either backgrounds or cards.

Buttons. These are the tools for mobility that let you connect different cards or stacks, so you can jump about at will. Again, you can place buttons on backgrounds or cards (see Figure 3-1).

User levels. Finally, *HyperCard* has a set of user levels invisible to the untutored user. They are:

1. *Browse,* where you merely view the cards.
2. *Typing,* where you can enter written information.
3. *Painting,* where you can supply graphics.
4. *Authoring,* where you can create buttons and fields.
5. *Scripting,* where you can write *HyperTalk* programs, which are called *scripts.*

Figure 3-1. Field and Button on a Background



Each level contains all the powers of the levels beneath. Most casual end users work in level 2, where they can't inadvertently do damage. If you are devising your own stack, there's no reason not to go straight to level 5.

There are two ways to set user level:

- From the User Preferences card, the last card in the Home stack. Here you simply click a radio button.
- From the Message Box. Choose Message from the Go menu or press Command-M. When the box flashes onscreen, type *set userlevel to 5* or whatever level you want, making sure that *userlevel* is all one word. Then press Return. This is the faster method.

How to Make a Stack

Here's a crash course in making a *HyperCard* stack. Again, if you intend to get serious about this program, you should probably buy one of the books devoted to *HyperCard,* particularly if what follows seems incomprehensible. But here is the procedure in a nutshell.

Outline the stack on paper. Macintosh software can be so slick it tempts us to leap right in, without planning. Paper is still

good for many things, and one is preparation for using powerful programs. You should think through what the stack should do, what it should contain, and who's going to use it (Novices? Sophisticates?).

Then you should map out a series of cards, indicating the function of each and the connections from one to another. This exercise provides the overall structure of the stack and shows the kind of mobility you have. Next, you should design rough thumbnails, or sketches, of each card or type of card—keep them rough. The thumbnails show you the graphics, buttons, and text of the cards, so you aren't lost when you commence card design. They also give you a chance to identify repeating elements, which you can place in a background.

Access the power. First, press Command-M, type *set userlevel to 5* in the Message box to establish the user level at Scripting, and press Return.

Initiate the stack. Now, open any stack and choose New Stack from the File menu. A dialog box appears. Deselect the box next to *Copy current background* so you can begin with a clean slate. Enter a name for the stack and press Return. You now face a bare screen and can commence.

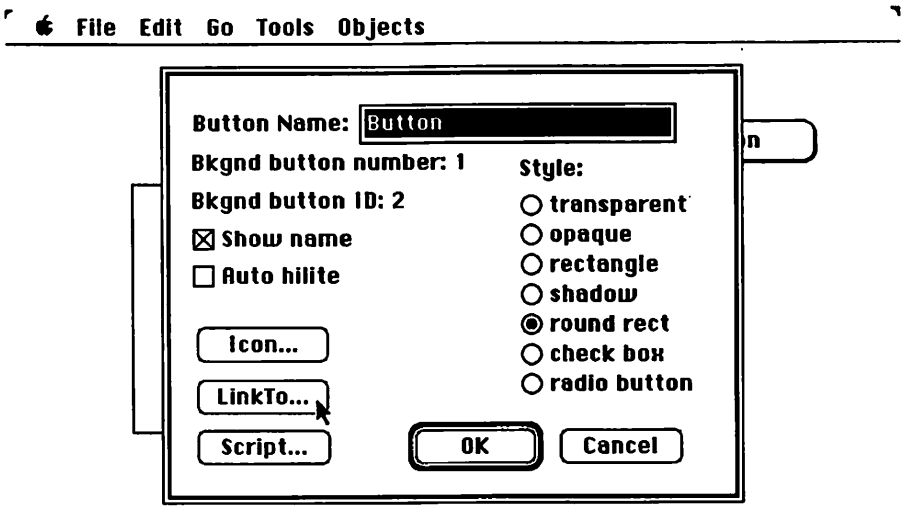
Bring up the background. Choose Background from the Edit menu or press Command-B. The menu bar at the top develops distinctive little nicks.

Add fields and buttons. Both are easy.

For fields, select New Field from the Objects menu. A set of lines appear on the screen surrounded by moving dots, like an old-time movie marquee. The field is selected, and you can now pull it around or change its size at will. (You can also create a field by choosing the Field tool in the upper right of the Tools menu, holding the Command key down, and dragging the mouse.) Now, double-click on the field and a dialog box appears; you can name it and bestow upon it such qualities as scroll bar, shadow, and special font.

Buttons work the same way. You select New Button from the Objects menu (or choose the Button tool from the upper middle of the Tools menu, hold the Command key down, and drag the mouse). A button appears surrounded by moving dots, and you can shift it around or change its size. Double-click the button and a dialog box lets you name it and set its characteristics. The name appears within the button if you also choose Show Name (see Figure 3-2). You can also add background graphics or prose at this stage.

Figure 3-2. The Button Box



Create the cards. To exit the background, press Command-B again. You are now in your first card. You add graphics, prose, fields, and buttons to it as you please, in the same way as above. Then you choose New Card from the Edit menu or press Command-N. Now you're on the second card, and once again, you see only the background. You design it, press Command-N again, create the third, and so on.

Link the buttons and cards. Go to the first card, choose the Button tool from the Tools menu, and double-click the button you want to link. When the dialog box comes up, click on the LinkTo. . . button. A dialog box appears, but you still have mobility through the cards and stacks of *HyperCard*. Go to the card to be linked and click This Card in the dialog box. (If you're going to another stack, go there and click This Stack.) If you misconnect, simply repeat the procedure and link up correctly. The prior link disappears.

The stack is finished. Now, this is really not very hard. If you've never used *HyperCard* it may seem complex at first, but as soon as you've done it once or twice, the difficulty simply drops away. The hardest thing about *HyperCard* is taking the plunge.

Stacks with more than one background. There is one complication that arises when you want a stack with more than one background, but even here, the adjustment is minor:

- Outline the cards on paper, and determine how many different backgrounds you need.
- Create the first background, and as many cards as it applies. Add all the fields and buttons the background needs.
- Go to the last card of the background and choose New Background from the Objects menu. This instruction generates both a new background and a new card. If you aren't at the last card when you issue this command, you'll find yourself with *three* backgrounds instead of two and you'll lose disk space.
- Add fields and buttons to the new background.
- Add as many more backgrounds as you need and fill in their cards.
- Link the buttons.

As you get more fluent with *HyperCard,* you'll find you don't have to follow these procedures to the letter. *HyperCard* is enormously flexible. But at the outset, these procedures provide the basic guidelines.

You can also modify existing stacks, a faster procedure. You simply enter the stack and change the user level to 4 or 5. You can then work with buttons and fields, alter the backgrounds, and otherwise customize the stack.

HyperCard Graphics

HyperCard has most of *MacPaint*'s features, so you can easily paint directly onto a card or background. However, paint in *HyperCard* is not quite the same as in *MacPaint.* There are a number of novelties.

First, *HyperCard*'s paint powers do not come into full view until you select a paint tool from the Tools menu. At that time, three new menus appear to the right:

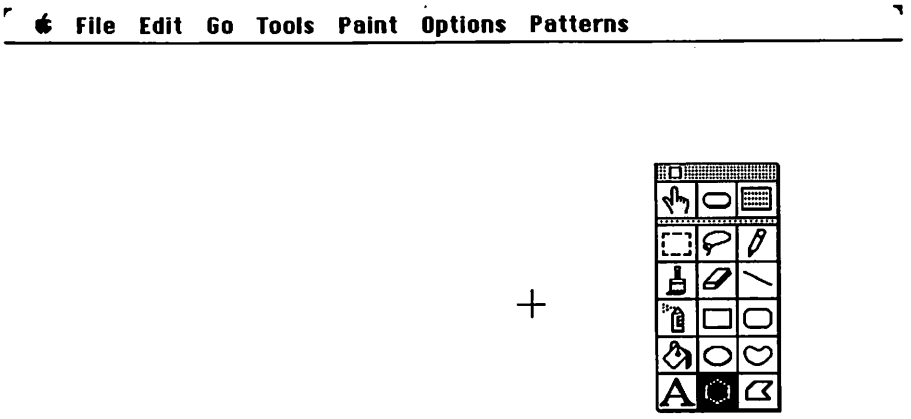
- Paint
- Options
- Patterns

In addition, the File menu gains the Import. . . and Export. . . commands.

The tear-off Tools menu has not only the familiar items such as the Pencil and the Spraycan, but also the vital Button and Field tools used to create buttons and fields; they're at the top and slightly marked off from the rest. It also has the Browse tool, which is

essentially the familiar pointer. At the same time, it lacks the Grabber, since you never need to pull hidden parts of a card into view (see Figure 3-3).

Figure 3-3. *HyperCard*'s Tear-Off Tools Menu



Though *HyperCard* automatically saves most acts at once, when you're working in graphics it holds back and gives you room to bail out. To save, choose Keep from the Paint menu or press Command-K. The program automatically saves when you go to another card or leave the paint tools. To resurrect the card as it was at the last save, choose Revert from the Paint menu.

HyperCard also has a few new graphics powers:

Regular Polygon. *HyperCard* has a Regular Polygon shape, that is, one that generates polygons with sides of equal length. You choose Polygon Sides from the Options menu (or double-click the Regular Polygon tool in the Tools menu), and a dialog box appears. Choose the number of sides you want, and then pull the shape out. The Regular Polygon has several interesting distinctions. It's the only shape that automatically draws from center. Moreover, if you turn the mouse as you drag, the image rotates. This power thus provides an excellent way to turn a square into a

diamond, and otherwise to fully rotate it. To constrain rotation to 15-degree increments, hold the Shift key down as you pull.

Pickup. The Pickup command in the Paint menu lets you select in special shapes, rather than in the rectangle of the Marquee or the external edge of the Lasso. For instance, if you wish to Pickup a circle out of a graphic, you would choose Draw Filled from the Options menu; draw the circle (Shift-Oval); choose Pickup and see the shimmery outline; and then either move the item, Cut it, or Copy it to the Clipboard (see Figures 3-4 and 3-5). The Pickup command can be a potent device and yield unusual forms.

Darken and Lighten. These two commands in the Paint menu let you add and subtract black pixels to and from a selected area at random. They're rather like an airbrush, working within limits you define. They are sparse, and you may need many commands to fill or deplete an area. Among other things, these commands are excellent for creating a neutral tone, because they can yield a grayish area that also looks rather uneven.

Draw Multiple. Here's a nifty trick: Choose Draw Multiple from the Options menu, then choose a regular shape from the Tools menu. As you pull it out, it yields a sequence of shapes of different sizes, all starting from the same point. Thus, pulling out a

Figure 3-4. Pickup Command: Step 1

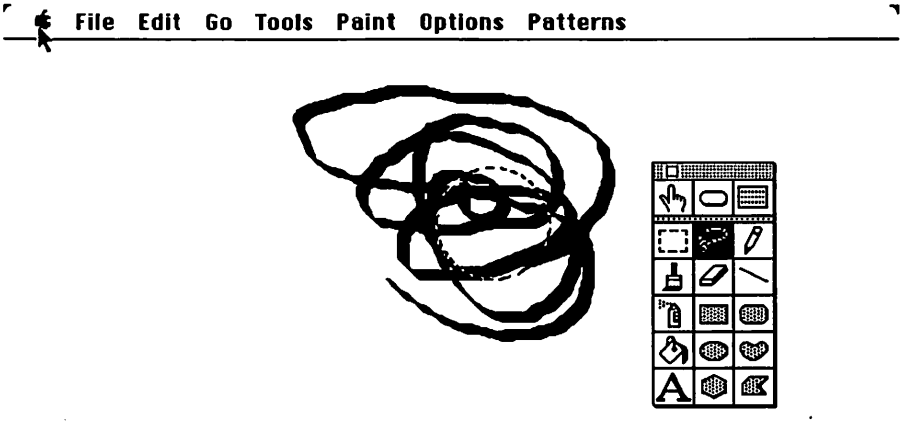
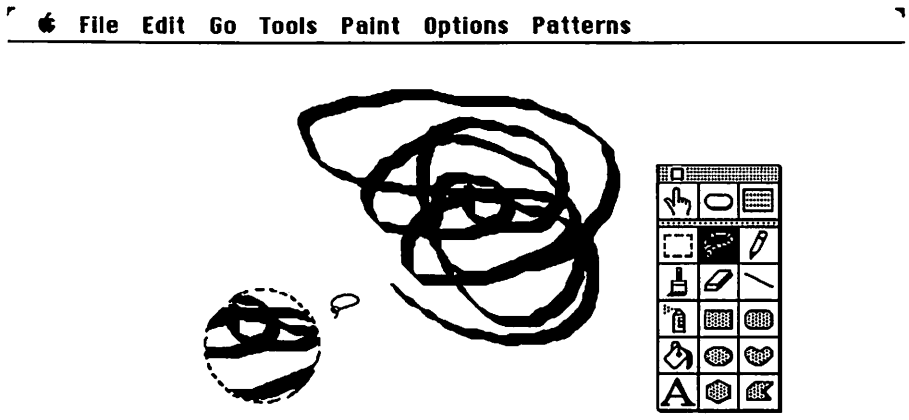


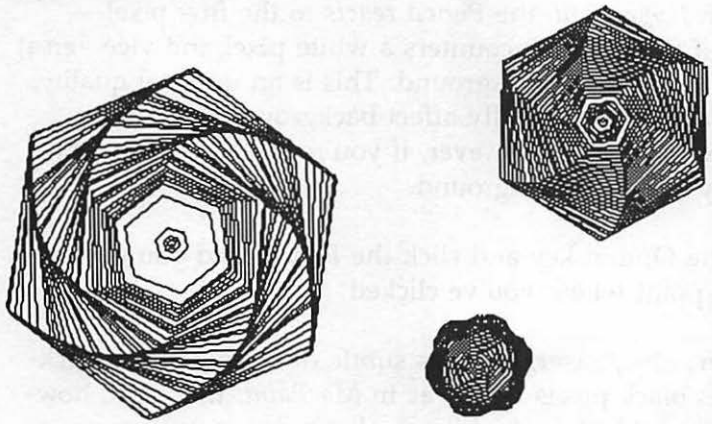
Figure 3-5. Pickup Command: Step 2



circle can yield a cone. (You can make the shapes concentric by choosing Draw Centered from the Options menu.) After you choose Draw Multiple, you can also press Option and any number from 1–9 to set the interval in which images appear. Some of these shapes make good buttons. For instance, the Rounded Rectangle with Draw Centered yields unusual shapes, as does the Regular Polygon, especially when rotated. If you turn the mouse as you pull out the Regular Polygon, the images rotate as they grow, creating an effect like the iris diaphragm aperture of a camera (see Figure 3-6).

Transparency. You can make the white of any image transparent in *HyperCard* by selecting it and choosing Transparent from the Paint menu. This power also affects images you Paste in. You can always return to the default setting, which is Opaque.

Figure 3-6. Vortices



The Tools

As you've seen, the Regular Polygon replaces the Grabber on the Tools menu. Apart from that and the new top tier, the *HyperCard* Tools menu looks pretty much like the *MacPaint* menu.

That similarity is deceptive. *HyperCard* graphics have a slew of subtle differences. For instance, *HyperCard* affords more freedom with the Option key. In *MacPaint,* pressing Option almost always changes the cursor to the Grabber. Here, with no Grabber, the Option key is free.

HyperCard does, of course, retain a great many of the qualities of *MacPaint.* Let's go over the tools one by one and note the differences.

The Paintbrush. The Paintbrush works a bit differently in *HyperCard.* For instance, it does not paint over buttons and fields in the same layer. In a background, it doesn't paint over background buttons and fields, and in a card, it doesn't paint over card buttons and fields. However, in a card you can paint over buttons and fields in the background—they're still there and still work, so painting over a background button enables you to hide it.

- Hold the Command key down as you pull and the Paintbrush becomes an eraser, in whatever brush shape you've selected.

The Spraycan. The Spraycan has one new trick. If you hold the Command key down and spray, you now get a mist of white.

The Pencil. As we've seen, the Pencil switches the color of the

first pixel it touches and then changes every other pixel it touches to that color. In *HyperCard,* the Pencil *reacts* to the first pixel—drawing black if it initially encounters a white pixel and vice versa) whether it's in the card or background. This is an unusual quality, since the graphics tools generally affect background only when used in background mode. However, if you're in a card, the Pencil doesn't actually alter the background.

- Hold down the Option key and click the Pencil, and you go into FatBits at the point where you've clicked.

The Eraser. The Eraser, too, has subtle differences. In a background, it turns black pixels white, as in *MacPaint.* In a card, however, it makes both black and white pixels transparent, so any black pixels from the background show through. Thus, you can find yourself passing the Eraser over white areas and making graphics appear, a seemingly non-Eraserlike function.

- Hold the Command key down and pull, and the Eraser replaces all black and transparent pixels in a card with white ones. This method essentially gives you the Eraser of *MacPaint.*
- Double-click the Eraser icon and you eliminate just the graphics material on a background or card, not the buttons or fields.

The Straight Line. The Straight Line works the same as in *MacPaint,* with these exceptions:

- Press Shift as you pull out the Straight Line, and you constrain it to 15 degree increments, rather than 45 degree increments.
- For patterned lines, hold the Option key down as you pull (not Command, as in *MacPaint*).
- Double-click the Straight Line icon and the Line Size box appears. The line sizes no longer repose in the Tools menu, but have their own command in the Options menu.

The Paint Bucket. The Paint Bucket remains generally the same potent little monarch, prone to stunning error.

- Double-click the Paint Bucket icon in the Tools menu and the Patterns palette appears. Double-click it again and the palette vanishes.

The Shapes. The shapes—Rectangle, Rounded Rectangle, Oval, Freehand, Irregular Polygon—have most of the same powers as in *MacPaint,* but they do a few things a little differently.

- To choose a filled shape, double-click its icon. This act turns all six shape icons gray like the permanent icon in *MacPaint.* You can also choose Draw Filled from the Options menu. (To choose the filled Regular Polygon, you must double-click another shape icon first, since double-clicking the Regular Polygon itself brings up the Polygon Sides box.)
- Hold the Option key down and pull out the shape, and the border appears in the pattern selected in the Patterns menu.
- Hence, for a borderless filled shape, double-click the icon (or choose Draw Filled from the Options menu), hold the Option key down, and pull it out. This act replicates the Fill command in the Paint menu.

The Irregular Polygon. The Irregular Polygon has one extra feature missing from *MacPaint.* Hold the Shift key down for constraint, and you can create lines in increments of 15 degrees, not 45. In this regard, it resembles the Straight Line in *HyperCard.*

Text. You can add text to stacks in two ways: with fields and with the Text tool. There are a few differences. It's easier to use the Text tool, since you don't have to create a field and then make it invisible. Moreover, since Text tool characters become graphics, you can use special fonts without worrying whether someone on another system has the same fonts. However, Text tool characters suffer at printout. As graphics, they go to the laser printer bit-by-bit, though you can usually improve quality by checking Smoothing under Page Setup in the File menu. Field text automatically turns into laser fonts in the LaserWriter and prints at 300 dpi.

- Double-click the Text icon and you see the font dialog box, the same one you get with the Field tool, which lets you select font, size, style, alignment, and line height.
- As in *MacPaint,* you can alter font, font size, or line spacing by pressing the less-than key or greater-than key plus Command, Command-Shift, or Command-Option, respectively.

The Lasso. Hold the Command key down and click the Lasso inside an item, and it selects black pixels near the point of clicking

plus any pixels that touch them. This is a very handy way to select a closed figure.

The Marquee. Hold the Command key down as you pull out the Marquee, and it completely surrounds your item and changes to a Lasso. Why not just use the Lasso? Try this and you'll see. It's a whole lot faster.

HyperCard Clip Art

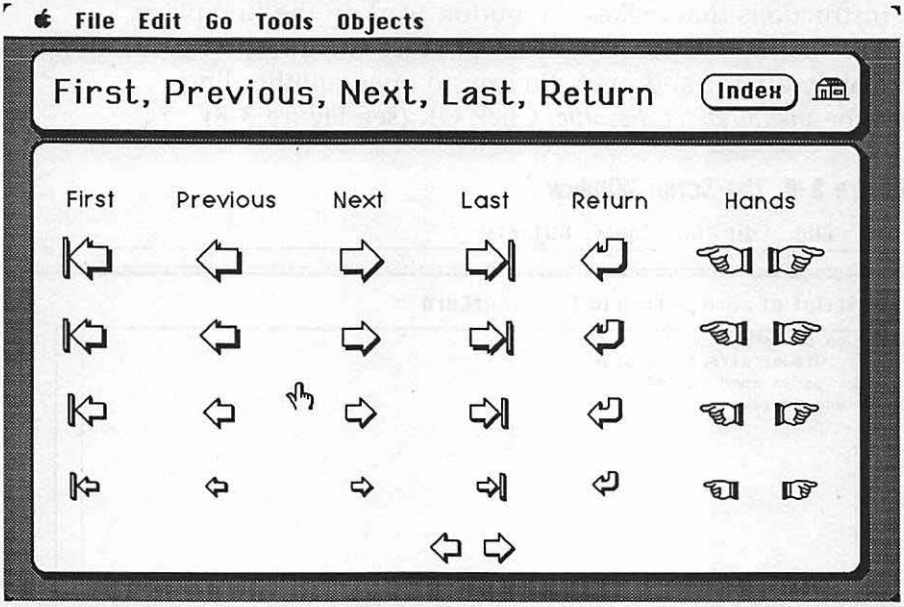
HyperCard abounds in clip art, which you can select and move all over the place. The Art Ideas, Button Ideas, and Clip Art stacks have plenty of graphics, which you can dip into at will, and for snappy stacks it really makes sense to familiarize yourself with the wealth available. You may even wish to print out the clip art for fast reference. To move this art into your stack, follow the same steps as with any Mac program. You select with the Marquee, then Copy and Paste from the Edit menu.

You can also use art as buttons. With buttons, however, the procedure is a little more involved, since you want *HyperCard* to recognize the graphic as a button. Here's how to put an arrow—one of the most common buttons—where you want it:

- Create at least one background.
- Go to the Home card, click on the Button Ideas stack, and flip down to the card with the arrows (see Figure 3-7). (This stack also has Home and Macintosh icons, plus a raft of others.)
- Choose the Button tool on the Tools menu, then click on an arrow and copy it by pressing Command-C or choosing Copy Picture from the Edit menu.
- Return to your stack by choosing Recent from the Go menu and clicking on the mini-picture of the card in your stack.
- If you want to place the button on the background, press Command-B or choose Background from the Edit menu. Otherwise, the button can exist solely on that card.
- Paste the arrow by pressing Command-V or choosing Paste from the Edit menu. You can always move it once it's pasted.

You can also import graphics from outside *HyperCard,* if they're in the *MacPaint* format. You simply use the Clipboard or Scrapbook to import parts of files, and it works fine. However, if you want to bring the entire file in with the Import. . . command in *HyperCard* (under the File menu, but only after you've selected a paint tool

Figure 3-7. The Arrow Buttons



from the Tools menu), you must realize that it will completely cover whatever else you have on a card. Hence, the best approach is to create a separate stack especially for imported graphics, where each card is a single import. In building this stack, you choose New Card from the Edit menu, then choose Import. . . from the File menu, and pick from among the files listed. It fills the card, you issue another New Card command, and so on. Why use Import. . . at all? *HyperCard* compresses these files, saving disk space.

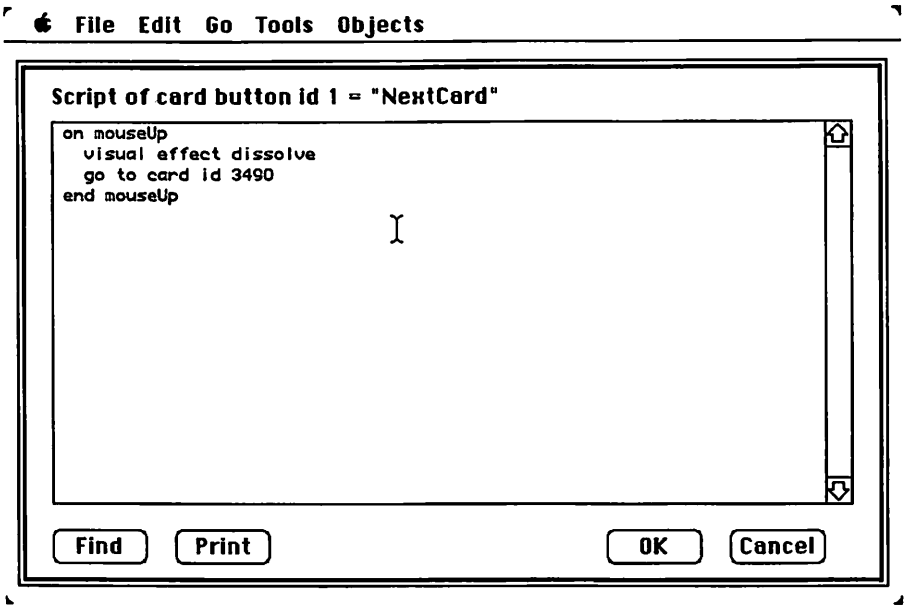
Transitions

One of the slickest things you can do with *HyperCard* is control the transitions from card to card. It involves a dip into programming, that fearful domain, but the results are so appealing, the effort so minor, and the sense of accomplishment so pleasant that it's worth the plunge:

- Choose Message from the Go menu or press Command-M. Type *set userlevel to 5* and press Return.
- Go to the card where you want to start. Choose the Button tool from the Tools menu, then double-click on the button you're leaving to get its dialog box.

- Click on the Script. . . button. This act reveals the set of *HyperTalk* instructions that makes the button work in the first place.
- The first instruction is mouseUp. Place the insertion point immediately after it and press Return, to open another line.
- Type *visual effect dissolve.* Click OK (see Figure 3-8).

Figure 3-8. The Script Window



Now when you click on this button, the card seems to break into tiny granules and fade into the next card. It's a striking effect.

The words *visual effect* (or simply *visual*) constitute the basic command that tells *HyperCard* to use a special transition. The last word, dissolve, tells *HyperCard* which kind to use, and you can substitute a number of other effects for it. (These commands won't work alone; they have to be part of a valid script and begin with proper commands like on mouseUp.)

- scroll up. The new card first appears at the bottom and slides up to the top.
- scroll down. The new card appears at the top and slides down.
- scroll left. The new card appears at the right and moves left.
- scroll right. The new card appears at the left and moves across.
- wipe up, wipe down, wipe left, and wipe right. These commands

work just like scroll, except they move in only new material. The scroll instruction moves in a whole new card, whether the background is the same or not.

- Barn door open. The new card appears first in a line down the middle of the screen and spreads to the sides.
- Barn door close. Halves of the new card appear at the sides and spread to meet at the center.
- Venetian blinds. Parts of the new card first appear at several lines across the screen, and slide up shutterlike to meet the lines above.
- Checkerboard. Parts of the new card first appear at the bottom of numerous squares, and slide up to meet the squares above.
- Iris open. The new card first appears at the center of the card and opens outward.
- Iris close. The new card first appears at the sides and spreads in to the center.
- Zoom open. The new card first appears where you click the mouse and opens out from there.
- Zoom close. The new card first appears at the sides and moves in to the point of the mouse click.

You can go wild with these instructions, but for most purposes a little discretion is appropriate.

The open commands should generally unveil a new, unseen screen, and the close ones should return you to where you were.

Commands with left and up in them also usually introduce new material, while the right and down commands retreat.

The iris and zoom commands are often used to reveal cards with more detailed information on them.

The dissolve instruction has several purposes. It can move you from the title card to the second in the stack, show the passing of time, or simply indicate a gradual transition from one card to another.

There are two more aspects of transition which you can also control with instructions: speed of transition, and intermediate shade.

To determine how quickly *HyperCard* moves from one card to another, place the following words after the visual effect commands above:

very fast
fast
slow (or slowly)
very slow (or very slowly)

For instance, you might type in:

visual effect checkerboard very slowly

For truly special effects, you can indicate an intervening shade after the speed. The commands here are:

to black
to white
to gray
to inverse

Hence, a complete instruction might be:

visual effect iris open slowly to inverse.

This intermediate-shade command absolutely must come after the speed command, if you use one, or *HyperCard* does not understand the instruction.

What do these commands do? They add another little visual element. If you type *to gray,* for instance, the screen briefly goes gray before revealing the next card. If you type *to inverse,* it briefly displays an inverted image of the next card—white for black and vice versa—before showing the true one. This latter effect works best on *very slowly,* since at faster speeds it creates a weird and startling flash (which, of course, you may desire). In general, though, you should reserve showy effects for appropriate occasions.

HyperCard mixes great graphics powers with a host of other capacities, but it still remains paint. To examine the next realm, we must move on to draw.

4
Mastering Draw

A paint program is like transparent tropic water, where you gaze down and see brightly-colored fish and think you've seen it all, until you don scuba gear, swim down among the reefs and discover there is much more. In draw, on the other hand, the water initially seems much murkier. Yet it teems with life, and ultimately may hold more possibilities.

If you come to a draw program straight from paint, you may find it constricting. Draw programs often have fewer commands than paint, and the approach may seem strange and arcane. Draw forces you to work with pieces—rectangles, circles, and lines—rather than pixels. It lacks the safety net of fast erasures and FatBits. Draw is not as intuitive as paint and requires a bit of study. You have to lift up the unprepossessing lid to see what's really going on.

But the very drawback of constraint can sometimes be a virtue. Since you work with shapes rather than pixels, you gain much more flexibility and control over your graphic. You may also gain access to features like fountains, which rarely appear in paint. Also draw yields better laser printout than paint, for reasons we have seen.

The key to draw is planning. Unlike paint, where you sail out into the unknown with a smile on your face and a moistened finger for a weathervane, here you must sketch out your work in advance, breaking it down into components. Later you assemble the pieces by grouping, rather like welding, and obtain a resilient image.

Let's go through a basic draw program, this time using *MacDraw II* as the model, and highlight its main aspects.

Basic *MacDraw*

MacDraw has a number of features that resemble those in *MacPaint,* but often they work somewhat differently. If you are used to paint, the result can be occasional disorientation, almost like culture shock, in which normal things just don't seem to work the way they should. The differences are often minor—a matter of altered approach rather than novel concept—but it may take awhile to understand this.

Creating Objects

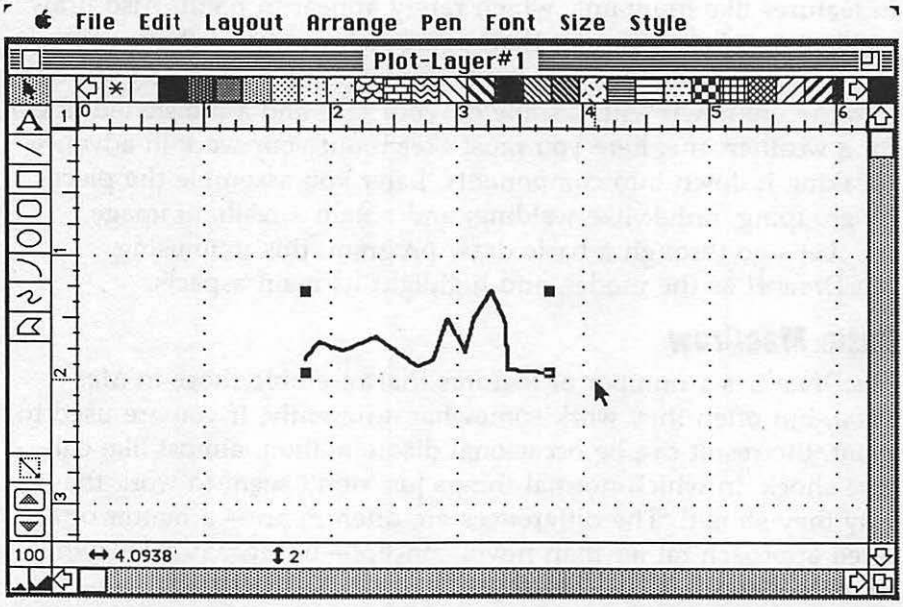
The first set of differences comes with creating objects. *Objects* are the building blocks of draw; they can be circles, rectangles, lines, combinations of shapes, or almost any form you can conceive.

Selecting Objects. Objects are easy to select, because the computer already understands their shape. In paint, you have to use the Lasso or Marquee to select a group of pixels, but in draw, you have two quick options. You either surround an object with the marquee that is constantly available from the tip of the pointer, or you double-click near the invisible rectangle around the object. If you're not sure where the rectangle is (it's invisible), you can usually bring it up by double-clicking at the point on the object furthest from the center.

You'll recognize a selected object at once by the tiny black squares called *handles* that appear around it. The pointer can grasp the handles to make further adjustments on the object (see Figure 4-1).

Group Selection. You can select numerous objects at once by Shift-clicking or pulling the marquee around them. Once they're selected, you can move them, clear them, fill them with a pattern, or perform some other operation on all at once.

Figure 4-1. Handles



Selecting Tools. You select tools for one of two durations: once-only or ongoing. Paint provides an example of the ongoing mode: You select a tool and it stays selected until you click another one. In draw, you have a choice, and the default mode is once-only.

Normally when you choose a tool, its icon becomes only partly dimmed. You draw an object and the program automatically selects it on the screen, contemplating that you'll wish to alter it at once. At the same time it deselects the icon so it turns white again. To use the tool immediately thereafter, you must click it anew.

You can select a tool for ongoing use by double-clicking its icon. The icon goes black. You can now create as many shapes as you like without reclicking the icon. The shapes appear on the screen without boxes at the corners, indicating that they are unselected. To bail out of ongoing mode, click the pointer icon in the upper left of the screen.

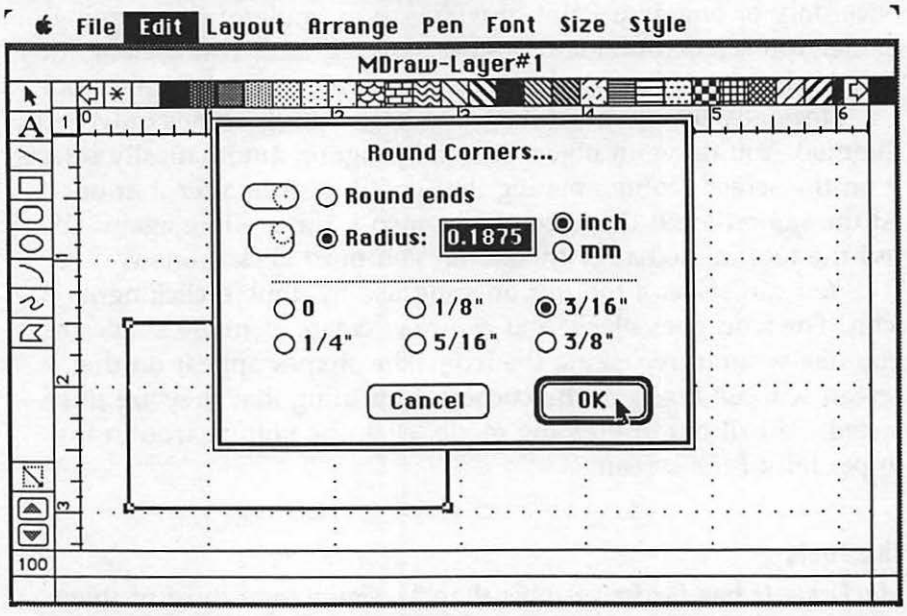
The Tools

MacDraw II has far fewer tools than *MacPaint,* and most of them are shapes. Their icons lie permanently along the left side of the screen, and they are:

- Straight Line
- Rectangle
- Rounded Rectangle
- Oval
- Arc
- Freehand
- Polygon

The Straight Line, Rectangle, Rounded Rectangle, and Oval work pretty much as they do in paint. However, the program lets you control the amount of curvature in a rounded rectangle by using menu commands. You create a square-corner Rectangle, choose Round Corners from the Edit menu, then type in the radius length under Radius. Since the curve is always 90 degrees, the radius equals the extent of the curve on each side. This dialog box also lets you turn two opposite sides into semicircles and create an oblong by picking *Round ends.* This command works by setting the radius to half the length of the side (see Figure 4-2).

Figure 4-2. Customizing Rounded Corners



The other three *MacDraw* tools merit a moment's attention. They don't fill automatically, and the Reshape command works only with them.

Arc. *MacPaint* has nothing like the Arc, which yields one quadrant (90 degrees, or one quarter) of an oval. If you want an Arc larger or smaller than 90 degrees, create an Arc, select it, choose Reshape under the Edit menu, and extend or retract it.

Freehand. The Freehand tool is the rough equivalent of the same item in *MacPaint.* You drag it wherever you like, and when you stop the shape is fixed. When you use it with line width at 0 points to make a filled borderless shape, the line appears onscreen as you draw. When you're finished, it vanishes, a box with four handles arises, and you fill. The Freehand tool does not close automatically.

Polygon. The Polygon is irregular, as in *MacPaint.* To make it close automatically, you must check the *Close automatically* box in Preferences. . . under the Layout menu.

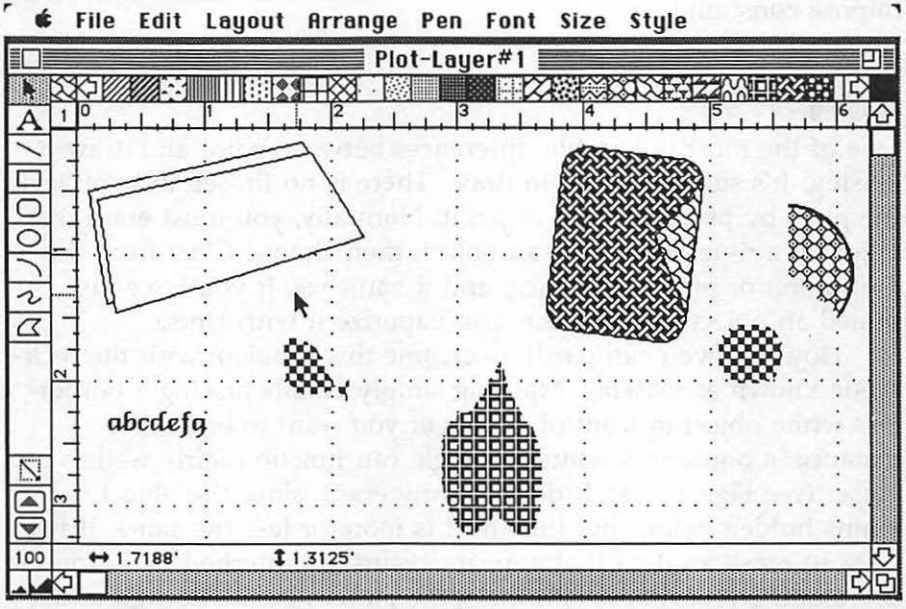
Borders. For all these tools, you set line or border width in the Pen menu. You either choose a preexisting option, such as eight point, or issue the Pens. . . command and type in a new size. That size then replaces the size currently checked on the menu and re-

mains there until you replace it with something else. The Pen menu also offers arrows, dashed lines, and other useful effects.

Fill. The Rectangle, Rounded Rectangle, and Oval always fill automatically with the pattern chosen from the array across the top. (The asterisk yields transparent fill, showing objects beneath.) To fill the others, you must select the shape and click on a pattern from the top.

Borderless shapes. To create a borderless shape, choose or type in 0 point in the Pens. . . dialog box under the Pen menu and then pull out the shape. If it's a Rectangle, Rounded Rectangle, or Oval, it appears in the prechosen pattern. Otherwise, it looks like a handled box around nothing and remains blank unless you fill it (see Figure 4-3).

Figure 4-3. Shapes of *MacDraw*



Constraint

MacDraw II has few of the secret commands that abound in *MacPaint*, but Shift still has the effect of constraining the tools. With the Rectangle, Rounded Rectangle, and Oval, it yields a square, rounded square, and circle, just as in paint. Likewise, Shift with the Arc yields one quadrant of a circle.

With the Straight Line and Polygon, constraint works a little

differently. Here, the result of pressing Shift depends on the setting under Preferences. . . in the Layout menu. At default it's 45 degrees, so you can draw lines only at 45-degree intervals.

However, if you set it to, say, 15 degrees, the program lets you draw lines either on the perpendiculars or 15 degrees from them in either direction. Hence, you can draw lines at 15 degrees, 75 (90−15), 90, 105 (90+15), 165 (180−15), and so on. You can't draw a standard line at 45 degrees from the horizontal, as it would not be 15 degrees from a perpendicular.

Constraint can be very useful with the Polygon for drawing parallelograms. You can simply set Preferences. . . to the acute angle within the parallelogram, press Shift, and draw the horizontal and angled lines. Shift is quite flexible in the Polygon. If you release Shift while you're adding sides, you suddenly have complete freedom, and you can depress the Shift key again at any time to reimpose constraint.

Erasing

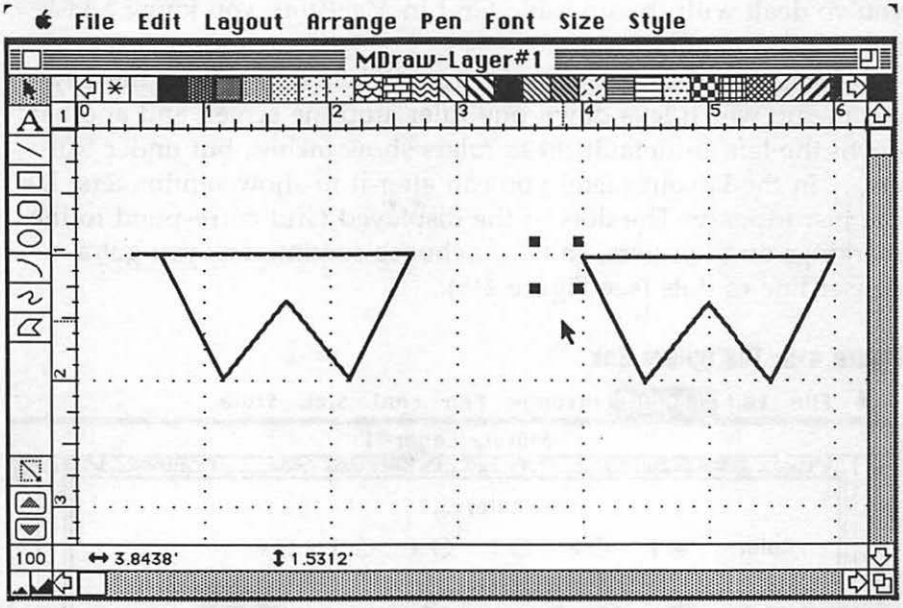
One of the most noticeable differences between paint and draw is erasing: It's simply harder in draw. There is no Eraser and you lack the pixel-by-pixel freedom of paint. Normally, you must erase one object at a time. You select an object, then choose Clear from the Edit menu or press Backspace, and it vanishes. If you have just pulled an object out, you can also vaporize it with Undo.

However, you can partly overcome this problem with the technique known as *masking*. Masking simply entails placing a borderless white object in front of whatever you want to erase. For instance, a borderless white rectangle can function fairly well as an eraser (see Figure 4-4). It doesn't truly erase, since the object remains hidden below, but the effect is more or less the same. If you want to mask an item that appears against a patterned background, use a borderless shape with the same pattern as the background.

Still another way to erase involves the *Reshape* command (of which there's more below). If you extend the line of a polygon a bit too far, you can often pull it back with Reshape. Select the object, choose Reshape from the Edit menu, grab the handle of the errant line, and gently realign it to the rest of the figure.

To erase the whole page, choose Select All from the Edit menu (or press Command-A), and choose Clear from the Edit menu (or press Backspace).

Figure 4-4. Masking



Patterns

MacDraw II lets you create your own patterns. You choose the Patterns. . . command in the Layout menu and a dialog box appears where you work pixel-by-pixel, as in FatBits. Double-click on any pattern in the row at the top, and this box appears onscreen automatically.

Replacing patterns, a headache in *MacPaint*, is a hayride in *MacDraw*. You just select the object and click a new pattern from above.

At times you may want to extend a pattern within an object. You can do so very easily by drawing a borderless filled shape atop the annexed area with the Freehand tool. It's like masking, which basically extends a pattern of white.

Grid

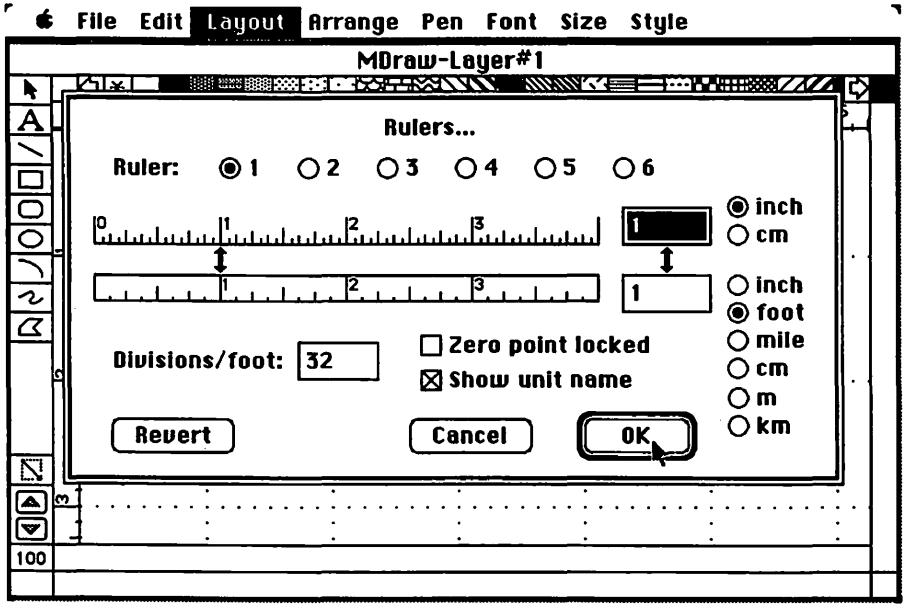
Like *MacPaint*, *MacDraw II* has a Grid, though here it's a more potent item. The Grid gives orientation, showing you where to place objects and how large they'll be. It's a useful feature, essential for plotting precise dimensions.

Most of the main Grid commands lie in the Layout menu. The first feature is the *Show Gridlines* command. Choosing it cross-

hatches the screen in dotted lines, displaying the Grid for you. If you've dealt with the invisible Grid in *MacPaint*, you know a visible one is a mighty asset.

For a better sense of place, choose *Show Rulers* from the Layout menu, which lays down one ruler atop the screen and another down the left. In default these rulers show inches, but under Rulers. . . in the Layout menu you can alter it to show centimeters. It's not just frippery: The dots in the displayed Grid correspond to the markings on the rulers, so if you choose centimeters, you get a denser line of dots (see Figure 4-5).

Figure 4-5. The Rulers Box



Moreover, the *snap-to* feature called *Autogrid* constrains regular shapes to the markings on these rulers, so centimeters can yield more finesse. Paint has a similar snap-to, as we've seen. Autogrid may be a big help or a fantastic obstacle. In default it's on, and if it gets in your way choose Turn Autogrid Off from the Layout menu.

The inches or centimeters on the rulers often correspond to other units of measurement such as miles, and you select these too in the Rulers. . . box. You can choose among not just inches and centimeters, but feet, miles, meters, kilometers, and other units. The Rulers. . . box shows two different rulers, one above the other.

The top ruler displays inches or centimeters as they actually are, in "real-space." The bottom one shows the ruler that appears onscreen. For instance, if you set 0.25 inch to equal one mile, the top ruler would show an inch as an inch and the bottom would show multiples of four at every inch—4, 8, 12, and so on. If you set one inch to equal four miles, you will get exactly the same result, because the scale is the same.

There are six different preset rulers under Rulers, and you can alter them to whatever you like and keep them conveniently available.

The third feature crucial for exact drawing is *Show Size.* Choose it and two notational devices appear in the lower left, informing you of the coordinates of the cursor up to four decimal points. If you choose, this feature also displays the unit of measurement you've selected, such as miles.

Movement

In *MacDraw II,* you can slide objects easily about on the screen in two ways. If you press the mouse button when the pointer is over an edge of the object and then drag, you see the object's rectangle following along until you release. If you carry out the same act with the Command key held down, the actual contours of the object follow. The latter method allows finer placement.

There are times when you may have many different objects clustered together and wish to move some while keeping others stationary. You can hold an object in place by selecting it and choosing Lock from the Arrange menu. To give it freedom of motion again, choose Unlock.

Duplication

As in paint, you can duplicate an object. You simply select it and choose Duplicate from the Edit menu. A new object appears offset slightly from the first. This command is very useful for creating objects that appear to be three-dimensional, such as cubes. You create a square, duplicate it, and pull it somewhat away. At this point, you can link the corners with straight lines, but you won't be able to fill in the apparent sides with white to hide the back contours. Lines are just lines, and you need planes. You can do better by using the Polygon to trace over two of the existing edges and linking the corners above and below. A second Polygon forming the top completes the cube.

MacDraw cannot leave an instant trail of objects in the manner of *MacPaint,* but if you select and then press Command-D over and over again, you'll get a string of copies you can then manipulate.

Zoom

MacDraw has an even more powerful Zoom than *MacPaint.* It lets you magnify up to 3200 percent, and shrink to a minuscule 3.12 percent. The Zoom commands are located in the lower left of the screen; they're the two boxes with what look like mountains inside. To magnify, click the box with the larger mountains. To shrink, click the smaller ones.

Rotating and Flipping

You can easily rotate an object to any degree you want. You select it, then choose Rotate from the Arrange menu. The cursor becomes a large X, you grab a handle with it, and turn it around. The Rotate command remains checked until you uncheck it.

You can also flip an object by selecting it and choosing Flip Horizontal or Vertical from the Arrange menu. Flip replicates turning an object 180 degrees about an axis. There are two axes through every object, so Flip Horizontal swings the object around like a door, and Flip Vertical swings it like a flap. If you duplicate an object and then flip it, you can gain mirror images.

Advanced *MacDraw*

The true glory of draw comes less from creating items, as in paint, than from *manipulating* them. You've already seen how easy movement and duplication are, but the formulaic nature of objects lends them even more powers. Once you have an object on the screen, you can work on it as a whole and alter it in almost any way you can imagine. You can change its size and shape, align objects, move them behind and in front of each other, fuse them together, and take them apart.

Changing Shape

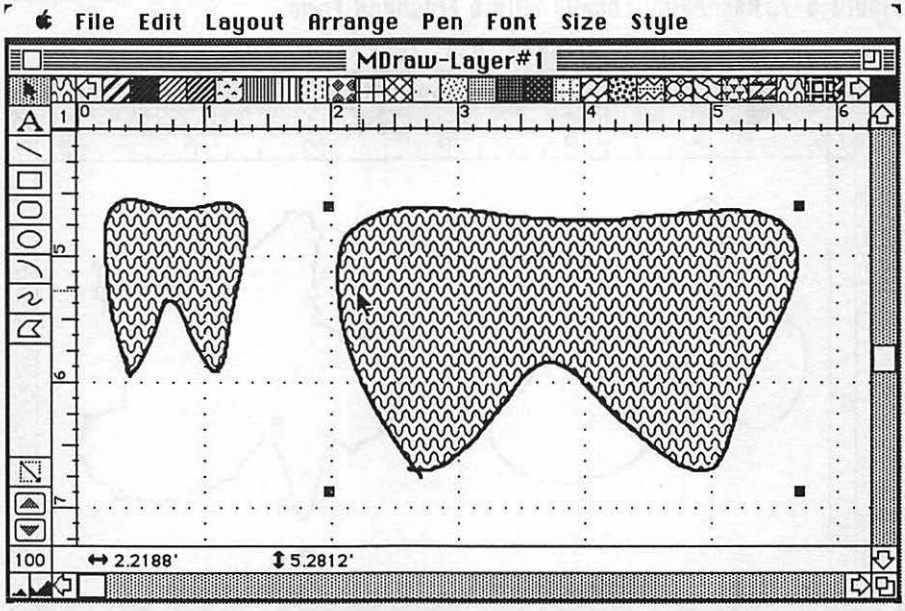
Changing shape is easy. You select an object, pull one of its handles, and it expands or contracts. For instance, a rectangle has handles on each of its corners. Place the pointer on one and drag, and the rectangle swells or shrinks.

Note that this power lets you change shape as well as size. You can make a squarish rectangle into a long, thin one. Where

you have an irregular shape, the change is even more dramatic. Select it and a box appears around it. The final shape can actually look quite different from the original.

MacPaint performs this feat too, but in a cruder way. For instance, *MacDraw* doesn't distort patterns as *MacPaint* does in stretching them, nor does it yield awkward double lines. Moreover, if you expand an image enough in *MacPaint*, you actually see the basic pixel shapes. You don't in *MacDraw* (see Figure 4-6).

Figure 4-6. Reshaping

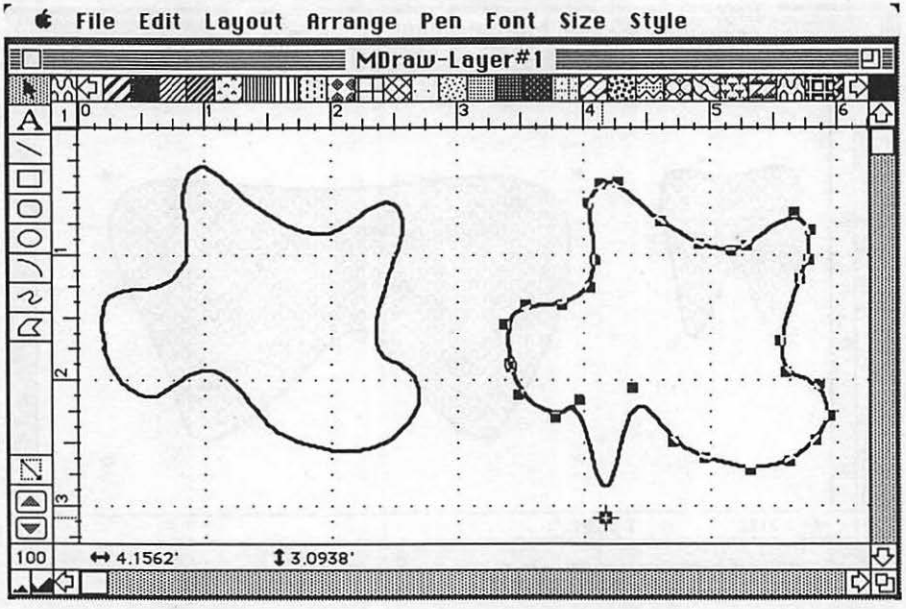


Reshape. Normally, handles appear only at the corners of the rectangles that enclose your object. You can move these corners in various directions, stretching and distorting the whole object like Turkish taffy, but you can't work locally.

However, with the powerful Reshape command in the Edit menu, you can go farther. This instruction adds handles at angles or other significant places of the shape itself, and it lets you move them about to change shape locally. Instead of stretching the entire object, you stretch only part of it. Reshape works only with the Polygon, Freehand, and Arc.

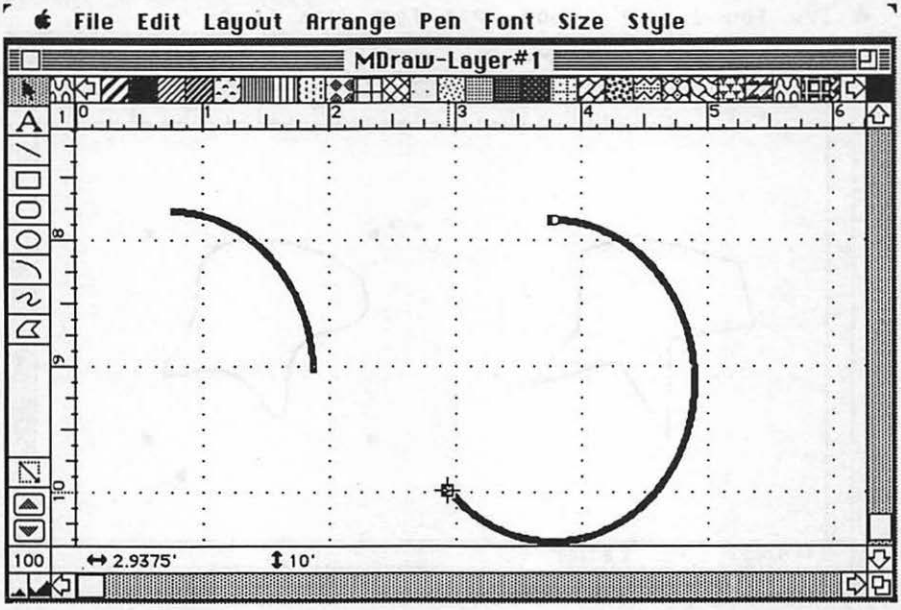
- With the Polygon, it makes the handle you grasp mobile so you can move it where you like in relation to the stationary handles on either side. Since the handles appear at angles, you can devise forms very different from your initial creation.
- With the Freehand tool, choosing Reshape creates a set of handles along the figure. You select one, and straight lines appear at once linking it to the handles on either side. You then move it about as you do with the Polygon, and when you stop, the program bends the new angle back into a curve (see Figure 4-7).

Figure 4-7. Reshaping Locally with a Freehand Form



- Finally, with the Arc, Reshape works a little differently. It constrains you to extending or contracting the Oval you've already begun to form, so you can go from 90 degrees of arc to any amount above or below (see Figure 4-8).

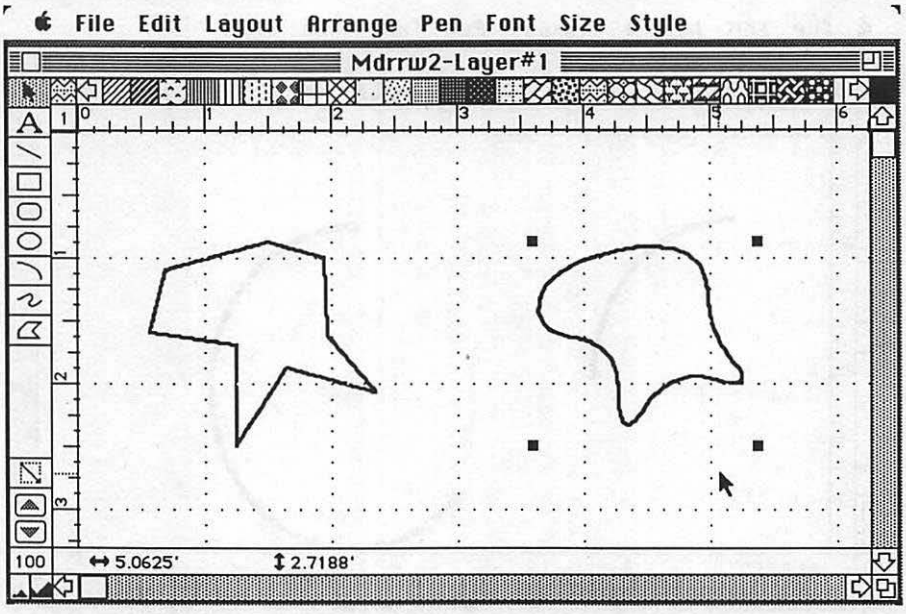
Figure 4-8. Reshaping Arcs



Smoothing

MacDraw II also lets you Smooth the sharp corners of Polygons. Select one, choose Smooth from the Edit menu, and angles become curves, rectangles, and ovals. The sharper the corner, the smaller the curve (see Figure 4-9). The Unsmooth command, also under Edit, lets you retract the Smooth at any time, a perpetually available Undo. It also turns Freehand shapes into Polygons.

Figure 4-9. Smoothing



Alignment

The Grid is very useful in *MacDraw*, but another feature that's equally so is the Align command. This instruction lets you bring two or more objects into alignment vertically or horizontally, by center or by edge. Instead of carefully placing objects at various gridpoints, the program aligns them for you. You first choose Alignment. . . from the Arrange menu, to set the kind of alignment you desire. Then you multiple-select the objects you want to align by Shift-clicking them and choose Align from the Arrange menu. The objects fall into formation.

Layering

Since the program can keep track of objects whether they appear on the screen or not, you can superimpose one atop another in layers. You can even hide numerous objects, one beneath another, and later uncover them. It's a good idea not to tuck too many objects away like this, since the program retains them in memory even if you don't, and the secret existence of little hidden objects boosts file size and slows printing.

Normally, the last object drawn is the one on top, but you can shuffle the objects around with commands in the Arrange menu. If

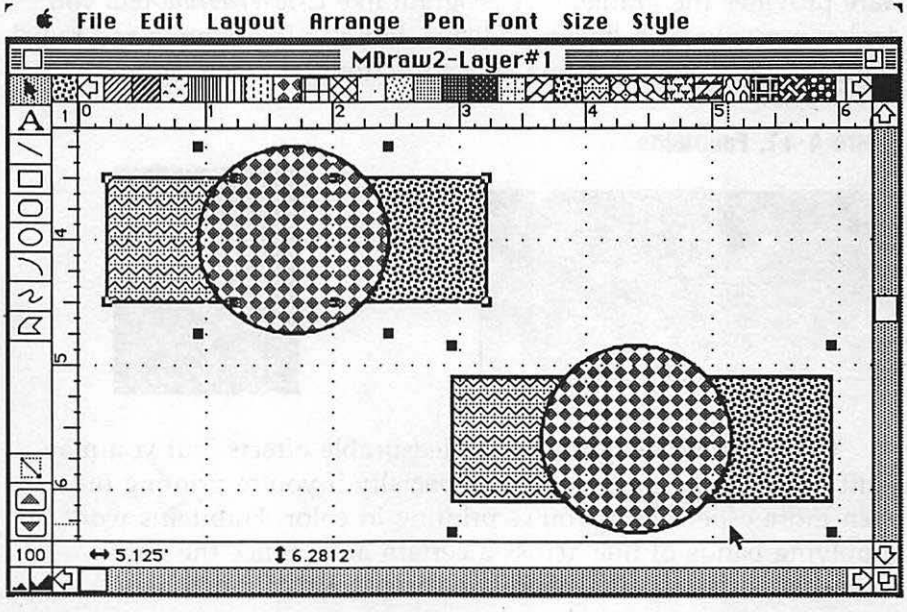
you choose Move to Front, the selected object jumps in front of all other objects. Likewise, Move to Back places it behind the pack. Move Forward and Move Backward shift the object ahead or behind one layer.

By checking *Multi-layer selection* under Preferences. . . in the Layout menu, you can select items in different layers and execute commands all at once.

Grouping

You can also combine objects on the screen so they act as one. Mathematically, it's usually a simple matter of adding plus signs to join the different formulas. This act is called *grouping*. It's particularly useful if you wish to move a collection of objects about on the screen, fill them with a pattern, or perform some other operation on them. You can distinguish ungrouped from grouped items by the number of handles they have. In *MacDraw II*, ungrouped ones will have four handles apiece, and the number of handles can rapidly proliferate. Grouped objects have four handles total (see Figure 4-10).

Figure 4-10. Grouping



You can group items easily, by clicking on one, then pressing Shift and clicking on as many others as you like. Next choose Group from the Arrange menu. If later you wish to separate them, you ungroup them by choosing Ungroup from the Arrange menu. The Ungroup command leaves all the component objects selected, so if you immediately perform some other action such as a fill, it affects them all. You must deselect them and then select one if you wish to act on it alone.

Beyond *MacDraw*

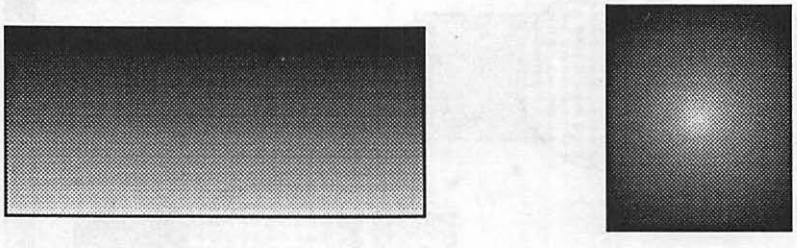
There are a number of programs such as *Cricket Draw* and *Illustrator 88* which go quite a bit beyond *MacDraw* in their capacities. Some of the new features are listed below:

Shear. Much of this software lets you slant an object. A rectangle, for instance, becomes a parallelogram of an angle you determine.

Autotrace. In *Illustrator 88, autotrace* is a tool that works like this: You click it near a bit-mapped form on a template. The program then creates a draw image of the outline of the form. Autotrace may work somewhat differently on other programs.

Fountains. Fountains (or *gradients, ramps,* or *blends*) are areas where the hue or shade changes smoothly into another, like a spectrum. You specify a beginning and end shade or color, and the software provides the gradient. A program like *Cricket Draw* lets you deploy not only such linear gradients, but also logarithmic and radial ones; the latter amounts to a concentric fountain (see Figure 4-11).

Figure 4-11. Fountains



These can be delightful and pleasurable effects, but you may want to use some caution here, especially if you're printing out—even more especially if you're printing in color. Fountains work by supplying bands of hue across a certain area. Since the bands should be imperceptible, there are three basic cautions here.

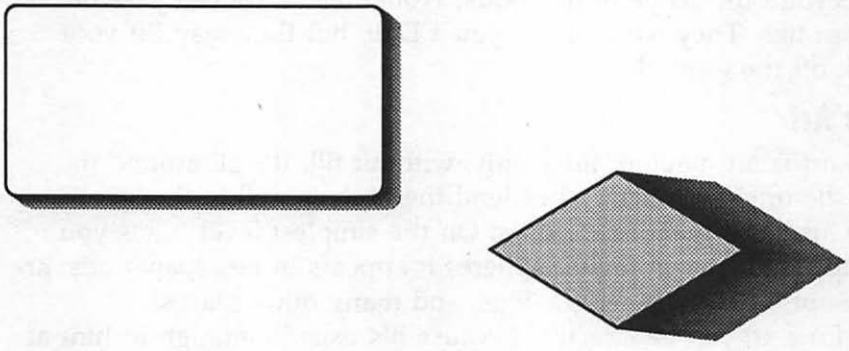
The first is size of the gradient area, because the greater the area you must cross, the more obvious the bands become. It's like the basic concept of resolution.

The second is the range of difference among the colors. If the colors are similar, you get a smoother blend, because you don't have to traverse as much territory. A centimeter-wide fountain from light to dark yellow can contain much finer intermediate hues than one from green to deep red.

The third is reducing the presence of black as much as possible in color, because black makes banding more visible. In the chapter on Output, you'll see that there's a fourth factor too—the resolution of both the halftone and the printing device.

Shadow. A program like *Cricket Draw* also creates *automatic shadows.* You select an object, pull out a duplicate, and the software fills the space between them with black or a gradient of your choice (see Figure 4-12).

Figure 4-12. Shadows



Conclusion

Although draw may seem a bit awkward at first, it really is a realm of intriguing effects. Draw programs are highly versatile and easily capable of creating much of the art we associate with paint.

5
From Pixel to Picture

From the bison-painters at Lascaux to David Hockney and his entrancing vacancies, people have sought to commit their visions of life to a permanent medium. Paint and draw programs give you the same splendid opportunity, and there's no reason not to take advantage of them. However, without a few tricks of the trade, your art may well just lie there, flat and unconvincing.

Artists aren't wunderkinder born with a transcendent gift, who simply sit before the canvas and respond to perfect inner dictates. Though excellence does require native talent, most artists also labor hard to master their craft and outline many versions of each picture before they finish it. For such reasons, a complete course in art is far beyond the scope of this book. Nonetheless, we can pass on certain tips. They won't make you a Dali, but they may lift your work off the ground.

Line Art

Line art is art made of lines only, without fill. It's all around us, and the original Macintoshes lend themselves well to this genre. Line art has a great many uses. On the simplest level it lets you create icons, and in higher spheres it appears in newspaper ads, architectural drawings, engravings, and many other places.

Line art can be effective because it's usually enough to hint at what we're drawing. In fact, it's often preferable. If a picture engages the brain, inducing it to fill in gaps and provide sense, we often feel more interested in the work. So, you don't have to fill in every detail; you only need capture the basics.

A major challenge to line art—to most art, in fact—is to render three-dimensional objects on a flat medium. There are an assortment of techniques to do this.

Line Width

It's vital to vary the width of lines. A picture with lines of uniform size lacks emphasis and richness, almost like a musical note without timbre. To the brain, some lines matter more than others, and you can play on this fact by thickening them.

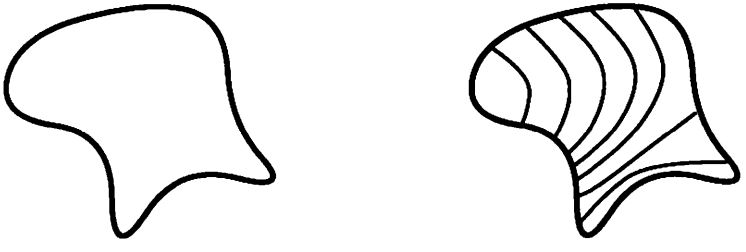
In particular, the outside contours of an item should be darker, to detach it from its surroundings. This rim is sometimes called the *cutting edge.* A cube, for instance, normally has six dark cutting-edge lines, and you can add them easily in both paint and draw by drawing over existing edges with the Straight Line at thicker width. With an irregular cutting edge, such as the crest of a mountain range, it depends more on the program. In paint, you should use the thicker width from the outset. In draw, if you make the crest an object, you can select it any time later and set a new width by choosing it from the Pen menu. Most people don't notice the cutting edge, though they pick up the effect subconsciously.

As thicker lines have more impact, thinner or broken lines have less and do well for internal contours or folds. For instance, in the portrait of the man lighting a pipe that comes with *HyperCard,* the outline of the figure is bold and black, but lesser lines, such as the creases in the hat and the breaks between fingers, are broken and impress us almost as gray. They engage the attention less, as they should.

Contour Lines

As the name suggests, contour lines (or *wraparound lines*) are lines that follow the contour of an item. The eye quickly identifies them and understands that they convey shape (see Figure 5-1). For instance, if you're drawing a salami, the cutting edge alone would look like an oval or oblong. But add a string of semi-circles down its length, and it fills out and we perceive it as a solid object. In paint, you can achieve such semi-circles easily, by Lassoing one end, pressing Option, and making several duplicates. In draw, if the end is an Arc object, you can make such duplicates by selecting and pressing Command-D. Contour lines are often not so simple, and each may demand separate labor.

Figure 5-1. Contour Lines



Scale

In general, we construe large items as being close to us and smaller ones farther away, since distant items occupy less of our field of vision. However, with items of significantly varied size, such as trees, it may be hard to tell whether they're short and close or huge and faraway. We can indicate the scale more precisely by including objects of known size, such as people, next to trees or buildings.

Overlapping

One of the plainest ways to show depth is by placing one item in front of another, or *overlapping*. It sounds too simple to be worth mentioning; however, overlapping has other virtues, not immediately apparent. It can give scale, especially if some items are immediately recognizable. In addition, if numerous objects overlap, you create an ample sense of depth pleasant to the eye. Overlapping also binds parts of a picture together, creating the sense of a coherent whole. Where items do not overlap but merely stand beside each other, we not only lose valuable clues about depth, direction, distance, and size, but also find ourselves confronting several little centers of attention, and the picture loses unity.

Distance and Shading

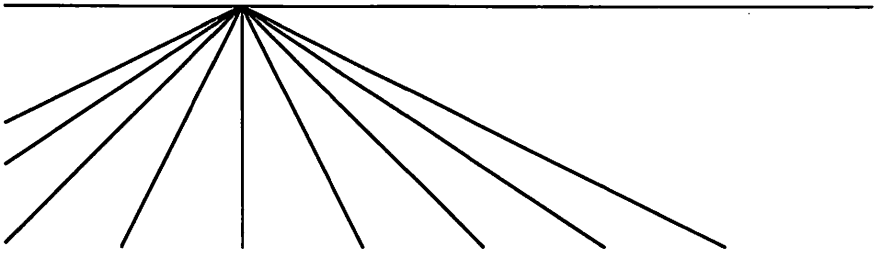
The shade of an object is also an important cue to its distance. As items recede, they tend to pale. Why? In real life, dust in the atmosphere filters out more and more light so less reaches the eye. You can see this effect yourself dramatically in mountain ranges that rise above each other in successive waves. Those farther away are distinctly lighter than those closer. Hence, as objects recede, you should lighten their shade.

Perspective

As every child knows, an item seems smaller at a distance than nearby. But how much smaller? And what about large buildings and other objects that recede uniformly—how do we convey their increasing distance in a convincing way?

Railroad tracks provide an important clue. We know the tracks are strictly parallel, or trains would have an unhappy time of it. Yet they narrow progressively as they recede and finally unite in a point on the horizon. Not before the horizon or beyond it, but right on it. This interesting fact is the key to perspective (see Figure 5-2).

Figure 5-2. The Vanishing Point



Developed by artists in the Renaissance, perspective in art seems highly improbable when explained directly, but it works dramatically. On the Mac, the Straight Line tool is a great help in achieving it.

There are three kinds of perspective: *one-point, two-point,* and *three-point.* They basically refer to the number of "railroad tracks" you have. Let's look first at one-point perspective.

Suppose you're facing a large block and the side nearest you is a full rectangle. Neither its height nor its width is receding, but its depth is. Hence, you have three kinds of lines: vertical, horizontal, and perspective.

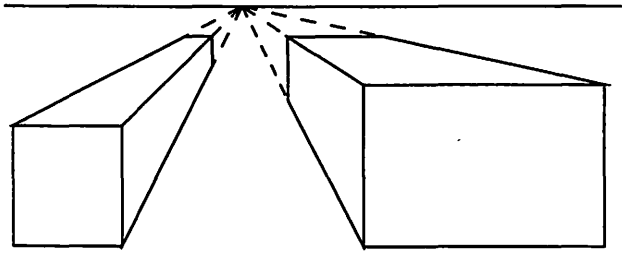
Here's how you make the perspective lines, the lines of depth. First, determine where you want the eye level to be and draw a horizon line there. Often that line extends across the middle of the screen, but to look down on objects you place it near the top. It's just like moving eye-level to the apex of the picture. Conversely, to gaze up at items, you place the horizon line near the bottom. If the items are of human scale, looking down on them makes them seem miniature and looking up, huge. Thus, a table drawn with a low horizon line resembles something out of Brobdingnag, the land of giants in *Gulliver's Travels.*

Next, select a *vanishing point* on the horizon. The vanishing point establishes your eye position along the horizon line. It can be any point left, right, or center, but if it's on the right, say, you're looking at items from the right in the drawing.

Let's suppose it is on the right. Now, create the rectangle part of the block, then draw spokes from its top left, top right, and lower right corners to the vanishing point. These are the perspective lines, and they show the structure steadily diminishing in size with distance. It's just as if railroad tracks emanated from the top and side of the building, and these lines show how the structure would appear to shrink if it extended to the horizon.

It doesn't, of course. You decide where you want it to end, and at that point insert lines parallel to the original rectangle. Erase the remnants of the perspective lines, and you now have a rectangular prism, in lifelike perspective (see Figure 5-3). Hang an array of them on the same vanishing point, and you get something that looks like a city.

Figure 5-3. One-Point Perspective



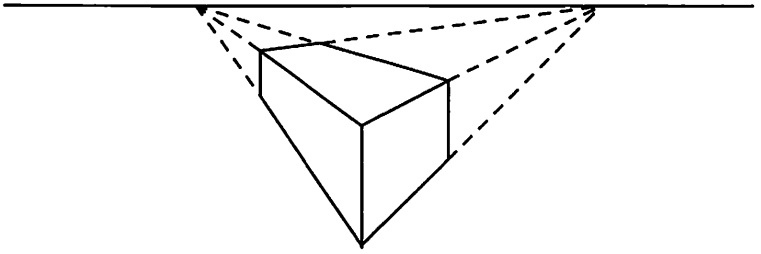
The procedure also works with curved items, like globes, people, and animals. You simply enclose the shape in a box and follow the lines to the vanishing point.

Perspective can also help determine the size of discrete objects at distance. For instance, perspective lines show the proper size of telephone poles following railroad tracks to the horizon. You begin by treating the poles as a single unit, drawing perspective lines from the top and bottom of the nearest pole to the vanishing point. Then you use the lines to determine the height of each pole. Note that, as the poles dwindle, you must place them closer and closer together. When done, you erase the perspective lines. The same trick works with people and almost any other item.

So far, we've assumed the structure we face presents at least one flat side to us. But what if we rotate the block so we're looking at it on edge. Now, instead of dealing with height, width, and depth, we have height, depth, and depth. How do we render it?

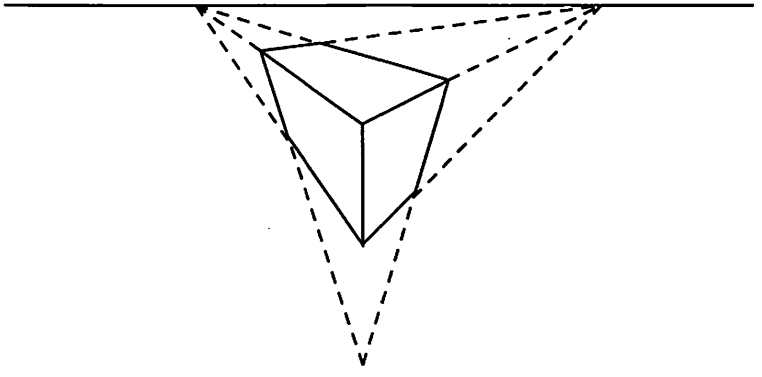
It's fairly easy. We just create a second vanishing point and a second set of perspective lines. One point lies to the left of the cube, the other to the right. We then mark off the two receding sides (see Figure 5-4). This approach is called, not unnaturally, *two-point perspective.* Two-point perspective uses only two kinds of lines: vertical and perspective.

Figure 5-4. Two-Point Perspective



Suppose now we tilt the cube, so we're looking down on a corner. Instead of height, depth, depth, we have depth, depth, depth. The cube recedes from us in three directions. We solve this problem by adding a third point, creating three-point perspective. Of course, that point can no longer go on the horizon line. We place it somewhere near the bottom or top (see Figure 5-5).

Figure 5-5. Three-Point Perspective



In theory, all perspective really has three vanishing points. With one-point, you have simply removed two of the points to infinity, so the horizontal and vertical lines can be parallel. With two-point perspective, only one point is at infinity.

Perspective is easy to render with paint, since you just draw the perspective lines with the Straight Line and then erase the parts you don't need. But it's also fairly simple with draw, though the technique is slightly different. You draw the perspective lines with the Straight Line and then carefully pull out trapezoids with the Polygon so they lie atop the perspective lines. (Here's a case where the "Close automatically" option in Preferences comes in very handy.) Then you select the perspective lines and Clear them.

Shadow

Shadow is another major means of conveying depth. It, too, relies on a matter of basic subconscious knowledge: shade means space. Shadow is impossible in a two-dimensional flatland. Where we see it, we know we're looking at an object in depth.

How do you draw a shadow? Consider how it arises. A source of light strikes an object, illuminating it. That object, in turn, prevents the light from reaching beyond. The area blocked out of the light is the shadow.

Hence, you begin by determining the height of the light. You draw a line from the light source to that part of the item's top nearest you and beyond to the ground. With most objects, you wind up forming a triangle in which the bottom portion shows the depth of the shadow. Once you have this triangle, you can use congruent triangles to place the shadow everywhere.

With a plane like a billboard, for instance, you can create the triangle at one end and then simply move it down to the other. You draw a line between the two (parallel to the base of the billboard itself), erase the lines through the air, fill the new shape, and you have the shadow.

With a solid shape like the cube, the process is slightly more involved. You may have to draw the triangle from three top corners: the one nearest you, the one farthest from the light, and the one farthest from you. You connect three bottom portions, erase extra material, and fill in. With a sphere, you identify a circle girdling it which ends the light, and draw a series of different sized triangles.

As it happens, this pleasant scheme gets a bit more complicated the more closely you inspect it. For instance, with large objects like buildings, you may need to adjust the shadow a bit with perspective, for the shadow recedes to the vanishing point, too.

Moreover, congruent triangles work fine as long as the light comes from the sun. The sun is essentially an infinite distance away, so we can say it casts shadows in parallel lines. However, suppose the light comes from a light bulb quite close to the object. Suddenly, the lines are no longer parallel. They diverge, and the shadow is now larger than the object that casts it. Moreover, if the light bulb is at one end of the object, the shadow is irregular. Here, we must simply project a cone from the light source to the object and beyond, and then devise the shadow.

In addition, if the surface the shadow falls on is itself irregular, or if it angles away, the shadow grows more distorted and complex.

Finally, shadow is not simply an affair of black or white. Most shadows have penumbras, grayish areas about the periphery where waves of light lap into the darkness despite the neat schema above. (Light is a very complex physical phenomenon.) Hence, you should blur the contours of large shadows, so they don't look crisp and clean. Penumbras are also apparent on the surface of curved objects. So, in shading a cylinder or sphere, you should provide a transition zone, perhaps of two different grays or a narrow fountain.

Reflected light often partly illumines areas that would otherwise be black. For instance, though the sides of a cube facing the light are white, the sides partly away from it should be light or dark gray. Only the side deepest in shade should be black.

Shadow is not just important to show bulk. It can also indicate bumps and dips in a surface. For instance, it's invaluable with faces—beneath cheekbones, in eye sockets, under the lips—to bring out the full contour. You can also show surface irregularities by means of little patterned shadows on walls.

Texture

A common problem is how to render areas full of random yet relatively uniform detail, such as fields or rocky cliffs. One possible approach is to sketch in everything, down to the smallest detail. You can do this, but it is wearying, both for you and the viewer. Moreover, such details are usually not important. The mind doesn't bother to register them, because we care more about the nature of the field than its precise constituents. In fact, too much detail can actually attract the eye to an area that just doesn't matter. Here, you want the equivalent of a broken line in line art.

The solution is to render such areas by texture. That is, a sparse, semi-repetitive pattern can often convey the waving grains of wheat or the fleecy outline of an oak forest better than a mass of detail.

A variation of this technique comes in handy when depicting crowds. To convey a crowd, you need not paint a set of individual portraits. In fact, the essence of a crowd is a mass of anonymous faces. Hence, you can individualize a few figures near the front of it, and turn the rest of the faces into more or less faceless copies.

This approach suggests the crowd as an entity rather than a component of individuals, and greatly simplifies your work. Likewise, you can supply the details of nearby cobbles in a road and schematize them as they grow farther away.

Capturing Reality

Despite the tricks above, there is, unfortunately, no magic route to drawing a tree, a dog, a face. You simply must study a tree, say, to understand the pattern of the leaves and the basic structure of trunk and limbs. Though a tree may seem extravagantly difficult to draw, with its myriad tiny leaves fluttering in the breeze, it's not as hard as you might think. The very combination of repeated detail and motion aids the task. The eye does not register the peculiarities of each leaf, so we can render them with little splotches.

To sketch animals and humans correctly, you need at least some study of anatomy, though not necessarily formal. For instance, you might think you could render the feathers of a bird with texture, but in fact it doesn't work out well, since feathers cover a fairly intricate substructure—and they often change in appearance according to whether they're beating down, when they close together, or up, when they spread open to let air through. Moreover, careful examination of bone and muscle structure is particularly important for drawing animals and people in motion.

Faces in particular demand study. Eyes, noses, and lips all vary subtly but potently from one individual to another. Moreover, hairline differences separate one facial gesture from another. While we can understand these gestures instantly when we see them, most of us find it preternaturally hard to explain what it is, exactly, that we're understanding.

But even here, there are tricks of the trade. For instance, consider the smile of the Mona Lisa, long synonymous with mysterious depths of character. In fact, the lips do seem unusual, smiling one moment, graver the next, as though in the same kind of subtle motion as a living person's. Yet the explanation is anticlimactically simple. Leonardo touched up the corners of the mouth with sfumato, a smokiness akin to soft-focus in a camera. As a result, the corners lack fixed lines, and the mind supplies varying contours itself.

Color

If you've never worked in color before, you may be a bit overwhelmed by the possibilities. Of course, you can splash the colors

around for their own sake. It's fun, and some artists have made a genre out of it. But you can also use them for more interesting effects.

Color can convey distance, with at least three techniques:

Pallor. As we've seen, dust in the earth's atmosphere always deflects light beams. Hence, distant objects lack the vibrancy of closer ones, and paler and grayer items seem further off. If you'll want a hillside to look miles away, don't paint it electric green.

Receding colors. Even in abstract art, reds, yellows, and browns seem to advance toward you, while greens and blues recede. Thus, landscape painters tend to put brownish hues in the foreground, greens and moderate yellows in the middle distance, and blues and grays far away.

Blue. Blue is not just a receding color, but the typical cast of far-off objects. Sunlight stimulates air molecules to emit this color. That's why the sky is blue. By the same token, the more distant an item, the more blue creeps into it. Don't overdo the blueness—it's a subtle phenomenon, and few people are consciously aware of it.

What color is a shadow? Until the 19th century, most artists rendered shadow with neutral tones like browns and grays, which correspond to our sense of what a shadow should look like and, in fact, suffice. But if you examine a shadow closely enough, you see it's a bit more complicated. Sand in shade can actually appear purplish next to sand in sunlight. Shadows on pink look greenish. Renoir even painted healthy flesh a bright green, and it was convincing in the context. Again, the effect is subtle, but you can explore it freely on the Mac II, since it affords almost endless gradations of color.

You can eschew shadow and achieve a light, airy feel. The early Impressionists, for example, filled their canvases with colors of uniform brightness, and it suggested a world full of sunlight, but also one without corporeality. If your work on the Mac II seems to lack body, you may be overusing the brilliant colors.

You should also be aware of a couple of pitfalls. Be careful about the colors you put next to each other. Some, such as bright red and green, create a vibrancy at their border that seems almost electric, and it may well distract from elements you wish to highlight. At the same time, beware of placing colors next to each other

that are too similar, unless you wish to have hues shade into each other. If you wish them to be distinctly recognizable, be sure the colors are sufficiently different that the eye easily tells them apart.

In real life, objects tend to pick up some of the color of other objects nearby. Thus, a yellow kite against the sky picks up a little extra blue. A white paper posted on a green wall gains extra green.

Art provides an excellent way to reproduce the real world, but of course on the Mac there is still a better way. You can import it.

Part 3
Imports

6
Imported Art

The world is a vast place, teeming with graphic images. Every day we see billboards, drawings, and magazine photos of everything from Hawaiian waterfalls to DNA molecules to Ukrainian beet farmers. The range and scope seem almost infinite and, as it happens, it's all accessible to you at the Macintosh.

You don't have to be an artist to exploit Macintosh graphics. The computer can imbibe images from almost any source and place them at your feet. It lets you not only trace drawings but pop in predigitized art, copy images from paper, read in frames from a VCR, and even take photos of the world directly. It also lets you alter these images in strange and magnificent ways.

Manual Copying

The most obvious way to copy art is to do so manually. It's very easy with the Macintosh, provided you have a digitizer pad. You simply place the art on the pad and trace over its lines with the stylus. It's even simpler than traditional tracing, because you don't have to worry about an extra layer of paper.

The mouse is not very good at this task since it lacks a central focus, but you can partly overcome this drawback by focusing on the point at the top of the mouse where the wire leaves. Place that point over the artwork and pull, and you may get a reasonable facsimile. Note that if you have an optical mouse, the kind that requires a special reflective pad, you probably can't use it to trace at all.

Clip Art

Clip art is simply art someone else has created on the computer—or scanned in from the public domain—and made available to you. It's like a digital decal.

When clip art first appeared soon after the introduction of the Macintosh, many viewed it as a frivolity. It received eager attention because of the void in Mac software, yet most people used it mainly to adorn letters.

Today the story is different. Since most desktop publishers prefer to paste art into their publications rather than create it themselves, clip art has grown into a sizable market. Over 30 companies now offer clip art for the Macintosh alone, and the number of disks available exceeds 100. Moreover, its use is spreading into the upper echelons. USA Today, for instance, uses the maps of *MacAtlas* from MicroMaps as the foundation for many illustrations.

Most Macintosh clip art comes in paint format. Thus, once you load it, you can modify it at will with *MacPaint* tools and move it directly into most page layout programs. Clip art is also appearing in PICT for programs like *MacDraw,* but the best is laser art in EPSF format; it has the virtue of occupying much less room in memory, and it prints out very well on laser printers.

The subject matter of clip art covers the gamut. Traditional topics include arrows, stars, pointing hands, portraits of famous people, patterned borders, animals, and cartoon characters. More exotic disks feature Mayan ruins, monsters from the grave, architectural symbols, Japanese lanterns, and so on. Since you might not know if you even want a clip art program without some preview, good computer stores keep a sample book on hand so you can see what you're getting.

A preview also tells you about its quality. Anyone can draw or scan in clip art, so its caliber varies wildly. The worst is simple stick figures with no conceivable appeal. The best is complex, precise, imaginative, and often clever.

Building a Library

The more graphics you have in stock, the better prepared you are and the more variety you can impart to your work. Yet clip art can multiply out of control, and it soon becomes vital to organize it in some way. There are several ways to do this.

Printout. You can print out every page of every disk, and store the sheets in a convenient place, each labeled with the name of the disk and file. Then, when considering illustrations, you can flip through the sheets until something strikes your fancy and boot it up. This approach is fast and lets you compare many different graphics at a glance.

You can organize the printed sheets by disk or by topic. If you group images by disk, choosing the right graphic may take longer, but you can locate the image quickly once you have it. If you

group them by topic—for instance, taking all the borders from all disks and putting them in one place, as well as all the flowers, all the portraits, and so forth—you normally find the right image faster, but you may encounter problems with organization itself. Some images fall into more than one category, and you should place those in both to be sure you don't miss them.

Software. You can also buy desk accessories that let you quickly scan through your clip art, so you can see what's there without leaving the computer. These, however, may take more time than flipping through paper, and you must keep your clip art at hand on the hard disk to access it. Image databases are also available, but they can consume vast amounts of disk space.

Digitizers

Clip art lets you paste other people's drawings directly into your publication, but clip art has already been digitized. A number of hardware products let you copy images from the real world—photos, sketches, maps, whatever. These items are called *digitizers.*

Digitizers originated in the space program. In the early 1960s, NASA found that analog video images from satellites were arriving distorted. So, with the Ranger 7 probe to the moon, NASA began converting the video signals to digital images so a computer could clean the images up. Costly digitizers soon migrated to other fields like medicine, where they evolved into CAT scans and other notable devices. In late 1984, companies began making inexpensive digitizers for the Macintosh.

At first, these devices encountered curious interest but no overwhelming demand. However, desktop publishing soon sparked sales here as it has in clip art, and new digitizers are now being launched onto the market at a rapid pace.

Since few Macintosh digitizers yield perfect renditions, you may have to touch up the image. A class of software called *image processors* exists for this purpose, and these programs can take you far beyond mere mopping up. Indeed, this software can convert the Mac into a sophisticated darkroom, where you can alter an image in a hundred different ways and create vivid and striking effects.

Digitizers come in two types with quite distinct capacities. The first is the *scanner.* Scanners act like copier machines, which they often resemble, and they transform patterns of light directly into digital data. The other is the *video digitizer.* Video digitizers are more like cameras; in fact, they require a video camera, VCR, or

some other source of video signals, and they transform those signals into digital data.

Scanners

Scanners read in the highest quality images, yet they also boast the highest cost. Moreover, they are limited to flat images, generally on paper.

Scanners work like copiers. Flatbed scanners even have a glass plate on which you put the paper and a traveling hardware mechanism that reads the paper from one end to the other. These are essential if you commonly scan material from books or other material not in sheet form. The majority, however, use paper-feed rollers, pulling the paper through the read instrument. Since these often have automatic feed, they can free you from dawdling about the machine.

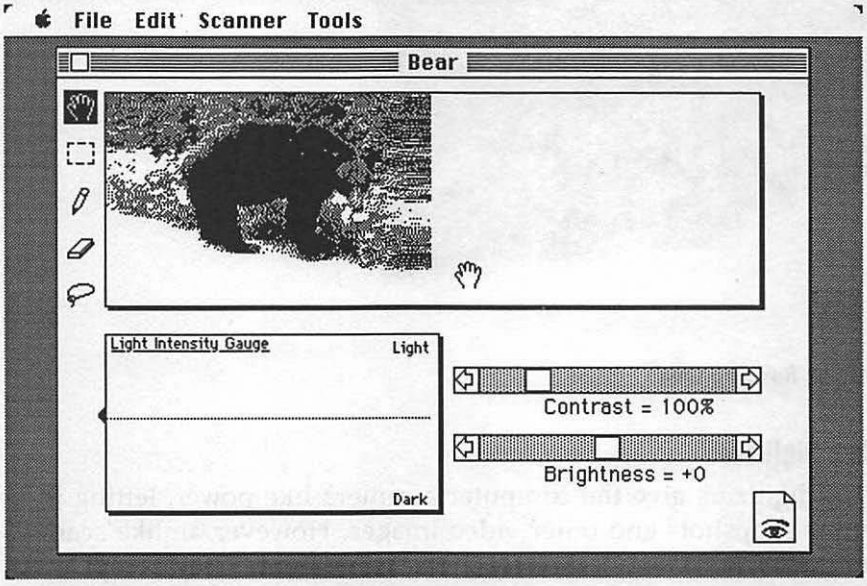
Here's how scanners work: Light from the original graphic strikes a photosensitive device, which translates it into a pattern of digital signals. In the case of most scanners, the light enters the machine straight from the page. However, one of them, ThunderScan, works a little differently. It emits two tiny beams of red light that the paper reflects and returns to the photodetector.

Scanners for the Macintosh today generally yield a resolution of up to 300 dpi—high enough to send to the laser printer. (Though if you're making halftones, you need scan in at no higher resolution than that of the halftone. For instance, if the halftone will have 150 dots per inch—very high quality—you don't really need 300 dpi at scanning, as the printer rejects the extra information.) They read both black-and-white and grayscale. They're also generally very fast, and some can scan a page in less than a minute. Scanners usually store information in TIFF format, and the files can be huge.

These devices remain relatively expensive, between $1,000 and $2,500 or more, though you can often rent them at a service bureau. But the best-selling Macintosh scanner of all is completely different, both in mode of operation and in price. It is ThunderScan.

ThunderScan costs about $250 and fits snugly into the ImageWriter printer, where it replaces the ribbon cartridge. You place the original document beneath the platen, where your print paper normally goes, and Thunderscan takes over. It inches the document forward, reading it line by line until the complete image enters the computer (see Figure 6-1).

Figure 6-1. The ThunderScan Image Processor



Why hasn't Thunderscan vaporized its more expensive competitors? Well, it has drawbacks. It's more cumbersome to set up and use; it's also slower. ThunderScan can take 20 minutes to digitize a full 8 × 10-inch document—though it lets you set the area to be read in, which is often much smaller—and during this time your computer is normally immobilized.

Moreover, sometimes you don't notice problems with your scan until ThunderScan is well into the process. Problems can stem from several sources. Infrared waves from nearby incandescent bulbs or sunlight can cause the sensitive photodetector to mis-scan. An improperly aligned original can cause problems for ThunderScan, which in any case sometimes has trouble with vertical lines. Probably the best way to use this instrument is to scan at 200 percent and then print at 50 percent. The final output has the same size as the original, but because you've enlarged and then reduced, you get finer detail.

The ThunderScan software has certain virtues. For instance, in halftone mode it captures grayscale data (see Figure 6-2). It also lets you go back over the scanned image, select a portion of it, and change the contrast and brightness, so you can retouch the image. Though ThunderScan is not the best scanner on the market, it may suit you well, particularly if you don't have deep pockets.

Figure 6-2. ThunderScan Grayscale

Photo by Rosalind Gold

Video Digitizers

Video digitizers give the computer a camera-like power, letting it digitize snapshots and other video images. However, unlike scanners they don't interact directly with visible light. They accept video signals and turn them into digital ones, and hence require an initial source of video signals, such as a video camera or a VCR.

Video digitizers have a whole new set of benefits and drawbacks. A prime benefit is cost. They start at around $300. Black-and-white video cameras can be had for as little as $200, so your initial investment would be at least $500—more than ThunderScan but far less than most scanners.

If you buy a video camera solely for desktop publishing, be careful. The most important factor to look for is resolution, which, in this field, is often expressed in terms of number of horizontal lines per inch. Most black-and-white cameras resolve 300 lines per inch, while most color ones resolve only 250. It's also important to note the size of the image pickup device—it should be at least ½ inch, and ⅔ inch is even better. Avoid features like stereo sound and automatic focus, which steepen the cost but don't help you out appreciably.

You should also realize that most video camera zoom lenses can focus on an area no smaller than 5 × 7 inches. To pick up smaller images you need auxiliary equipment. A set of close-up lenses, which you can screw onto the regular lens, lets you focus on objects as small as three inches square. A macro lens lets you digitize objects even smaller, such as stamps.

A video digitizer may require more than just a video camera.

For instance, MacVision, from Koala Technologies, requires 5 to 25 seconds to scan an image. Hence, the camera needs a tripod to keep it from quivering during exposure.

Most important of all, if you're using a video digitizer repeatedly to scan flat documents, you need to set up a formal copy stand. Video cameras require light at particular angles for best results, unlike scanners, which accept only flat images and hence have solved the light problem in advance.

A copy stand can be simply a table with a swivel lamp on either side. For best results, the camera should go directly overhead, facing downward. The lamps should shine down from either side at an angle of about 45 degrees. If one is brighter than the other, you see it in your results and you'll have to adjust for it.

Should you get a scanner or a video digitizer? Part of the answer depends on what you can afford. The scanners are like bookends of the spectrum. ThunderScan is economical; the other scanners are costly but faster, more convenient, and yield very high quality work. The video digitizers inhabit the midrange, though they appear to save more money than they do because of the hidden cost of auxiliary equipment.

Part of the answer also depends on your purpose. If you want to digitize three-dimensional objects or VCR images, you require a video digitizer. On the other hand, if you do either massive or occasional digitizing of flat images, a scanner may be right for you. If you need high quality pictures, you require a scanner, and if you want to read in prose, you need one with OCR (optical character reader) software.

Image Processors

Here is the ambrosia of imported graphics, the creative reward that comes after the hard work of entering the document. Image processors were invented to solve a very specific problem: Scanned documents were rarely perfect, as NASA found, so users needed software to spruce them up and enhance their qualities. Programs that perform this feat are called *image processors,* and they can be magical.

Image processors can give you a control over grayscale similar to that of a darkroom, but they work much faster and cover a far wider range. At the top of the line, with ImageStudio and Digital

Darkroom, they work best with a Mac II, 2MB (megabytes) of RAM, and at least an 8-bit monitor. You can use them, however, with the Mac Plus and black-and-white monitors, though many effects are too delicate to show up, and they work with color too. They can eat up great gulps of memory; their images are often between 1MB and 2MB, and some can reach 10MB in size. Image processors print out in halftones and even let you control the pattern of the halftone.

Among an image processor's powers are:

Despeckle. It can identify "noise" in an image, the places where random and incorrect pixel values have crept in, and eliminate them, yielding a smooth, sharp picture. In Figure 6-3, for example, the flatbed scanner has incorrectly added a white line to the photo of the mountain goat. After despeckling (Figure 6-4), the line is gone.

Brightness. It can brighten a dark image or darken a light one.

Contrast. If an image runs to mostly middle shades of gray, it can spread them out and make them more extreme.

Sharpening. It can sharpen the edges of items in the picture, to bring them into higher relief (Figure 6-5).

Figure 6-3. Scanned Image of Mountain Goat Before Despeckling

Photo by Rosalind Gold

Figure 6-4. After Despeckling

Photo by Rosalind Gold

Figure 6-5. Sharpened Image

Photo by Rosalind Gold

Softening. It can blur the edges to give the image a softer look. In photography, this trick requires a special filter.

Posterization. This process can drastically reduce the number of gray shades in an image, yielding images of stark contrast (Figure 6-6). To achieve the same effect in photography, you must make several negatives with different densities and contrast, then print

Figure 6-6. Posterized Image

Photo by Rosalind Gold

them together. You can see a crude kind of posterization by running a photo through a copier; it reproduces those grays that are dark enough and omits the others. Be careful with posterization. By reducing an image to, say, black, white, and mid-gray, you can make it bizarre and hard to grasp. Perhaps the best way to start is with a fairly simple image and experiment. An adroitly posterized image can have a surreal, haunting quality.

Pseudocolor. An image processor can let you assign specific, arbitrary colors to shades of gray. The result may resemble LANDSAT photos of the earth's surface, with crimson fields and cobalt-blue hillsides.

Warping. You can use this feature to change an image from a square to, say, a trapezoid, squeezing it at the top and creating an intriguing effect. Warping can be especially useful in designing logos or otherwise using display type, where you can alter the type to fit a novel shape.

Filtering. This feature can locate all the edges of an item and make a new image of them, or even let you lift the item out of its background and move it elsewhere.

So far, most image processors have addressed the desktop publishing market. However, there are also a few expensive image processors for the Mac II that work in color and serve the scientific, industrial, and medical community. These help analyze images by

highlighting salient portions in bright colors, harking back to the original use for image processors.

A Note on Copyright

It takes time, effort, training, knowledge, and often talent to write a book or draw a picture. Not everyone can do it, and few do it well. Yet once completed, prose and graphics can be copied easily by almost anyone.

To protect the creator, the U.S. copyright laws make it illegal to copy works without the creator's consent, who can rightfully make consent contingent upon payment of some sort. Without such laws, there would be little incentive to create original works, since pirates would steal them at once and siphon away the profits.

The copyright laws apply to a work as soon as you finish it. You no longer have to file a special form with the U.S. government to gain protection, though you may have a difficult time proving your copyright unless you file. Filing helps establish an approximate date of creation, which is useful if the issue ever requires adjudication in a court of law.

Copyright applies not just to writing and drawing but to phonograph records, software programs, and a wide variety of productions, including photographs. A photographer—or if the photographer is on salary, his or her employer—gains copyright instantly to all photos taken, and you can't use them without permission. You can usually gain permission easily by writing the artist, the artist's agent, or the publisher.

There are a few ways around this problem. First, after a certain length of time all works pass into the public domain, where anyone can use them. For instance, the novels of Herman Melville are public domain, and you can publish them without paying a cent to his heirs. By the Copyright Act of 1976, the life of copyrights was extended to the lifetime of the copyright holder plus 75 years, to provide a nest egg for descendants. In practice, because of the prior laws, almost everything created before August, 1906 is in the public domain. You can therefore copy old photos, pictures, and prose with impunity.

Second, there is the *fair use* exception. In essence, it means that if your copying plainly does not deprive the author of any profits, it is lawful. Thus, you can quote an author in a term paper or photocopy materials for your own use.

Third, you can copy material if you then alter it so much that it partakes substantially of your own creativity. Hence, you can scan in a photo and use it as a foundation for your work, making of it something different in kind. If the final product was not contemplated by the original creator and is substantially yours, the copyright rests in you.

Do not push these too far. Computer technology is new and changing very fast, and the courts move slowly. The emphasis lies on the amount of creativity you contribute, not on the amount you have changed a document. You must alter the document in a major way, and that way must embody creative thought of your own.

For instance, if you read in a photo and posterize it instantly with Digital Darkroom, you generate a very different graphic but your own contribution is minimal. Moreover, the computer graphic would still be *derivative*, that is, clearly dependent upon the original.

If you alter it further, so it is perhaps recognizable as stemming from the original but not yet fully your own, you could still be sued. You must change it in a major way, and to be safe, the alteration should be so great that the final product is not recognizable as deriving from the original. In that case, your own creative contribution will likely dominate.

Virtually all clip art is sold along with the right to copy it, otherwise it isn't worth much. Scanned photos you've taken are safe as well as your own scanned drawings. Traced drawings made by others are not; these are derivative works. For instance, a movie made from a novel is a derivative work—a work in another medium using the basic creative material of the original.

It's not merely sensible to follow these cautions, but it's shrewd. You may want the umbrella of copyright protection yourself some day.

Part 4
Presentations

7
Charts

John von Neumann, the brilliant mathematician and coinventor of ENIAC, the first U.S. computer, was himself a lightning calculator. He could compute elaborate sums instantly in his head, a trick that always impressed his party guests. Most of us are not so fortunate. We calculate awkwardly and fallibly, and even when finished we may have no clear sense of our number's portent.

Hence, statistics is not the Oktoberfest of academic disciplines. At best, a list of figures is a kind of delphic parchment, over which we may pore endlessly as if it holds some secret meaning; at the worst, it numbs the mind. Yet there is a simple tool that brings statistics instantly to life: the chart.

Charts are invaluable; for depicting numerical relationships, there's just no substitute. They turn numbers into simple shapes and juxtapose them to yield quickly perceived breakdowns, comparisons, trends, and contexts. They are like subtitles in a movie, translating foreign concepts into a language with which viewers are more comfortable. Hence, charts are vital in reports and they bloom in presentations, where viewers must grasp a mass of data in a moment.

All charts seek the same goal: to convey the gist of numbers quickly, clearly, and memorably. However, pay attention to your audience when devising them. A chart in a report can be a fairly detailed item, over which the reader may wish to linger. A chart in a presentation must be much simpler, since it appears for a moment and is gone.

In either case, mastery of charts is a great professional advantage. It provides you with a wealth of persuasive and explanatory tools, and gives you power to communicate difficult facts almost instantly.

Note: The nomenclature in this field has run amok for some reason. A single chart can have three, four, or even five different names. Don't worry about it—the important thing is their capacity.

Parts of Charts

Before we leap into the charts themselves, we need a brief reconnaissance to survey the ground we'll be talking about.

Most charts are either circles or rectangles. The circular ones, *pie charts* and *polar charts,* are plain and easy to understand; the rectangular ones are less so. However, all share the following traits:

Title. A good title not only describes the chart but provides a guide to its workings. For instance, a chart comparing eligible, registered, and actual voters could be called *Voter Participation,* but a better title would be *Voter Participation by Group.* The informality of presentations permits the best title of all, the summation: *Eligible Voters Far Exceed Actual Voters.* Some charts simply squirm away when you try to pin pithy titles on them, and you may have to choose between vagueness and prolixity. The biggest pitfall is the title with more than one meaning, which confuses or misleads the reader.

Data. Charts rarely show great precision, and often you must include the data figures nearby.

Labels. You must indicate what you're measuring. To heighten impact and clarity, you should place labels as close as possible to the feature they describe.

Rectangular charts have these special characteristics:

Horizontal and Vertical Axis. Sometimes called the *x-* and *y-axis,* respectively, these lines form the framework of the chart. Commonly the horizontal axis runs along on the bottom and the vertical down the left, but either may bisect in the middle, particularly if the chart shows negative numbers. The horizontal axis often indicates time, which we tend to think of as a *flow.* The vertical normally indicates amount.

Scale. The scale is the set of numbers along an axis. It defines each point on the graph, showing how much is being measured per unit of distance. It's rather like the scale on a map, but more important. Occasionally you see charts without a scale, especially in pain reliever ads on TV; such a chart is almost meaningless.

Grid. The grid is a net of lines extending from the numbers on the scale to make the meaning of data points more apparent. Grids can be whole or partial. A whole grid has lines from every major number and is usually dense with them. A partial grid has lines

from every second or third major number. Whole grids are useful where it's vital to grasp every point in the graph quickly. Partial grids work better where specifying each point is not so essential, since they reduce the clutter. You need not show a grid at all.

Kinds of Charts

In the presentation jungle, charts come in a few *genera* and in wildly various species. It's crucial to master the major types, so you can select the best one for your purpose (though the bar chart does almost everything). The first three are the most important, while the fourth and fifth are sometimes also useful. The graphs and their main uses are:

- Pie Chart: Percentages.
- Bar Chart: Absolute numbers, range of numbers, comparison of breakdowns, comparison of percentages.
- Line Chart: Trends, absolute numbers, range of numbers, comparison of breakdowns, comparison of percentages.
- Scatter Chart: Correlation.
- Polar Chart: Geographic distribution.

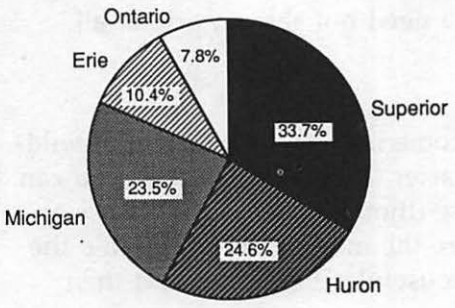
A good chart program can render these graphs, but it may not give you all of their subtypes. For these, you need to save the chart in PICT format and move it to a paint or draw program. As it happens, this process is easy and paint gives you much control over charts.

Percentages: The Pie

The pie chart is a virtuoso with a narrow talent: It does percentages. While other charts can also perform this feat, none does so with the flair and grace of the familiar pie chart.

The pie is the simplest chart of all and the most popular. It's simply a disk cut into slices, each a portion of the whole. For instance, if a pie has two perpendicular lines dividing it into four equal pieces, each would represent 25 percent. Part of the pie's appeal lies in its self-evident nature. As a circle, it can only represent percentages—no one is going to confuse the slices with absolute numbers. The analogy to a pie works perfectly, and the contours attract the eye. Do not hesitate to use this helpful little tool if it's appropriate (see Figure 7-1).

Figure 7-1. The Pie Chart



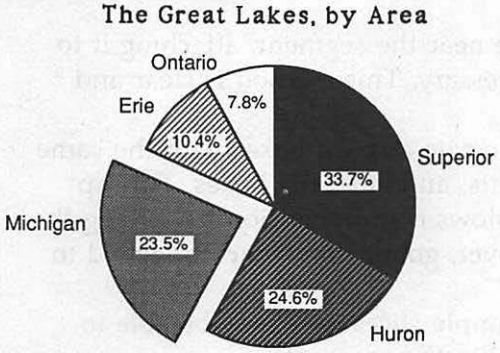
However, not all situations call for the pie. If you divide the pie into more than six or seven segments, it becomes crowded and hard to grasp. Moreover, slices smaller than 2 percent are very difficult to tell apart. Finally, the pie is ill-suited for comparison, since you need two full pies to contrast two sets of figures, and even then it's hard to match the segments against each other. Percentage comparisons work much better on bar or line charts.

Each slice should have a different color or pattern. By tradition, the largest slice is black and the smaller ones are progressively lighter, but don't feel bound by this custom. Exploit the patterns. For instance, darkness draws attention to a slice, so if you really only care about one or two slices, make them black and leave the others white. Likewise, if you have narrow slices, around 3 or 4 percent, a darker color helps keep them from going unnoticed.

You can achieve special effects in other ways:

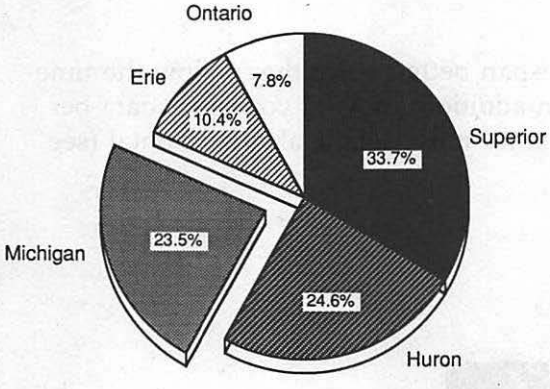
Exploded Pie. An exploded pie has one or more slices extracted for emphasis (see Figure 7-2). Avoid pulling out a hefty segment like 47 percent, since it splits the pie down the middle, and a slice that large really doesn't need emphasis. Never extract a majority section, like 70 percent, because you wind up spotlighting the leftovers. If you pull out all the slices, you make the smaller segments more distinct.

Figure 7-2. Exploded Pie



Three-Dimensional Pie. The three-dimensional pie usually looks better because it affords a pleasing sense of depth, of concrete presence rather than intangible disk (see Figure 7-3). It may resemble a coin, in which form it's particularly useful for representing money. However, be sure that the pie really looks three-dimensional. Some coin-like pies simply have a second line more or less parallel to the bottom curve and strain for effect.

Figure 7-3. Three-Dimensional Exploded Pie



Pies are fairly simple to label. As a general rule, place the data—the percentage—within the slice if there's room. If not, set it just outside on the rim. Don't worry about the inconsistency of placement. It's a common practice, and the reader grasps it quickly and easily.

Here are some ways to label slices:

- Place the label outside the pie near the segment, attaching it to the segment with a line if necessary. This method is clear and straightforward.
- Use a *legend* (or *key*). That is, create a set of boxes with the same color or pattern as the segments, and label the boxes. This approach may look cute, but it slows comprehension by forcing the reader to make an extra stopover, going from chart to legend to label. It also takes up space.
- If you have short labels and ample slices, you may be able to place both name and data within the segments.

The Versatile Bar Chart

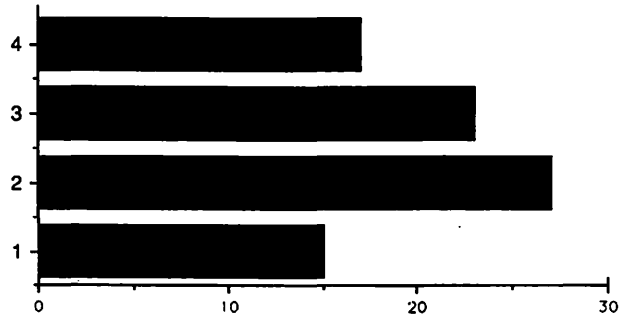
In contrast to the pie, the bar chart is a multifaceted, protean item, the Renaissance man of charts. It has an array of varieties and uses, and it particularly repays study.

Bar charts come in almost tropical profusion. Special indicia distinguish each kind, and occasionally they fuse into a single hybrid chart. Let's begin with the most basic trait: bar direction.

Bars can be either horizontal or vertical, and in the latter case the graph is commonly called a *column chart* (or *pipe-organ chart*). Statistically, the two are identical. How do you decide which to use?

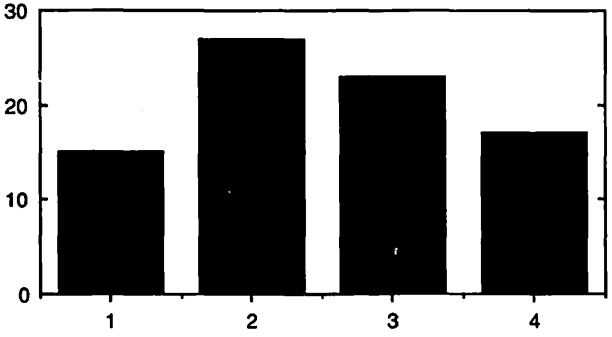
- Horizontal bars show timespan better, since they follow the time-oriented horizontal axis. In addition, they let you place data beside the bars more easily, since most data is also horizontal (see Figure 7-4).

Figure 7-4. Simple Bar Chart



- Vertical bars do almost everything else better. The column chart excels at absolute numbers, such as earnings or stock market closings, which we normally see in terms of height, and they also render percentages well. Visually, they seize the viewer's eye. However, you may find it hard to place complex data near the column (see Figure 7-5).

Figure 7-5. Simple Column Chart



The simple bar chart is the prototype: a row of bars starting from a baseline. Despite its fundamental nature, it's extremely useful for comparing a string of numbers, and you can easily enhance it:

Emphasizing bar chart. You can darken one or two bars of special interest and leave the others white.

Three-dimensional bar chart. As with the pie, adding a third dimension conveys a sense of perspective, of objects in space rather than ink on the page, and so pleases the eye. A three-dimensional bar chart can yield columns that look quite thick, like square pilings.

You can enhance the look of a bar chart with another trick: *drop shadows.* These are dark rectangles behind each bar that suggest shadows cast onto a second plane that's otherwise invisible. Drop shadows are absent from most chart programs, but you can fairly easily create them in paint or draw with the duplicate power.

Even a simple bar chart can become complex. There are three major variations on it: the *bilateral,* the *paired bar,* and the *range chart.* Within the last category you'll find a number of subcategories.

Positive and negative: Bilateral bar charts. Suppose you wish to trace the net earnings of a company with both profits and losses.

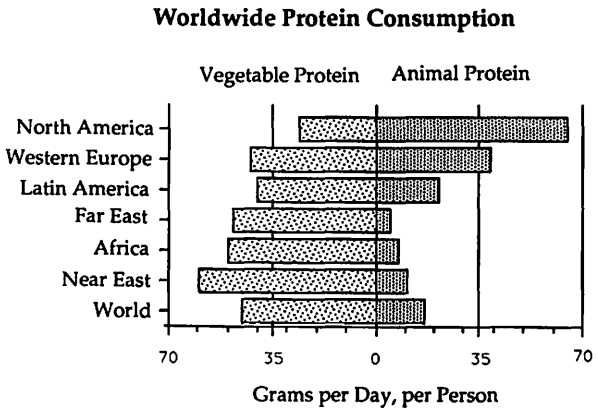
You can easily show the profits, but what about the losses? That's easy, too. You hoist the horizontal axis to midpoint, call it zero, and hang the bars representing losses below like stalactites.

Of course, you could also shift the vertical axis to the center and pull bars right (profits) or left (losses). In either case, the graph is called a bilateral (that is, two-sided) bar chart. Most chart programs generate bilaterals automatically with negative numbers.

Two parts of a whole: Paired bar charts. With just a minor adjustment to the bilateral chart it can show figures for two parts of a whole, in which case it's called a *paired bar chart* (see Figure 7-6).

For instance, if you're measuring total population by age, you can move the vertical axis to the middle and use it to separate men from women. For each age group, such as 60–65, the number of men would extend to the left, of women to the right. At the same time, the overall bar would show the total number of individuals of that age.

Figure 7-6. Paired Bar Chart



The paired bar chart is beyond much chart software, but you can still generate it, with help from paint or draw. The best way is to trick the chart program into thinking you're working with positive and negative numbers. Since it doesn't place both a "positive" and a "negative" bar on the same line, you must create them separately and later shift one part of the chart atop the other. Here are the steps:

- In the data table, type the numbers for the right-hand bars. Then, immediately below and in the same order, type those for the left-hand bars but give each of these a minus sign.

- Generate the bar chart. In the upper half, bars extend in one direction; in the lower half, the other.
- Save the graph as a PICT. Open it with a draw program, press the mouse button, pull the selection rectangle around the chart, choose Copy from the Edit menu, and Paste it into paint.
- Select the top half of the chart with the marquee and move it down adjacent to the bottom half.
- Erase the minus signs on the scale, and otherwise dress up the graph to please the eye.

Outer limits: Range charts. No rule says the bars in a bar chart must be moored at an axis. They can hang in air, as they do in a *range chart* (or *floating bar chart).*

Range charts, not surprisingly, show the spread of numbers. Here, too, the bars can be vertical or horizontal. A range chart with horizontal bars is called a *progressive bar chart,* and it comes in handy for depicting time.

For instance, suppose you're illustrating the life-course of various Paleozoic reptiles from first appearance to extinction. Above a timeline on the bottom, you can place a horizontal bar for each animal, beginning and ending in empty space. Start at the upper left with the creature that evolved earliest, and proceed in order of advent. Hence, the left side slants down and right, while the right side is ragged.

The progressive bar also works well with the lifespans of individuals such as famous authors, showing instantly whose lives have overlapped (see Figure 7-7). You could also indicate events on the scale, such as the invention of the light bulb, to give the social context.

A special kind of progressive bar chart is the *Gantt chart,* named after Henry L. Gantt, who devised it during World War I. The Gantt chart helps organize projects by mapping out their stages. If you're writing a report, for instance, you can plot research, outline, first draft, outside critique, and final draft against the time line, and gain a helpful picture of the workplan (see Figure 7-8). Gantt charts accommodate themselves well to computers, since they fit in well at presentations and since schedules often change.

The range chart can also use vertical bars, in which case it's called a *high/low chart,* since it normally measures fluctuation in quantity. Each bar extends from the high to the low for a given pe-

Figure 7-7. Progressive Bar Chart

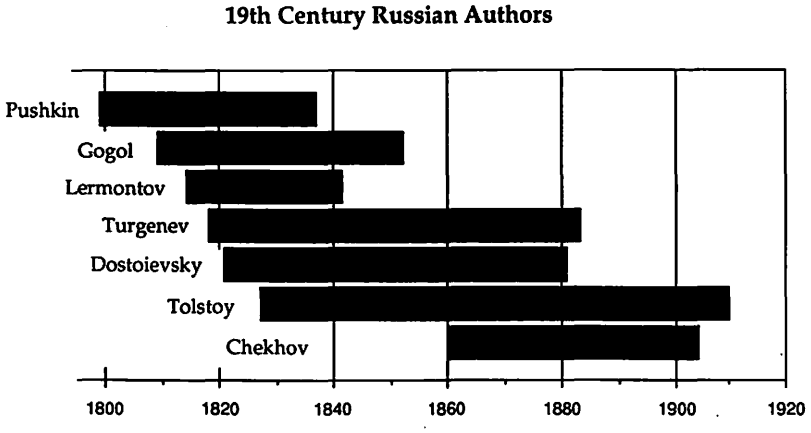
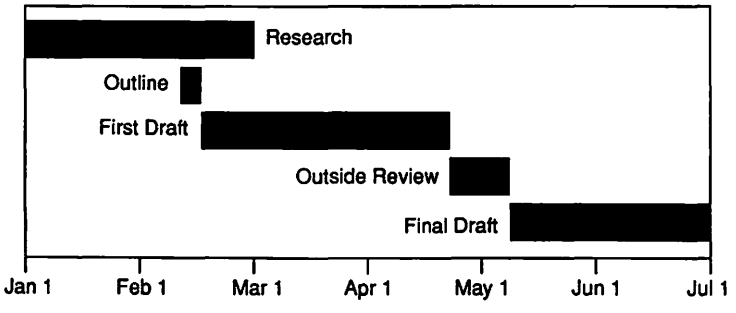


Figure 7-8. Gantt Chart



riod and emphasizes the stretch between them. Such a chart can yield a vivid record of the highs and lows of temperature, tides, or stock prices. Each bar may have a tick to mark a significant datum, like average temperature or closing price (see Figure 7-9).

We end this section with a mimic, not a true range chart at all. It's the *step-bar chart,* which shows percentages. Though the bars hang in the air, they represent segments of the whole, not separate entities. The chunks begin at upper left and move down toward the lower right like floating steps. The tipoff here is that they never overlap. Where one ends, the next begins (see Figure 7-10).

Of course, the step-bar chart lacks the talent of the pie. It can't compare percentages as well, since the bars don't line up, and it doesn't show the amount of each percentage as well either, since

Figure 7-9. High-Low Chart

Dow Jones Average, Over Two Weeks

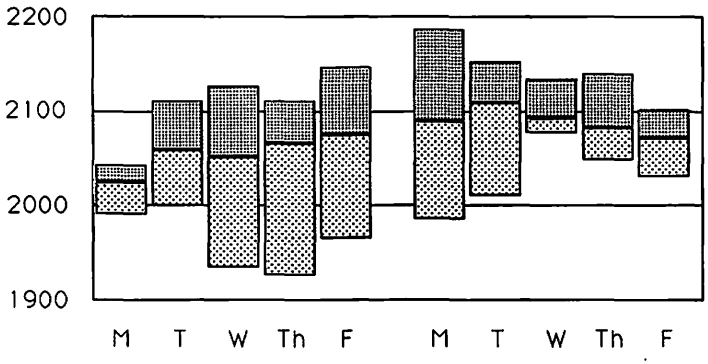
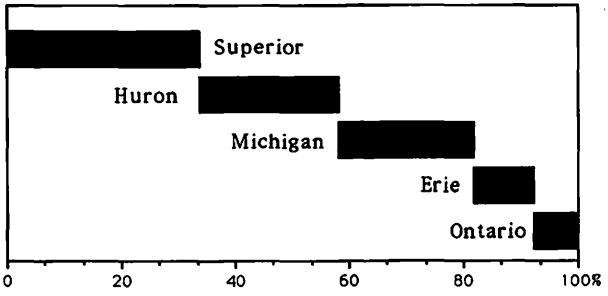


Figure 7-10. Step-Bar Chart

The Great Lakes, by Area



most don't touch the baseline. However, sometimes these are advantages.

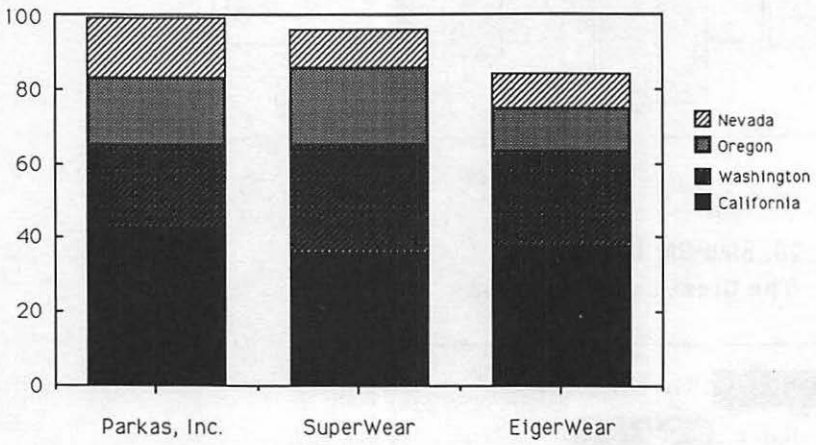
Up to now, this tour of bar charts has resembled a walk through an aquarium, where one tank succeeds another and we gaze at the contents. So far the fish we've seen have remained fairly plain—flounder, bass, and trout. It's time to move on to the tangs and Moorish idols.

Breakdowns: Stacked bar charts. The simple bar chart is fine for many purposes, but it may lack power. For instance, suppose you wish to show not just quarterly gross income, but also the breakdown of that income. You could devise a separate bar chart for each source of revenue and watch graphs proliferate over the page. Or you could divide the bars into segments, each representing an income source and each with its own color or pattern. The result is a *stacked bar chart* (or *subdivided, divided, segmented, com-*

pound, or *component bar chart).* A stacked bar chart shows components very well and, if you haven't partitioned it into too many pieces, remains fairly easy to grasp (see Figure 7-11).

Figure 7-11. Stacked Bar Chart

Parka Sales for 1989, in Thousands



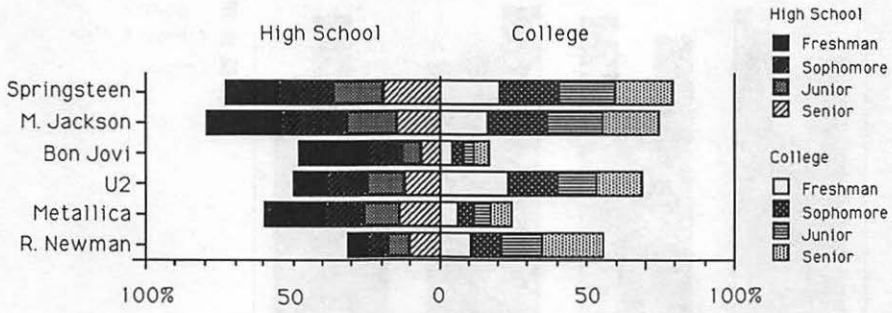
It has one major problem: Since some segments sit atop other segments of varying height, they lose contact with the uniform baseline. Hence you can derive their absolute value only by a kind of mental subtraction. Since the section on the baseline is the easiest to grasp, you should give thought to it. It should be 1) Plainly the most important or 2) (if no clear winner exists) the least variable, or 3) all else being roughly equal, the largest.

The stacked bar can fuse with the paired bar chart above. If the segments fall into two categories with a clear and special gap between them, and you want to emphasize these categories, you can set up a *paired stacked bar chart* or a *sliding bar chart.*

For instance, suppose you're charting the favorite rock performers of students in each year of high school and college. The figure per year matters, but you might also want to highlight the difference between high school and college. Hence, for each performer, you can float a horizontal bar with the vertical axis separating high school and college. You can then divide each category into four parts, one for each year (see Figure 7-12).

A stacked bar chart can depict not only absolute numbers but percentages. In fact, a lone stacked bar can replicate an entire pie,

Figure 7-12. Sliding Bar Chart



though it lacks the pie's visual impact and instant comprehensibility. However, as we've seen, the pie falters when comparing percentages of several different items, and here the bar chart comes into its own. You can set several percentage bars next to each other and see the differences at once. This chart is sometimes called a *stacked 100-percent bar chart,* and, unlike most bar charts, the height of each bar is the same: 100 units. The columns line up like pickets in a fence, and the effect is immediate and clear.

A sliding bar chart can also show percentages with a simple twist on the rock performer example above. However, it's less familiar than the stacked 100 percent bar chart, and since the bars don't match up and are less obviously the same size, presentation viewers may not grasp the information as quickly.

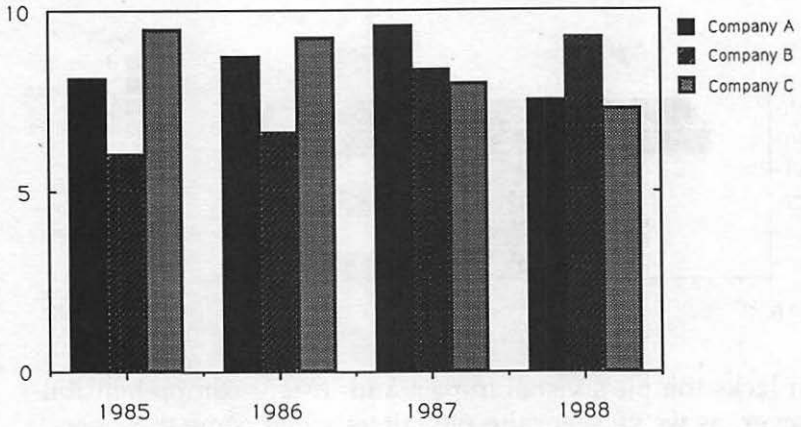
A stacked bar chart can bear a great deal of information if you let it but it's not always wise, especially in presentations. Bars divided into more than five or six parts offer an admirable wealth of information, but they also demand more of viewers, especially if you use a legend.

Clusters: Group bar charts. Suppose you wish to compare the revenues of Companies A, B, and C across the four-year period from 1985 to 1988. You could set up four separate bar charts, one for each year. Each would have the same axes and scale, and only three bars. The eye would roam from one to another, attempting to compare the bars.

Or you could save space and heighten effect by telescoping them into a single chart: a *group bar chart* (or *grouped, multiple,* or *multiple unit bar chart)* (see Figure 7-13).

Figure 7-13. Group Bar Chart

Company Revenues, in Millions of Dollars



Note what happens: Each former graph becomes a cluster of bars and instead of a series of columns you now have a series of clusters. It's as though you've stretched the horizontal axis of the first chart out to cover all four of them.

Hence, the baseline now has two different variables at once: firm and year. Companies A, B, and C sit atop four invisible subscales, and the broader horizontal scale shows the years 1985–1988.

Thus, you need some way to differentiate the companies. Of course, you give each its own color or pattern—say, black, stippled, and lined. The year-by-year comparison is now vivid, as is the companies' relative annual progress.

A major hazard of group bar charts lies in trying to cram too much detail into them. You should avoid clusters of more than three or four bars, as they start to resemble city skylines. And don't try to subdivide a group bar chart; *stacked group bar charts*—the very name is clumsy—just baffle the eye and look like quilts. You can enjoy more latitude with reports and books, where the reader can study a chart at leisure, but in presentations, a stacked group bar chart stuns the viewer and deadens the optic nerve. If you have any concern that a group chart is overdone, simplify it.

Data placement. Placing data on bar charts may seem like a mechanical matter, but it's actually an exercise in good sense, taste, and even craftiness.

For horizontal bars, numerical data should go just to the left of the vertical axis. Tacking it to the right of the bars, some argue, creates an optical illusion that seems to extend their length, so bars with long data or short length appear proportionately greater. Placing data within the bars fosters the opposite illusion: The eye tends to match up the blank parts of the bars, so bars with short data or greater length seem longer.

For columns, you have a set of choices. You can place data beneath the bars but rotated 90 degrees, so the viewer cranes his or her neck to read it. This choice saves space but is otherwise poor. Second, if your data accommodates, you can place it beneath each bar horizontally. This approach may call for extra white space between the bars, and it can make the data itself look cramped and unsightly. Third, you can display a table before the graph or along with it, a particularly effective approach if the numbers are complex. The approach you take may depend on the importance of precision. If exact numbers are not critical, as in occasional presentations, you may be able to omit the explicit data and just rely on the scales.

Label placement. Labeling the axes is fairly simple. To save space, you commonly can label these axes parallel to the axis itself. Thus, you may have to tilt your head to read the vertical axis, but since it's usually brief the hardship is small.

The best approach to labeling bars is to identify the labels as closely with the bar as possible. You can place the label inside the bar, and a good program easily lets you do it, though as we've seen, this method heightens impact with short names or long bars. The purist's solution is to place the label just above a bar, if there is room, or below a column.

With a stacked bar chart you must label segments, and you generally have two alternatives. The first, and preferable, is to place the label near the segment on one bar and draw a line connecting the two. You need only link label and segment on one bar, since the analogous parts on the others have the same pattern and order. Second, you can use a legend, as with the pie, and label its boxes. Legends add an extra step, but they're helpful with group bar charts, where it may be awkward to connect labels directly.

Trends: The Line Chart

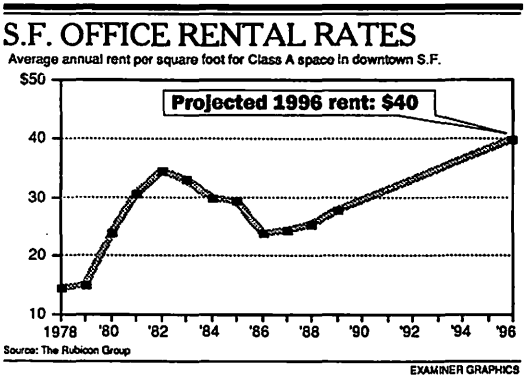
A bar chart with columns packed tight—*a staircase chart*—can even indicate trends, at least in the short term. For instance, a

string of columns showing the Dow Jones average over the last ten days illustrates its progress quite nicely. But the master of the trend is the *line chart.*

The line chart resolves a trend into a single shape and thereby crystallizes it. With a bar chart, you must follow the tops of the bars.

The line chart has another advantage: It divides into theoretically infinite units. While each column must represent a discrete moment, the line fuses all moments together into a smooth timestream, and thus conveys a greater sense of progression (see Figure 7-14).

Figure 7-14. Line Chart



Courtesy of Lance Jackson, Syntax Design Associates, and the *San Francisco Examiner*

Of course, the line does not truly indicate exactly what has happened at any moment. You derive the line by plotting as many points as you can and then joining them together. But it gives the effect of continuous change over time, and thus strikes the eye more vividly in this regard.

However, the line chart has drawbacks. It lacks solidity. The bar chart dramatizes each number in terms of its distance out or up, while the line chart simply shows endpoints. The bar chart is thus more visually appealing.

The line chart also falters where variation is relatively slight. The steplike bars stand out more clearly and seize the attention, while the wavering line is harder to comprehend.

The line chart has uses other than plotting changes over time. For instance, it can indicate frequency, as in the familiar Bell curve,

in which case it's called a *histograph.* But it generally shows the same data as the bar. Hence the question arises: When should you use a line chart and when a bar?

All else being equal, choose the bar. It is simply more dramatic, and flair matters, especially in a presentation. However, you may want a line chart where:

- You have many separate values in a series, particularly more than 15.
- You are stressing movement over time—the line—more than individual amounts.
- The group bar chart becomes too bulky. The group bar chart suffers when comparing performance of two or three entities at many points in time.

You should avoid the line chart where:

- You have relatively few plotted points.
- You wish to stress change in amounts over time rather than overall trend.
- You have three or four lines intersecting in a complex skein.
- You seek impact.

Like the bar chart, the line chart comes in prolific varieties. Many simply mirror the bar chart, but sometimes the line chart yields offspring of its own.

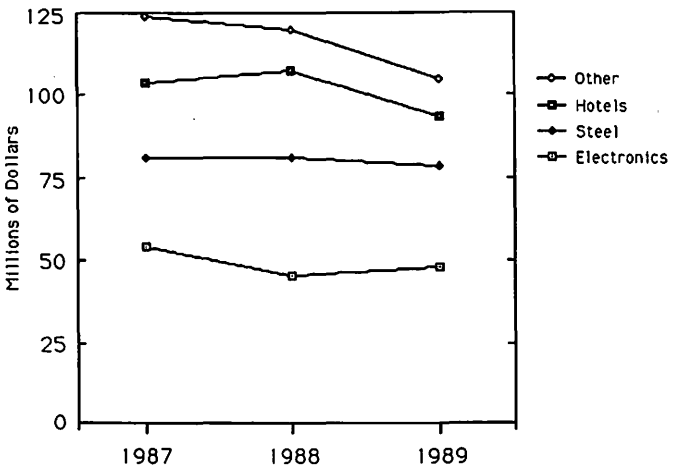
Positive and negative: Bilateral line charts. The most common bilateral line chart has the horizontal axis in the middle and shows a line swinging above and below it to indicate profits and losses. Its familiarity suits it well for presentations.

Outer limits: Range line charts. There's no reason why you can't create progressive or high/low charts with lines instead of bars, except that bars are thicker and make more of a visual impression. In fact, the term *high/low chart* most often refers to a line chart.

Breakdowns: Stacked line charts. You can subdivide a line chart like a stacked bar to show parts of the whole. For instance, if the chart depicts earnings over a three-year period, the top line shows total revenue and lines below illustrate income from various sources (see Figure 7-15).

Figure 7-15. Stacked Line Chart

Revenue Breakdown of Broadbase, Inc.



Of course, when you place multiple lines on a chart you have to differentiate them, and you do so mainly by:

Pattern. Lines can have myriad patterns, such as solid, double, dotted, dashed, dot-and-dash, triple-dot-and-dash, dash-and-cross, line-and-dot, and line-and-crossline. Hence, patterns are useful with numerous lines, but be careful not to confuse the reader by placing similar patterns beside each other.

Symbol. You can repeat certain symbols—square, triangle, circle, and so forth—along each line. However, these devices are small and not always conspicuous.

Thickness. Thickness not only differentiates lines but helps emphasize them. Hence, if you wish to show the relative significance of two or three lines, use thickness.

Color. Colored lines are the most effective of all, since few people might mistake one color for another.

The *stacked line chart* shows trends among segments better than the stacked bar, since it highlights their performance over time.

However, the stacked line chart comes with a caveat: It tends to exaggerate the items highest on it in a kind of piggyback distor-

tion. Since it relies on curves, the effect is more misleading than with the stacked bar.

For instance, suppose a stacked line chart measures the rising cost of food, clothing, housing, and fuel over the years and arrays them in that order on the chart. If all increased at the same rate, it would appear at a quick glance that the price of fuel was rising most rapidly, because it would have the steepest curve. Actually, its slope would derive from its position atop three other curves, each steepening the curve below it. In fact, each curve really measures the cumulative total. The first shows food, the second food plus clothing, and so on. It's just not obvious at first sight.

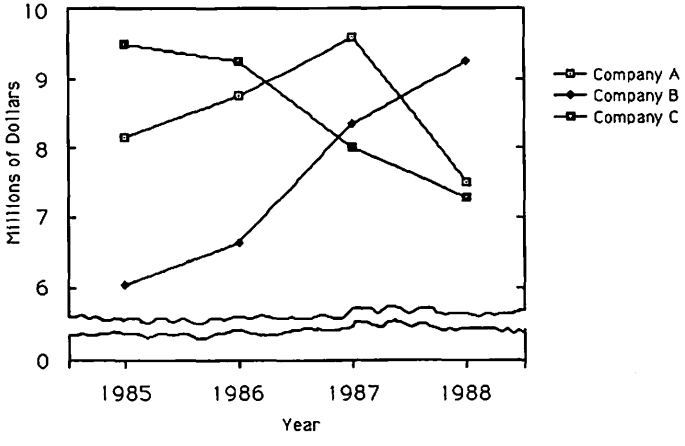
Clusters: Group line charts. A line chart can also compare clusters, like the group bar chart. For instance, you could represent Company A by a solid dark line, Company B by a dotted line, and Company C by a double line.

At first glance, this chart may look very much like the stacked line chart, since both show several lines zigzagging across the chart. Here, however, the lines may intersect. In the stacked chart, they never do (see Figure 7-16).

The group line chart is far more elegant than the group bar for comparing entities at many points in time. However, it suffers when the items change rank often, as that leads to crisscross lines and ultimately a complex weave that challenges the eye.

Figure 7-16. Group Line Chart

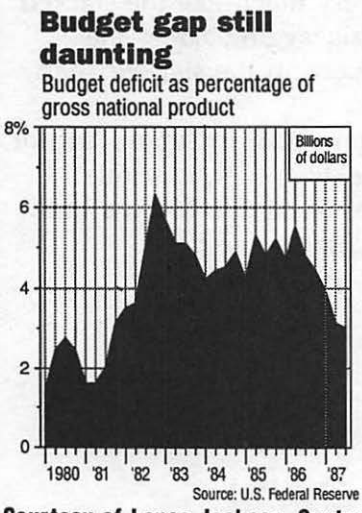
Revenues of Three Companies



One effective enhancement of this chart highlights positive and negative differences by shading in the space between two lines. Say you're comparing production and supply of bricks in Belgium. Wherever the nation's production exceeds its supply, some have plainly left the country, and you can indicate net exports by filling the gap between the two lines with one pattern. Where Belgium's supply exceeds its production, some have been brought in, and you can show net imports by filling in with a second pattern.

Area charts. As you've seen, the line chart looks insubstantial, like a mass of telephone wires. You can partly overcome this drawback by filling the chart below the line, in which case it's called an *area chart* (or *surface* or *silhouette* chart) (see Figure 7-17). You can go further and render it in three dimensions for even greater presence.

Figure 7-17. Area Chart



Courtesy of Lance Jackson, Syntax Design Associates, and the *San Francisco Examiner*

An area chart can replicate a stacked bar graph, in which case it's often termed a *band chart* (or *multiple surface chart*). The band chart, which derives its name from the layers of different patterns or colors spanning it, is useful for displaying the growth or decline of parts of a whole. However, it, too, suffers from the piggyback effect, and since it's more vivid the effect is more pronounced.

The band chart is most effective as a *100-percent band chart*—that is, where each band is a percentage of the whole. Since this chart fills a rectangle, the steepness of line has less impact. More-

over you tend to read it from top down as well as bottom up, reducing the cumulation effect. Finally, since it measures percentages rather than absolute numbers, it's easier to grasp. This band chart is also, of course, very similar to the 100-percent stacked bar chart.

An area chart can replicate a group bar chart, but only with pain and difficulty. If you place the revenues of Company A atop Company B atop Company C, you wind up with a chart that looks very much like a breakdown of components. You also make it hard to compare the figures; it's particularly demanding to assess the income of Company A, which rests upon the cumulated revenue of the other two. You forestall all kinds of problems by sidestepping this one.

Multiple scale charts. Finally, there's a special line chart that can be very powerful but demands caution: the *multiple scale chart.* This graph matches up two trends that share one variable but not another. Hence, one of its axes has two completely different scales. When the dual scale is on the vertical, it is sometimes called a double-*y* chart; on the horizontal, a double-*x*.

Why plant two scales on one axis? Well, it can show correspondences. For instance, a multiple scale chart can depict the relation over time between sunspots and auroras. One line could show the rise and fall of sunspot levels, the other of auroras. They would parallel, and the correspondence would be plain.

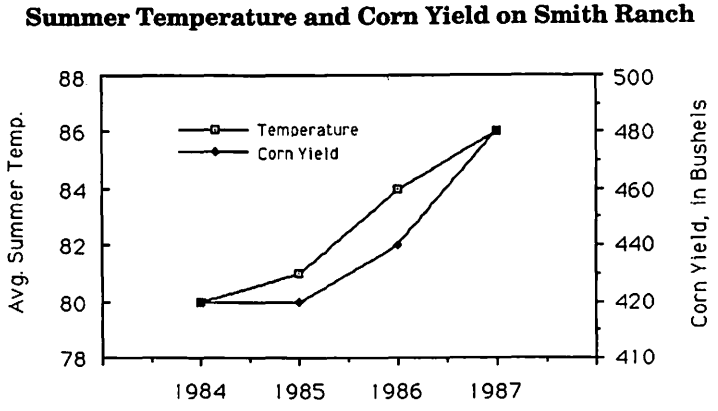
How do you depict the two scales? You could simply align one beside the other to create two adjacent strings of numbers, but this method is clumsy and bewildering. The better tack is to place one scale on one side of the chart and the second across from it on the opposite side. Thus, in a double-*y*, one appears on the left, the other on the right (see Figure 7-18).

The multiple scale chart has several pitfalls, especially for presentations. It's not instantly obvious, and hence can be confusing. Though the scales on either side differ, the chart seems at first to measure similar items. In addition, the multiple scale is not a common chart, and the audience may need time to assimilate it.

Yet, it's a good persuader, and if you want to display it in a presentation, consider using a *build,* or successive overlay. First, show the trend in one line chart. When viewers have grasped it, superimpose the second chart, so everybody clearly sees the nature of the graph.

Many chart programs offer multiple scale charts. If yours doesn't, you can create one by merging two different charts in a

Figure 7-18. Double-Y Chart



paint program. You may have to detach one vertical axis and move it to the right.

Labeling. In general, you don't need to label individual data points on a line chart, since it doesn't stress them. You may, however, wish to cover the chart with a grid, if it's important to trace back from the line to the scale. For the lines themselves, you can either place the label nearby or use a legend.

Correlation: The Scatter Chart

A line chart always shows a one-to-one correlation between figures on the vertical and horizontal axis. For instance, a stock closing is one and only one number for each day.

However, not all matchups are one-to-one. If you're investigating, say, the relationship between the IQ of parents and of their offspring, the matter is definitely hazier. Parents with an average IQ of 120 can produce a child with almost any IQ, but the children's ratings tend to fall into a certain range. To express this relationship, you can plot a set of points on a chart. One axis shows the averaged IQ of mother and father, the other the IQ of the child. Each point indicates a single matchup, and the overall pattern shows the correlation.

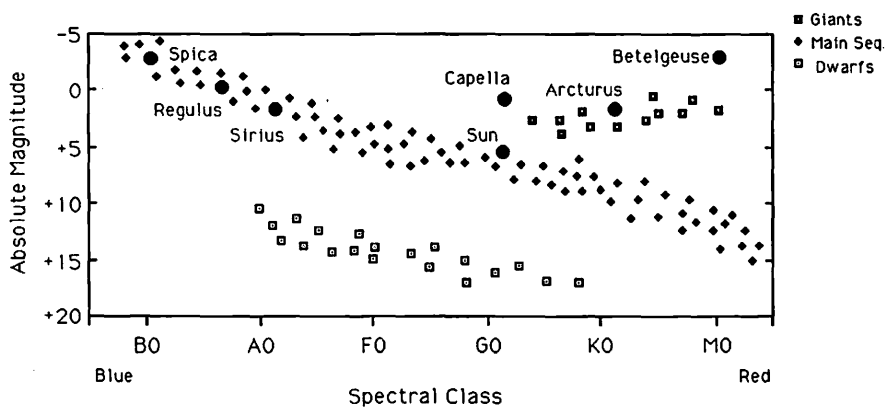
Such a chart is called a *scatter chart* (or *dot chart* or *X-Y chart*).

Scatter charts reveal the extent of correlation by the narrowness of the band of dots. Perfect positive correlation is a straight line sloping up 45 degrees from lower left to upper right. Perfect negative correlation is a line sloping at the same angle in the opposite direction. A relatively narrow band indicates good correlation,

while a larger and more diffuse one shows medium correlation. A circle or random pattern indicates no correlation at all.

A scatter chart displays not just the pattern of correlation but also exceptions, and these may be important, too. For instance, a chart matching the color of stars against their luminosity has proved quite revealing (see Figure 7-19).

Figure 7-19. Scatter Chart



This star scatter chart yields a broad swath from upper left to lower right, showing that white stars are generally very bright, blue ones less so, yellow about average, and red the dimmest of all. Most stars fall into this band which astronomers call the Main Sequence, but there are two exceptions. In the lower left is a cloud of dim white stars, now known as white dwarfs. In the upper right is a band of extremely bright red stars, the red giants and supergiants. The famous star Betelgeuse is a red giant.

The scatter chart can also compare two or more patterns of correlation. You simply use different symbols to represent the points in each pattern. For instance, the first might be an open circle, the second a cross.

For at-a-glance comprehensibility, the ideal comparison yields two nonoverlapping patterns. More often, of course, there is overlap. For instance, Item A might form a disk and Item B a lens-like shape within it. If you aren't sure the audience can distinguish the two, you should resort to a build and display first one, then the other.

A scatter chart may call for a *trend line,* a line sloping through the dots to indicate their gist. Essentially, the trend line seeks to reduce the unruly scatter chart to the simplicity of a line chart. The trend line is especially vital where that trend is not immediately noticeable, though you can use it for emphasis too. It can also depict an expected trend, which is useful if the real data is different.

Don't hesitate to label certain dots, particularly if they're well known. In fact, if the chart has just a few dots you may want to label all of them. Such tags are welcome to the reader, since they anchor the chart in reality and provide useful contextual information.

One interesting kind of scatter chart is the *bubble chart,* the range chart of this field. It replaces dots with circles or ovals of various size, to show the spread of sets of values. These charts are commonly used to show ratios.

Geographic Distribution: The Polar Chart

Polar charts are actually a crude kind of map, lacking all detail except the location of certain physical objects or events around a single point. They are circular with spokes radiating out from the hub. You plot individual points on them according to distance from the center and direction, normally north (0 degrees), east (90 degrees), south (180 degrees), and west (270 degrees).

The most familiar polar chart is the radar map on ships, which displays other craft as blips. The chart is also often used to show the relationship of an earthquake's epicenter to local towns, or the distribution of stores in a chain.

A Recapitulation

Now that you've seen the range of charts, let's go back and sum up the situations calling for them:

Information to be displayed	Chart to use
Percentages	Pie, step-bar chart (weak).
Compared percentages	100-percent bar chart, 100-percent band chart, pie (weak).
Absolute numbers	Bar chart, column chart, line chart, area chart.
Positive-negative numbers	Bilateral bar, line, and area charts.
Two parts of a whole	Paired bar chart.
Range	Range bar and line charts.
Periods of time	Progressive bar chart.

Workplan	Gantt chart
Breakdowns	Stacked bar and line charts, band chart
Group comparisons	Group bar and line charts
Trend	Line chart, area chart, staircase chart
Correlation	Scatter chart
Geographic distribution	Polar chart

Advanced Chart Graphics

As you've seen, a chart is generally a tool. It has a function, which it usually performs best when simplest. However, charts can also ascend into the realm of art. Such techniques as three dimensionality and drop shadows enhance the appeal of charts, and there are further methods for making them look attractive and striking.

Pictorial Charts

You can construct most of the graphs above with a decent business graphics program. There is another kind of chart, however, that tends to elude such software, but creates a very vivid effect: It's the *pictorial chart* (or *pictograph).*

Pictorial charts show quantity through symbols—either a string of them or a single one varying in size. They're marvelous for driving home a point, because they make the link between numbers and the real world immediate and unmistakable. They also provide welcome diversion from the typical bar and line charts.

Pictorial charts aren't always called for, however, and you should avoid them unless your information is fairly basic. They're often a good substitute for simple bar charts and occasionally for pie charts, but pictorial charts can rarely take the place of line or scatter charts.

You need a convenient symbol for the units. A coin conjures up earnings; a silhouette, people; and a barrel, oil production. Each symbol, of course, represents many of itself. A person normally stands for, say, a thousand people or a million. Hence, you must provide a key so the reader can decode the image.

The symbol should be uncomplicated and immediately recognizable. A detailed symbol, even if instantly obvious, may call so much attention to itself as to detract from the chart. You can mix symbols—supplying, for instance, a cartoon man, woman, and child for different bars in a chart—but if their differences rest on fine distinctions, the reader may miss them and assume they're

identical. Finally, you should make the symbols of similar size or the chart looks ungainly.

Where do you find the symbol? Clip art abounds with simple images suited to this purpose. You could also try creating them yourself, particularly if you have a model before you. Since these figures must be kept small and rudimentary, the task is manageable, especially with the aid of FatBits or LaserBits.

HyperCard lets you create basic coin charts in its Plots stack. You simply type in numbers in the column on the left, issue the Coin chart command, and the chart appears before you. However, it's not a very sophisticated item. The coins look rather like Go stones and you must export the file to a paint program to add labels.

However, since most graphics programs don't offer pictorial charts, you may need to create them. It takes more time, but it's not too difficult. You devise the comparable bar chart on a chart program, move it into paint, and erase all of each bar except the very tip. Then you introduce the symbol and multiply it with the lasso. Replace each former bar with symbols until you reach the end. If the final image exceeds the tip of the bar, chop part of it off.

Image Underlays

The line chart tends to look abstract; it's mostly white space with a few lines across it, and it simply lacks the panache of, say, a three-dimensional bar. But you can bring flair to a line chart very quickly with an image underlay.

An *image underlay* is just a picture beneath the chart. For instance, if you're tracing the decline of forestland in Nepal you might superimpose the graph over a stand of timber. If you're charting the population of Brazil, you might slip a map under it. Figures 7-20, 7-21, and 7-22 show examples of image underlays.

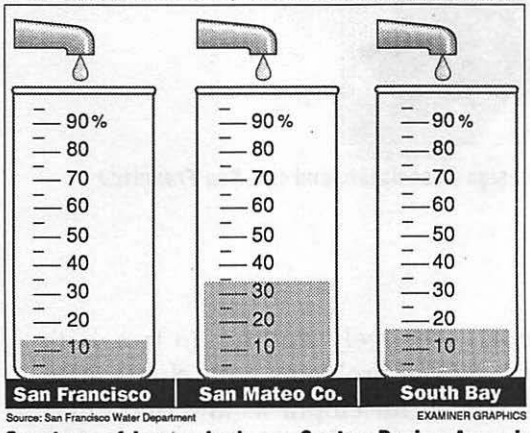
The image underlay is outstanding at linking chart with subject matter. It adds a sense of depth or, with a map, of great aerial height. It also permits you to grace the chart with professional quality graphics, since you can bring in images from anywhere.

The key fact about image underlays is that they must not overshadow the chart. They should linger ghostlike in the background, and hence are often line drawings in gray or light colors. It may seem a limitation, but it also gives the image underlay a sense of understatement and thus confers a note of class.

Many chart programs don't permit image underlays, but you

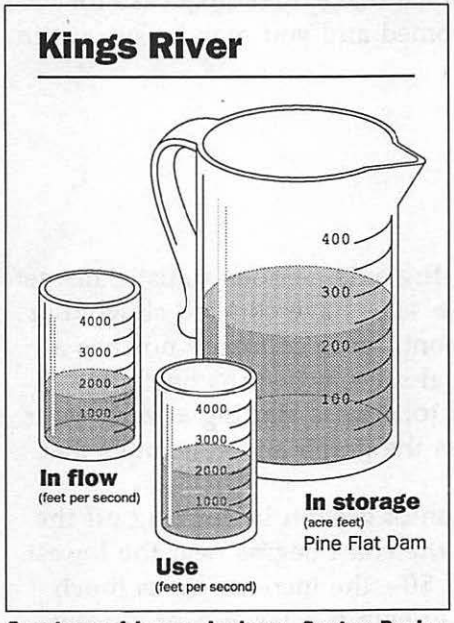
can create them easily enough yourself. You either draw a picture, digitize it, or copy it from clip art. Then you edit it, if necessary, and move the chart atop it.

Figure 7-20. Image Underlay Example 1



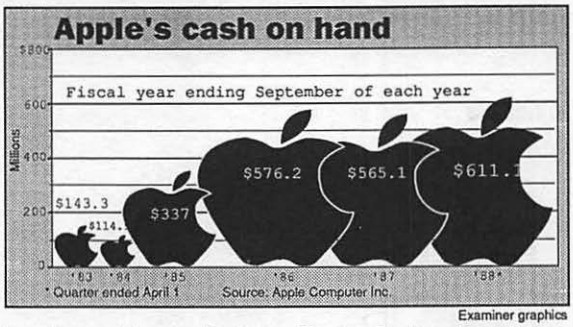
Courtesy of Lance Jackson, Syntax Design Associates, and the *San Francisco Examiner*

Figure 7-21. Image Underlay Example 2



Courtesy of Lance Jackson, Syntax Design Associates, and the *San Francisco Examiner*

Figure 7-22. Image Underlay Example 3



Courtesy of Lance Jackson, Syntax Design Associates, and the *San Francisco Examiner*

Coda: Lying with Charts

Like photographs, statistics look deceptively truthful. In fact, both can be highly misleading. Most ethical problems with charts arise in the gray zone between adjustment for emphasis and outright misrepresentation.

It's always tempting to shape the facts to our particular arguments, but the penalties can be harsh. If you use a misleading chart and someone calls you on it, you must make a credible case for yourself or your presentation is doomed and you may be suspect in future presentations.

There are two basic tricks:

- Amputating the axis
- Altering the scale

Trick number 1: Amputating the axis. Serious statisticians get quite excited over this one. Suppose sales have climbed slowly but steadily over the past year. Each month your company notches a slight increase, but compared to total sales, growth is negligible. If you create a chart with the axis for total sales starting at zero, your audience sees little difference across the graph and concludes that sales have remained flat.

You can heighten the impression of growth by lopping off the bottom of the vertical sales axis. If the chart begins near the lowest figure—at, say, $500,000 instead of $0—the increase looks much more dramatic. Suddenly monthly growth is a far greater percentage of the total scale, and the firm seems to be growing faster as

well. You are distorting the chart. Of course, some observers would notice the labels on the scale to the right, but the impression remains misleading.

Yet often it's important to see the gradient of improvement, however slight. If it's otherwise undetectable, or if small increments have great impact, you have no choice but to elide part of the chart.

The safe, candid, and preferred method is to cut a jagged *white zone* out of the chart's middle (refer back to Figure 7-16). The graph looks as though you've ripped out the center and discarded it, and numbers on the scale above the break are much higher than those below it. Such a chart both warns the viewer and preserves the basic scale.

Most chart programs lack this feature. You can devise it yourself with the following steps:

- Create an area chart with amputated axes that highlights the variations. (You can generate it by subtracting the same large amount from each number before you enter it into the data table and later altering the numbers on the scale.)
- Create a second area chart from a data table with the same number of entries, but only enter the highest number from the first chart in each one. This chart should look rectangular.
- Save each as PICT, open with paint, and save as paint documents.
- Erase the bottom part of the first area chart and the top of the second one, creating sharp, flinty contours.
- Bring them into alignment, positioning the first chart above the second one.
- Link the vertical axes and adjust the numbers in the top part of the scale upwards.

A more dubious specimen is the chart with an uneven edge at the bottom. Often the edge just wavers slightly, coyly evading attention. Even if people notice the rough baseline, they might think it's a technical error and not grasp its feeble signal.

In some cases, you can omit the zero baseline with impunity, usually where zero is an arbitrary value rather than "nothing." For instance, a time axis with years—1988, 1989, 1990, and so on—need not go back to the birth of Christ. Likewise, an axis of temperature need not start from zero, since it's another arbitrary value.

(It doesn't need to start from absolute zero either, since we're accustomed to Fahrenheit or Celsius.)

Trick number 2: Altering the Scale. In the sales example above, you could further enhance the impression of achievement by condensing the horizontal time axis. Shorten it, and the ascent of the sales figure steepens; stretch it, and the rise flattens out. You can also steepen the sales line by expanding the dollar axis, by letting each centimeter represent $1,000 instead of $100,000. Suddenly the line flies up into space.

To some extent, again, this tactic is justifiable and even necessary. It helps emphasize your point and involves no attempt to mislead the reader. Moreover, there is no standard size which all axes must be. This ploy only goes from emphasis to misrepresentation when the scale is drastically shortened or lengthened.

Charts are adroit persuaders, and as such, key elements in presentations. But there is much more to a presentation than charts.

8
Presentations

Persuasion is among the most useful of arts. It allows us to unfold our visions before others, to make them see and share our enthusiasms, to enlist them in our glowing cause. Great orators like Demosthenes and Daniel Webster gained almost magical sway over listeners and rose to power and eminence. Few of us are so gifted, yet we can use the tool of presentation graphics to communicate to the best of our ability.

Presentations are illustrated speeches. A slide show of last summer's vacation is a presentation, as is a training session with an overhead projector. Most often, though, presentations seek to convince people to take a serious course of action, and an adroit touch here can pleasantly spur the career and enhance well-being.

Four fundamental elements go into a computer-based presentation:

- The script, the main track of the argument
- Visuals, the graphics which clarify and highlight key points
- The presentation program itself, which links the graphics together
- The medium of presentation.

The Script

The *script* is the verbal thread of the presentation, the cord from which the graphics hang. If that cord sags or twists back on itself, graphics lose their force and cannot save the presentation. Hence, the script is by far the most important consideration and deserves great care.

Where do you begin? The classic script promotes a course of action, such as "We should buy Company Z." Most such proposals trigger a string of questions automatically:

- Why do it?
- Can we reasonably do it?
- What are the hazards?
- How soon must we act?

Once you prevail on these issues—benefits, feasibility, risks, and time constraints—the road to action usually stands clear.

Moreover, they form a convenient order in which to proceed, though the particular demands of your presentation may force you to alter it. However, a pure four-part organization is a little bald, and you can profitably elaborate on it. Let's look first at a better developed order and then examine the four main elements more closely:

- Introduction. You may wish to highlight some need the proposal fulfills.
- Brief statement of proposal.
- Benefits. This section answers the question "Why do it?" and also the question "Why are we listening to this?" It whets the appetite for the rest of the presentation.
- Feasibility, Part I. The details of the plan.
- Risks or drawbacks, and how the plan treats them.
- Feasibility, Part II. The budget and the source of initial expenses.
- Time constraints, if any.
- Conclusion, restating the benefits.

Though all issues are important, benefits matter most. You want to conjure up a great gleaming nugget, one plainly worth a little pick and shovel work. If the goal doesn't seems rewarding, the rest of the presentation crawls.

Feasibility is the second part: *Can we do it?* If your company is near-bankrupt, say, it may have to forgo the plan no matter how appealing it is. Generally, you prove feasibility by outlining a plan, and its sheer details often answer this question: the steps of action, the personnel, the budget, the availability of funding, and other major factors in the scheme.

Third, you must anticipate and provide for the risks. Every plan has pitfalls, and you must show you've considered them. You want to minimize risk, provide for contingencies, and even occasionally offer safety nets. This part can be the hinge of the presentation, for if you evoke alluring benefits and then allay doubts, you vaporize most objections. However, your description of the risks demands a certain delicacy. If you harp on hazards, the audience may pick up your defensive attitude and feel the enterprise is ringed with peril, even if it plainly isn't. The outline above subsumes risk into the overall plan, thus de-emphasizing it and plac-

ing it in a context of control. Such a structure also shows the forethought that has gone into the plan.

In general, do not simplify a risk or objection into a "straw man." The temptation may be strong because the feeling is so pleasant: You exaggerate a position, attack the exaggeration, and vanquish it with delightful ease. But this approach ignores the issue and disturbs a sophisticated audience. It also undercuts your credibility. Listeners worry that you've not scrutinized other real dangers and that your plan harbors secret weaknesses. You should convey the opposite impression—that you've identified and forestalled even more problems than you mention.

Finally, most proposals have certain deadlines. Action must occur within a certain period of time. You should indicate the window of opportunity to the audience, as both a matter of information and, if necessary, a prod to decision.

It makes sense to conclude with a reminder of the benefits, not a parroting of the original line, but a refurbishing in new verbal raiment. At this point, with hazards minimized and feasibility proved, the benefits acquire even greater luster. The finale of a presentation also tends to linger in the mind.

Sometimes the success of a presentation hangs on one major aspect, such as benefits. In such cases, you may have to marshal a string of arguments and their order becomes critical. You should make your strongest point first rather than working up to a climax. The audience begins formulating its decision from the outset, and you want to create a good first impression and gain momentum. If you lead with a weak argument, audience members may dismiss it outright. Present a weak argument after one or two stronger ones, and the audience tends to add it to the previous ones. The difference may be enough to put you over the top.

Finally, there are certain more or less mechanical rules that go into a persuasive script. They are:

Make It Brief. Studies show the average audience attention span is between 8 and 12 minutes. Presentations must often be much longer, but shorter ones benefit everyone.

Make It Simple and Direct. You only run through the presentation once, so you communicate instantly or not at all. An intricate script with eloquent Proustian clauses spreads out into fog. And don't rely on handouts; they can be helpful, but only the presentation gives you a chance for impact.

Use Active Verbs. The passive voice is the Uriah Heep of prose. *It was done by them* sinks to the floor next to *They did it.* (The only real use of the passive is to obscure communication. For instance, a criminal attorney would rather say "The house was robbed" than "My client robbed the house.")

Avoid the Subjunctive. The subjunctive conveys hesitation; therefore avoid saying things like, "If it were so..." or "We should insist the zoning ordinance be changed." Also substitute *will* for *would* and *can* for *could.* Avoid *I think* and *I believe.* These tags not only add verbiage and complicate the message, but drive the audience to contemplate your own credibility.

Make It Conversational. After all, you're going to have to say it. If it's wooden, audience members drift away into their own comfortable, private thoughts. You want them to feel you're addressing them directly, and your script should follow whatever speech patterns are natural to you.

Visuals

As photos spruce up a magazine article, graphics deepen a presentation. They flesh out the string of words and enrich the total experience. They can also be very persuasive in themselves.

Visuals are not necessarily pictures. They can be—and most often are—mere words flung on the screen for visual impact. Whatever their nature, they have several virtues:

Clarity. They bring order to complex matters. Even a list of main points helps structure a presentation, while a chart can instantly sum up a set of numbers and a cutaway drawing of a car conveys its makeup at once.

Brevity. They save time. They communicate facts far more rapidly, leading to shorter meetings and, in the long run, greater productivity.

Emphasis. Flashing a slide is like underlining a sentence in text—it burns the contents into the mind. You should reserve a visual for every major point and avoid them for subordinate points, which you can explain yourself.

Engagement. A straight speech engages the ears but gives the eyes little to do, so they may wander. Presentation graphics occupy both eyes, the ears, and help hold the audience's attention. They're particularly important in today's world, where TV has habituated us to receiving information optically.

All visuals have one main caveat: The moment you display one, the audience shifts its attention away from you for as long as assimilation takes. You should pause after flashing a visual and make your comments either beforehand, to introduce the slide, or later, to sum it up.

There are five basic visuals:

- Text charts
- Tables
- Number charts
- Diagrams
- Illustrations

They constitute a gradient from all text to all pictures, and each has its singular virtues. These visuals are not types of frames but rather building blocks, to be shown either alone or mixed together.

Text Charts

Text charts are simple lists of words or phrases. They are by far the most common visual, the easiest to devise, and the most generally useful. For instance, an introductory list of key points can fix them in the audience's mind and give a framework for your talk.

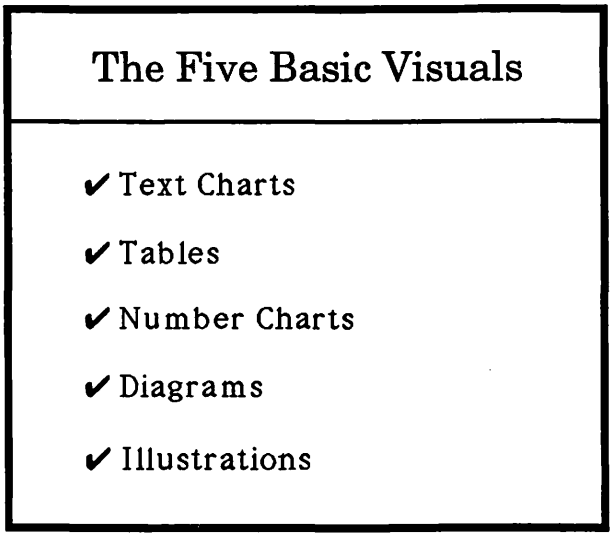
As basic as they seem, text charts have their snares. For instance, their very ease of use sometimes leads to overuse. You should deploy them only for important points and let the screen lie dark in between. Above all, do not put most of the script onto text charts, or your presentation shrivels. The audience then feels it's reading a report, and your own presence, repeating words on the screen, seems slightly ridiculous.

Keep the list simple. Use no more than five or six lines total, and five or six words per line. The word-per-line restriction forces you to pare your prose, an exercise which often has happy effects, though you should avoid a telegraphic style if possible. Each point can have two lines, but more than that starts to look like a paragraph (see Figure 8-1).

You should cleanly separate each item in the list. There are two principal ways to do so:

- By placing bullets to the left of each item, either numbers to indicate priority or devices like black circles or dashes.
- By providing physical breaks between the items, such as lines or

Figure 8-1. Text Chart



centered bullets—black circles, stars, squares. Zapf Dingbats has a panoply of decorative bullets.

Often you want to subordinate some points to others. Normally you indent the minor points and use one of two kinds of bullets, depending on the need for priority:

- Numbers for main points and lowercase letters for minor ones
- Black circles for major points and dashes for lesser ones

You must also make sure text is readable to individuals who may be seated at some distance. As a general rule, avoid type sizes below 18 point. Select a clear, sans serif headline font, such as Futura or Franklin. You can use body text fonts such as Times if you like, but their special virtues are largely lost. Don't mix more than two fonts.

Finally, you may wish to underline highly significant words or phrases in these charts to make sure they register on the viewer. Once again, use restraint—over emphasis is no emphasis.

Tables

Tables are data arrayed in columns, and they can go far to focus the presentation. They come in two kinds: text and number.

Text tables. Text tables are simply text charts with more than one column. Most often they contain two columns, but they may have three or even more.

The archetypal text table consists of a pair of columns comparing two categories. For instance, the heading of the left column might read *Company A* and the right, *Company B.* Below, each line matches the firms on a single criterion. For instance, one line might read *No Youth Market* and *Growing Youth Market.*

Of course, a two-column table need not compare; it can list a set of items on the left and comment on them at the right. For instance, if you labeled one column *Risk* and the other *Response,* the righthand column essentially offers a reaction to each entry in the left list.

Many of the strictures that hold for text charts apply here as well, for obvious reasons. However, the verbiage should be even briefer, and you should supply ample space around the words so the eye can easily distinguish them (see Figure 8-2).

Figure 8-2. Text Table

Asian Capitals	
China	Beijing
Laos	Vientiane
South Korea	Seoul
Burma	Rangoon
India	New Delhi
Japan	Tokyo

Text tables can veer surprisingly close to number tables. For instance, suppose we employ three columns, the lefthand one listing a set of features and the other two headed by the names of prominent presentation programs. The center and right columns could show presence of each feature with an *x*: a text table. If the feature

involved quantities instead, such as minimum RAM, you would insert numbers: a number table.

Number tables. Number tables are familiar to everyone. Most list one variable across the top and a second down the left. For instance, the years 1985 through 1987 might extend across the top, and Companies A, B, C, and D down the side. The result is a grid, where figures such as total revenue appear at each intersection.

Number tables can get more complex. For instance, if you place a percentage figure in parentheses after each number, you essentially set up two strings of numbers within each column, fusing two tables into one. Obviously, such tables are much more difficult to grasp quickly.

In presentations, number tables are mainly useful for showing exact numbers. Graphic charts usually sacrifice precision for overall relationship; number tables remedy this deficit. At the same time, tables are harder to absorb. If you do show a table, you may want to precede it with a chart. Once the audience grasps the lay of the land, it can progress to the exact figures involved.

In reports, number tables are more important. They can lay forth a great mass of data which cannot be neatly summarized any other way, and which the reader can study at leisure. Such tables can be magnificent repositories of data, but they overwhelm presentations.

In general, be wary of numerical tables in presentations. They threaten information overload. If you have a complex but significant table, you may want to distribute it as a printed handout, for viewers to peruse later.

Number Charts

You've seen the variety and usefulness of number charts in the previous chapter. They have this trick: They turn complex sets of numbers into simple spatial patterns. You can scan a graph and grasp the major relationships in an instant. A good chart crystallizes diverse aspects into a single gleaming unit.

As with other visuals, you should use these charts whenever they drive home a vital point. Save them for key issues. Even the most basic chart engages the mind in some decipherment in order to imprint it on the memory. Moreover, a number chart often stands out among the text and other graphics of a presentation. That's just the way you want it. If you overdo it, you may lose the critical charts amid the casual ones.

Diagrams

Diagrams show abstract but nonnumerical relationships, usually of structure or process. Like charts, diagrams convey the gist of complex matters. They not only communicate quickly and effectively, saving you verbal toil, but they also drive home points. (Unfortunately, diagrams are often called charts. The nomenclature is loose, and perhaps the less we think about it, the better.) The most common diagrams are tree charts, movement diagrams, and flowcharts.

Tree charts. Tree charts show hierarchies. Their arms branch like trees, with one line forking into others, which split into others still. Most often tree charts show the flow of authority in organizations, though they can also depict genealogies, match-ups in tournaments, and other pyramidal concepts.

These charts have certain generally understood rules. Names of individual or position appear along the lines and the endpoints, and boxes often enclose them. The higher the box, the loftier the post. Relation lines indicate who reports to whom, and hence a box can have several others immediately beneath it, but is usually directly connected to only one box above.

Boxes in the same tier don't necessarily have similar importance. For instance, if too many persons report to one individual—say, the CEO—lack of space may force you to move some below others of equal rank and attach them to the CEO box with a longer line. Conversely, even if there is plenty of room, you may not want to indicate relative significance; you would simply place all who report to the CEO on the same level.

However, if you do want to show tiers of importance, you simply shift boxes up and down until they rest at the proper echelon. If four people report to the CEO, but three matter more than the fourth, that trio would occupy the second echelon and the fourth would sink below, opening up white space.

In tree charts, you normally link boxes with relation lines at 90 degrees to each other. A single line drops from the upper box to a perpendicular, which extends horizontally across the lower boxes. Lines then descend from the perpendicular to the subordinate boxes. Why use this structure? The alternative is a set of lines converging on the upper box, and these look cramped and may cause an unwanted perspective effect.

Relation lines need not be solid. They can be broken, to show a transient or weaker relation. For instance, you could integrate a subcontractor into an organization diagram by placing a box to one

side and connecting it with a dotted line to the individual to whom he or she reports.

Trees allow several means of emphasis. For example, you can highlight the boxes

- Subtly, by thickening their outline
- Noticeably, by dropping shadows behind them
- Conspicuously, by filling them with shade, pattern, or color

You can also expand box size. In fact, you may occasionally wish to place a vastly enlarged parent box at top, setting forth information about the head of the firm or the company itself.

In some tree charts, box size reflects the number of employees in each unit, its revenues for the past year, or some similar factor. Such a diagram smacks of the area chart, and can be an instant portrait of an organization.

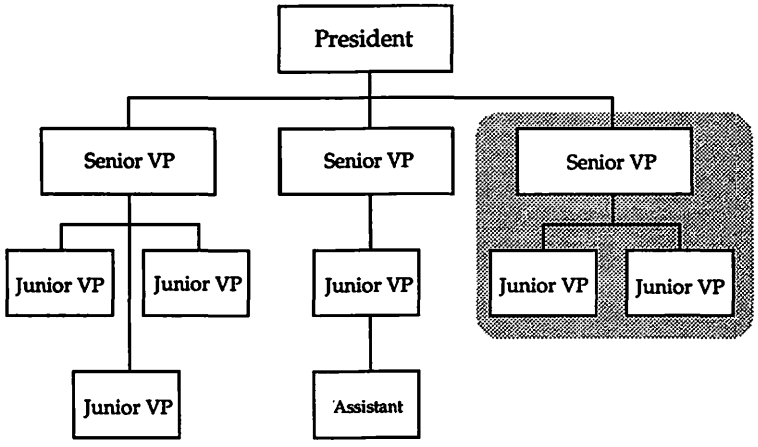
The tree can also take a cue from the step-bar chart and show unit size in percentages. Here, the top box becomes a bar across the entire diagram, and boxes in the first tier are shorter bars covering their share of the total. Boxes in the second tier extend across their percentage of the one above, and so on. Here, too, the resulting graphic provides a vivid picture of the company, as bars at each level replicate their portion of the whole. The main problem here is that the box/bars on the lower levels can become rather slender.

Particularly in large tree charts you may want to highlight whole portions of the organization, to emphasize them or clarify the overall structure. You can surround a group of boxes with a thick line, but you gain more visual interest by placing a light shade in the background (see Figure 8-3). To handle overlapping parts of the organization, either use different kinds of lines—for instance, solid and broken—or differing background patterns, shades, or colors.

Now and then a tree chart depicts compound relations. For instance, if one person owns two companies, you can place one box at the top and hang two separate structures from it. Since the eye might fuse them together on casual glance, you should do one of the following: divide the top box into two shades, give each box a distinct company shade, provide two different backgrounds, or use a blend of these approaches.

HyperCard has a tree chart. It's located in the Stack Ideas stack, titled Org Chart. So far, automatic tree charts are not available on

Figure 8-3. Emphasizing Tree Chart



many Mac programs, but you can devise them fairly easily with draw programs or presentation software such as *PowerPoint*, which works like a draw program.

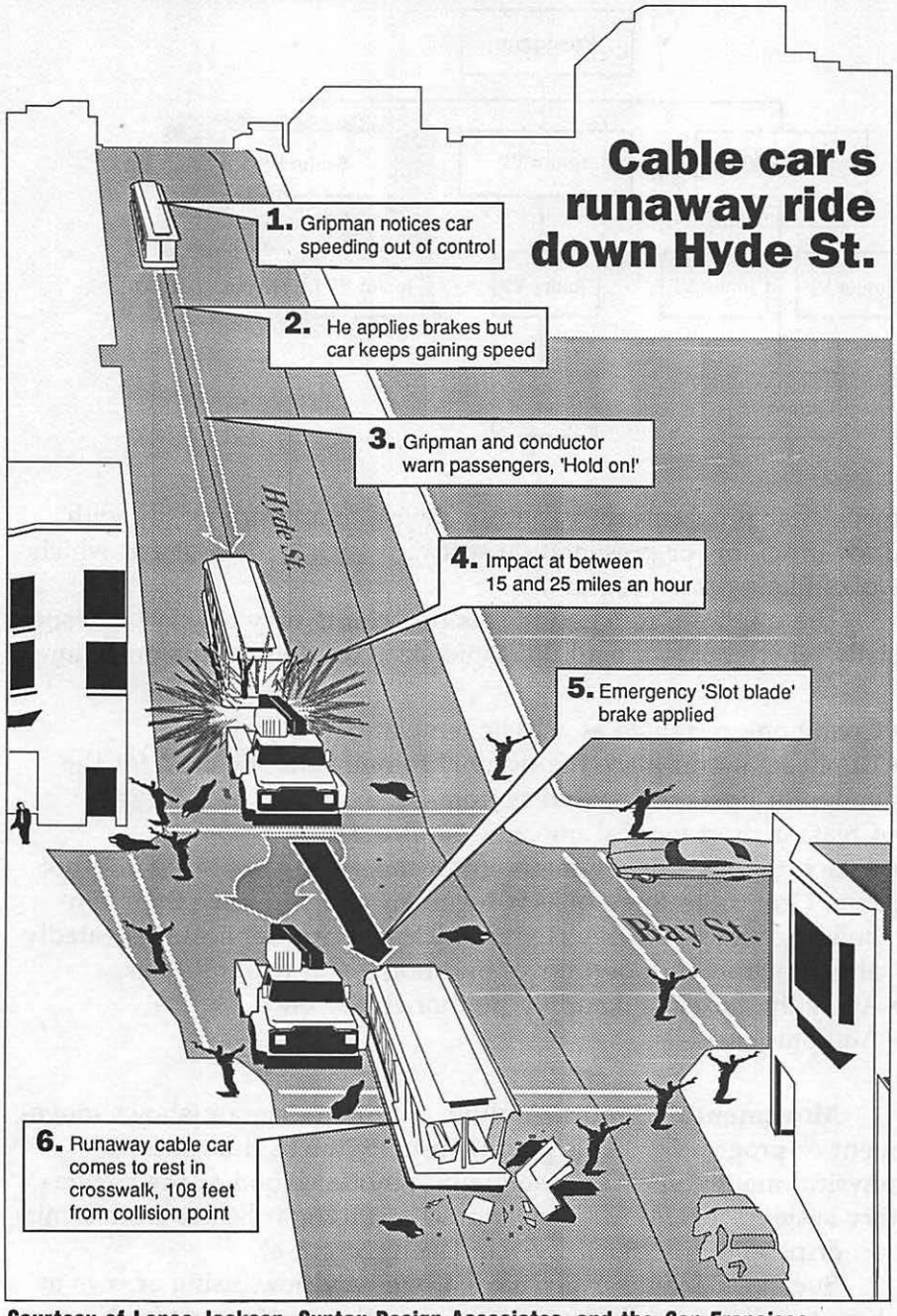
The duplicate function makes tree charts easy to concoct, especially where boxes are all the same size. You follow this procedure:

- Create one rectangle as a basic template.
- Duplicate it and place the original to one side. It's used for the endpoint boxes at top and bottom.
- Create a short vertical line and duplicate it.
- Attach the lines to the midpoint of the second box's top and bottom. Group the three objects together, and you have the main building block of a tree chart, which you can duplicate repeatedly and attach to endpoint boxes and horizontal relation lines.
- Array the boxes and supply the horizontal lines.
- Add emphasis.

Movement diagrams. Another common diagram shows movement or progression. This graphic usually tracks the course of physical matter, such as gasoline in a motor, blood in the circulatory system, current in an electronic circuit, light beams from a mirror, or people in a transit system (see Figure 8-4).

Such systems normally have a one-way flow, using arrows to show the direction. (In tree charts, the relationship goes both ways—subordinates answer to superiors, superiors control subordi-

Figure 8-4. Movement Diagram: One Way



Courtesy of Lance Jackson, Syntax Design Associates, and the *San Francisco Examiner*

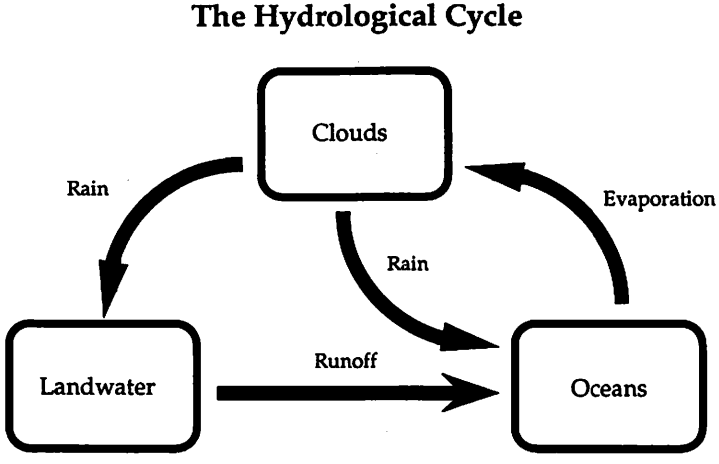
nates—and straight lines suffice.) In the less-common case of two-way movement, these diagrams use either double arrows or a single one with two arrowheads.

Movement diagrams, too, can partly replicate area charts, usually by varying the size of the arrow. For instance, a common world-trade diagram shows a map of the earth with arrows running from one region to another. Their thickness shows the volume of trade, often of a single commodity such as petroleum.

These graphics can be quite abstract, with mere boxes linked by arrows. For example, instead of the map above, an oil trade diagram could consist of arrows linking a series of squares with labels like *Middle East, Europe,* and *United States.*

If the arrows return to the starting point, the diagram depicts a cycle (see Figure 8-5). For instance, a box labeled *Landwater* might send an arrow right to one labeled *Oceans,* which might loft one up to an apex box reading *Clouds,* which might drop a third down to *Landwater* again: the hydrological cycle. The three boxes form a triangle, but since we think of endless processes as circles, you can render it better with curved arrows, easily created on a program like *MacDraw II.*

Figure 8-5. Movement Diagram: Cycle



Flow charts. The flow chart is a highly developed and specialized form of movement chart. It displays the steps in certain processes, notably those involving decisions. Programmers use flow charts to map out the logic of the software they're writing, but they

can also represent almost any procedural sequence, such as steps needed to gain a grant or identify a mineral.

Flowchart symbols have different shapes depending on their nature. For instance, a rectangle is usually an instruction such as *Add one to the counter.* A diamond is an IF branch (a question with a yes/no answer); two arrows emerge from it labeled *Yes* and *No.* Such points can create loops. For instance, if the instruction says, *Does the counter exceed 50?,* the *No* arrow would return you to a previous point in the logic. This structure essentially says, *Do not pass this point until you have carried out the loop operation 50 times.*

You can create flow charts with draw programs in much the same way as you do tree charts. Again, if you wish to emphasize certain steps, you can shade, pattern, or color them, or thicken their lines. You can also vary the connecting lines, making them thick, thin, broken, or dotted.

Illustrations

Sometimes only a picture does it. Illustrations are particularly vital for spatial relations, which notoriously evade the lasso of words. They can show appearance, composition, and relative size. You can also use illustrations for simple adornment, to make the presentation look more beguiling.

Appearance is, of course, an obvious use for illustrations. The outward aspect of real-world items such as projected buildings is often crucial, and sketches and photos can play an important role in a presentation.

But illustrations can also reveal detail in large objects. Commonly, you highlight a small part of the item, perhaps by surrounding it with a small circle, and extend conical lines to an enlargement of it. The viewer sees both the initial size, the location of the area, and the pattern as if through a magnifying lens. This method is intuitively clear and highly effective.

Internal composition is another key arena for illustrations. If you're explaining the mechanism of an automobile, for instance, you could find a simple sketch of its innards invaluable. Instead of simply babbling about engine, brake system, drive train, and other salient parts, you could point to them. Such drawings come in a wide variety:

Cutaway. Here you remove part of the exterior, so the viewer sees both the inside and its relation to the remaining hull.

Transparent shell. The *transparent shell* is simply omitted, as if it never existed.

Exploded structure. For a fuller look at the parts, you can pull them away, much as in the exploded pie chart. This approach depicts each major element and shows its place in the structure through radial lines. It sacrifices the vision of the parts assembled, which often appears after the cutaway or transparent shell.

Cross section. You can show the object as if you had sliced through it and thrown half of it away. Cross sections are especially useful where several planes lie atop each other, as in geological strata or stories of a building.

Semisection. You can display the item as if you had cut into it two or more times and pulled out a chunk. With a model of the earth, for instance, you could make three cuts, pull out a quarter of the sphere, and display the structure within. The semisection preserves a view of the outside, which is effective here.

Segment. You can show the part removed rather than the part remaining.

Schematics. You can reduce the parts to abstract figures. Some items simply resist accurate depiction. For instance, if you're discussing DNA an actual picture of genes doesn't help you much, so a schematic sequence of them is essential.

Relative size is also prime material for illustrations. For instance, astronomers typically use a string of spheres to show the relative sizes of the sun and planets. Schematic illustrations in atlases depict the longest rivers in the world, the highest mountains, the largest countries. All these diagrams smack strongly of area charts.

Finally, you may wish to add illustrations to other visuals, either as sidelights or overlays. Either can perk up a text chart, say, but you must be careful the illustration does not dominate. An overlay in particular must be ghostly and discreet. If everyone is admiring the picture, the point may go begging.

Presentation Programs

Presentation programs let you create the actual series of frames for presentation. Of course, you can create them on other software, such as chart programs, and often that's best, but presentation programs bring it all together. They also let you create a repeating mo-

tif for frames and change it throughout much more quickly than other methods.

These programs generally contain word processors for text charts and draw features for diagrams and other simple charts. The extent of these features varies from program to program, and new versions are constantly filling gaps and adding new features, so you should consult reviews in computer magazines to see which best satisfies your needs.

To ease the labor even further, many presentation programs come with templates so you need do little to set the frames up. Templates generally require little time to learn and use; they can also be simple to customize. If you want to spruce one up with a company logo, for instance, you can scan one in, autotrace it, clean it up, and move it over to the template.

Means of Presentation

You can display visuals for a presentation in a variety of ways:

- Overhead transparencies
- Slides
- Computer screen images

We discuss the process of making transparencies and slides in the final chapter, but for now the question is "Which do you choose?"

Overhead Transparencies

Overhead transparencies are best for low-cost, informal presentations where there's much interaction with the audience. You can display overheads in partly darkened rooms, indicate parts of the visuals with a pointer, and generally discuss the frames much more openly. They're fast, easy, and inexpensive to make on the laser printer. If you have access to a color printer, you can make them chromatic. However, overhead transparencies sacrifice some detail, and they're not suitable for important presentations to sophisticated audiences. They may also be impossible to use in large halls.

Transparencies afford many advantages, such as the capacity to point to parts of them directly. You can do this in several ways: You can use a pen or pencil to point to a specific part of the transparency. You can also write on it with a marking pen or, if you're worried about smudging the ink, on a clear transparency atop it. You

can also place a sheet of paper on the transparency and pull it down to reveal one point after another. Finally, this approach easily lets you overlay one transparency with another.

Slides

Slides yield topnotch quality, especially for detailed images, and may be necessary for presentations on which much depends, such as sales presentations. They're almost essential for large audiences of any type. However, they require fully darkened rooms, reducing audience participation and leading to more formal proceedings. It's also harder to point to slides. You can use *light pointers,* flashlights that project arrows onto the screen, but these arrows are usually quite small, and if the image is large the audience may need time to find it. Slides are also more expensive and take more time to develop. Film services are an inexpensive and easy-to-use way to make slides. However, film recorders are dropping in price, and they let you develop your own film, which may matter if security is an issue.

Computer Screen Images

The Macintosh screen is the third major way to display a presentation. It copes easily with last-minute changes,provides an effective way to move from one frame to the next, requires no printout at all, and saves time and labor. Computer slide shows can also be self-presenting. You can save them to disk with the script on disk or printed, and send them out to others who can move through the presentation themselves.

The Mac screen offers other special benefits. First, you can create special animation-like effects with a sequence of slides. For instance, instead of merely displaying an exploded pie chart, you could show first a normal chart and then one with the piece pulled out. If you have several frames, you can click rapidly and the piece appears to move in and out.

The main disadvantage of the Macintosh screen is its size. Viewers must sit very close to the Mac to see it clearly, and even so you may need a large screen for visibility. For presentations to groups of over 20, you may even require a projection TV.

Handouts

One of the main drawbacks of any presentation is its temporal nature: When it ends, it ends. Hence *handouts* can be an important

adjunct to help make sure the audience leaves with some of your points firmly in grasp. Handouts can be as simple as the basic outline of major points, or they can contain complex but essential information that may have eluded presentation on the screen. In any case, the handout should generally be a supplement to the presentation, not a substitute.

Part 5
Alphabetic Art

9
Typography

In Ireland, the greatest art treasure is not an oil, a fresco, or a sculpture. It's the Book of Kells, an illuminated manuscript from the ninth century. Though a Bible, its true subject is the alphabet. Its makers drew letter after letter from a background of blue or gold and spun them out into ornate, delightful webs on the page.

In fact, as a graphics element the alphabet is remarkably flexible, varied, and expressive. It's not really too surprising, for letters began as pictures. The Chinese character for *sun,* for instance, was originally an open circle with a dot inside. Over time, burnished by endless use, these pictograms grew stylized and hard to recognize, but in China, at least, they retain their roots.

In the West, they evolved into a small set of designs, each representing a single sound. We're so familiar with the alphabet we tend to ignore its graphic aspect, but in fact it affects us all, every day. A font can be more or less readable, or can look rubbery, marmoreal, boxy, scriptlike, wooden, floral, and on and on and on.

What accounts for this diversity? A character is not a rigid shape but a loose formula of lines. The lowercase *t,* for instance, is at heart just a vertical line with a short crossbar near the top. Look at the curved tail on it. It's completely unnecessary, but we still recognize the letter at once. In fact, you can stretch the basic formula very far indeed without confusion. (That's why we can read other people's handwriting.) Hence, we can poke and prod characters to enhance esthetics, legibility, noticeability, and whatever trait we want. We can make the shape of letters expressive beyond their meanings.

A *font* is any such design applied to the whole alphabet. (Historically, it is one complete set of characters of a specific style and size. For instance, 12-point Garamond is a different font from 14-point Garamond, and both differ from 12-point Garamond Italic. Thus, a printer buying one font would expect to receive so many characters of a very specific contour. In the computer world, when you buy a font you get a spectrum of styles and sizes, so the term

has grown to embrace the design itself.) A font can be spare or incomprehensibly ornate, light or heavy, sober or frivolous. The study of type design is called *typography.*

Body Text and Display Text

Fonts have two main uses: for body text and display text. They are as different as a judge and a circus barker.

Body text is a long tract of prose. It's meant to be read through and, if you're lucky, thought about. Hence a body font must not call attention to itself. If it does draw attention to itself, it detracts from the writing; used discreetly, it imparts a distinctive air to the text. In this regard, typography is a realm of smiling secrets, of subtle tricks to influence readers without their even recognizing it. This is body text.

Display text is brief, grabber verbiage, as in headings and advertisements. It's meant to attract the eye, to call attention to itself and, often, to direct the reader into subsequent prose. Novelty is a plus here. Thus, while body fonts come in relatively few, proven vehicles, display fonts are endless. They need not be readable in large blocks, and most aren't. Indeed, they can be almost unintelligible, as when they bulge out into each other or when they arc in silhouetted human shapes to form *b*'s and *p*'s. The heading above, *Body Text and Display Text,* is display text.

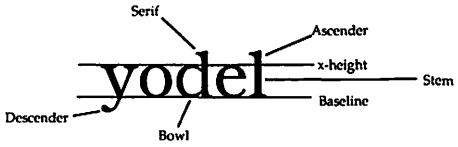
The exotic appeal of display fonts causes the basic beginners' error: using them for body text. When *MacWrite* first appeared and writers suddenly had access to fonts like Venice and San Francisco, they reacted like youngsters in a deserted candy store, printing out long paragraphs in strange and wonderful lettering. Glut set in fast. Almost all quickly realized it didn't work. Display fonts are not meant to be read—they're meant to be noticed.

Anatomy of a Font

Typography, like most specialties, has its own jargon. Hence, we must begin by defining the parts of letters so we can discuss them (see Figure 9-1). They are:

x-height. As its name implies, *x*-height is the height of an *x*. More generally, it refers to a font's midsection, that is, the area occupied by such letters as *x, e,* and *m,* and the bowls of *b* and *p*. In general, the greater the *x*-height, the more legible the character and the larger the typeface looks.

Figure 9-1. Anatomy of a Font



Bowl. This is the rounded form in such letters as *o*, *b*, and *q*.

Stem. This is the vertical stroke of a letter, like the stalk of *k*.

Ascender. This is the part of the stem above the *x*-height. The letters *b*, *d*, *f*, *h*, *k*, *l*, and *t* have ascenders.

Descender. This is the part of a character below the *x*-height. The letters *g*, *j*, *p*, *q*, and *y* have descenders.

Baseline. This imaginary line runs along the bottom of the *x*-height. It's analogous to the parallel blue lines on binder paper and provides a place for each letter to rest. Without it, text would undulate like a snake.

Serifs. These are the tiny projections at the ends of lines, such as the ledge atop a *d*. They are not decoration. They link the letters of a word, particularly at the baseline, and so give words greater coherence. More importantly, they notify the eye of the end of an ascender, descender, or other part of a letter, and make a font more legible.

Measuring Type

Typographers have special units to measure type and other parts of the page, such as the space between lines. The main two units of measurement are *points* and *picas*, and if you plan to work seriously with type, you should know them as instinctively as feet and yards.

Points

A point is 1/72 inch. Since there are 72 pixels per inch on the Macintosh, a point is one pixel.

Points are the universal measure of typefaces. The middle sizes, from 9 to 14 point, are generally used for body text and are called *text faces*. Sizes larger than 14 point are called *display faces*. Traditional point sizes were integers, but computers make it possible to create any size in between.

You may be surprised to find that fonts of the same point size are not the same actual size (see Figure 9-2). For instance, 12-point Times looks much shorter than 12-point New York. Why? Originally,

Figure 9-2. Various Fonts, All 12 Point

Avant Garde
Bookman
Calligraphy
Chicago
Courier
Helvetica
New Century Schoolbook
New York
Palatino
Times
Venice
Zapf Chancery

typefaces were set in lead and came as small blocks. Since often the face itself had no clear zenith or nadir, printers used points to measure the height of the metal, from below the deepest letter to above the tallest. This distance may bear scant resemblance to letter size, so you must simply learn the sizes of various fonts, one by one. It's crazy.

Picas

A pica is 1/6 inch. It is also, therefore, 12 points long. Picas are not as important as points with computers, partly since the machine makes it as easy to work in one as the other. Given the choice, you might as well pick points. They give more finesse.

Describing Fonts

A font is an individual design, with its own air about it. It necessarily makes a subjective impression, and adjectives for fonts occasionally approach the comic subtlety of those for wine. But many terms have specific meanings, and we need them too:

Style. Style refers to fundamental variations on a font. Roman is the norm, the familiar look of print. Italic and oblique are slanted versions of it. (Technically, oblique is mere slant and italic is a different design, denser and more delicate, with such distinguishing traits as a fully-rounded *a* rather than a barred one. In the computer world, this distinction is blurring.) Outline and shadow are other styles.

Width. Characters can be narrowly compressed, as in Helvetica Condensed, or broadly drawn out, as in Futura Extended.

Weight. The thickness of line in characters is referred to as weight. Font weights are usually either light, medium, or heavy. A normal font may be thickened for special purposes. Such type is called boldface, as in Times Roman Bold.

Contrast. The variation in weight within individual characters is contrast. Some fonts have no contrast and are the same weight everywhere. Others, like Bodoni, have high contrast and use hairlines at the bottom of the *O* or where the arch of the *h* meets the stem. Such a font is often striking in headlines, but an entire page of it can convey an impression of glare and be somewhat hard to read. Medium contrast yields the most legible fonts.

From Gutenberg to the Modern Era

History lives in fonts, especially text faces. Not only do we still use historical terms to describe them and historical names to denote them, but their development reveals much about their nature and proper use.

Body fonts have passed through three main stages:

- Old
- Transitional
- Modern

In the first, or old, stage, fonts mimicked handwriting and sought clarity and legibility. In the brief transitional stage, beginning in the Enlightenment, they broke away somewhat from these bonds. And in the modern era, which commenced in the early nineteenth century, a stark and compelling new style emerged. At the same time, display fonts proliferated, and printing moved into a brave new world.

Old Style

Johannes Gutenberg printed his famous Bible in Mainz, Germany, in 1456. Six years later, Adolf of Nassau led an army into Mainz and sacked it, demolishing its economic base. Gutenberg remained, old and penniless, but most the younger printers departed, fanning out to the leading cities of the continent.

They soon ran up against a serious typographical problem. Gutenberg had created a thick, angled typeface modeled on Teutonic

lettering, but it was hard to read and unpopular elsewhere. In Renaissance Italy, where scholars prided themselves on their graceful script, wags dubbed it *Gothic* and printers scrambled to find new fonts.

The new technology found a particularly eager welcome in Venice, then a busy hub of world trade. Its first printer, Johannes de Spira, a Mainz goldsmith, created one of the initial Roman fonts, a design which would evolve lighter and lighter contours over the centuries and become familiar to readers everywhere in the West. De Spira also issued the first book with printed page numbers.

The noted scholar Aldus Manutius opened his Aldine Press in Venice in 1495, intending to promulgate the work of geniuses from antiquity. His brilliant assistant Francesco Griffo da Bologna greatly improved on de Spira, and Bembo, a twentieth century adaptation of Griffo's font, remains widely popular. Among other things, he heightened contrast and leveled the crossbar of the *e*. He also invented italics, which he modeled, legend tells us, after the handwriting of Petrarch. The name proudly declared its non-Gothic origin, and the typeface itself economized, since it filled less space. Italics, however, proved almost as hard to read in body text as Gothic, and it survives mainly as an emphatic device. Griffo disappeared from history in 1515, after clubbing his son-in-law to death.

The French also contributed to the old style. In Paris around 1510, the scholar-poet-printer Geoffroy Tory introduced the apostrophe, the accent mark, and the cedilla into the French language. His protégé, Claude Garamond, developed the famous font bearing his name, which dominated typography for 200 years and remains common today. Indeed, Apple employs it in much of its literature. Garamond also first cast italics as a variant of Roman.

By the 18th century, the English had taken the lead in typography. William Caslon designed the pleasing and extremely legible Caslon font in 1722, and for the next 60 years it enjoyed hearty vogue. Benjamin Franklin brought the font to the United States, where it was used to print the Declaration of Independence. It was one of the last fonts to appear in the old style period, though old style fonts like Times are still devised today.

Transitional

Caslon's contemporary John Baskerville helped inaugurate the transitional style. He had made a fortune in japanned ware, and

around 1750 he turned to a boyhood love: type design. His Baskerville font was noted for its elegance, lightness, and readability. His countrymen spurned it, partly because it departed somewhat from the sacred model of script, but it had much influence in Europe, and Baskerville is a famous name in fonts today.

Modern

In 1791, Giambattista Bodoni created one of the first modern fonts. Son of an impoverished printer in northern Italy, Bodoni entertained notions of working for Baskerville but soon rose to become court printer to the Duke of Parma. He lived in the Enlightenment, imbibed its notions of rationality, and applied them to type. His Bodoni font was clean, even sparkling, but had a bit too much contrast for easy reading. It also had hairline serifs at right angles to stems rather than tapering gently into them. It didn't look like handwriting at all.

Bodoni ushered in another innovation. He used identical shapes for similar parts of different letters. For instance, he made the ascender of a *b* the same as for an *l* or an *h*. Hence, the eye could concentrate on the parts of letters that differentiated them rather than lingering on similar parts rendered differently. This made it very easy to read.

Body Text

The Macintosh has two kinds of body fonts: bitmapped and laser. Bitmapped fonts are useful for screen display and the ImageWriter but cannot fully exploit the laser printer. Fortunately, most of them are named after towns, such as Chicago and Stuttgart, so they're readily detectable.

For serious printout, you'll most often work with fonts that use the PostScript page description language. They embrace the range from old style to modern, but each has its own personality. If you understand it, you can greatly enhance your work.

Note: A font can be copyrighted and owned. Yet if you make fairly slight alterations in one, you can create a legal original and obtain rights to it yourself. If you then give this near-clone a name that suggests the source, like Nouveau Times, buyers nod and understand. Hence, many popular fonts come in a fog of similar names, all referring more or less to the same design.

There are five main PostScript fonts for body text:

- Bookman
- Schoolbook
- Times
- Palatino
- Courier

Bookman. Bookman originated in the Ludlow foundry in 1925. It has a major distinguishing feature: exceptional roundness. Its *o* is almost an exact circle. As a result, it occupies much space on the page, probably too much, for it tends to make the eye impatient. We can read faster than Bookman lets us, and the font thus smacks of the grammar school (see Figure 9-3).

Figure 9-3

Bookman

However, Bookman is a soft, comfortable face, not to be underestimated. It's based on Garamond and offers some of its virtues. For instance, it has *bracketed serifs*, that is, serifs that curve into the stem as though on supports or brackets. Its fat bowls also convey softness, as does its lack of hairlines.

Bookman radiates a Mom-and-Pop air, and hence works well for publications without pretense or formality. Similar venerable fonts you may find in forms downloadable to laser printers are Garamond and Goudy.

Schoolbook. Schoolbook is a transitional style, like Baskerville. It derives from Century, a face designed by Lynn Boyd Benton and Theodore DeVinne for the magazine *Century* in 1895. The publication had two columns, and designers sought to fit more type into less space.

Schoolbook differs so plainly from Bookman that most people can tell the difference at once, though few can explain it.

In fact, there are several differences. First, Schoolbook squeezes the bowls in letters like *b* and *p* more tightly, so they sit upright (see Figure 9-4). As a result, it permits more characters per inch and keeps pace with reading speed.

Figure 9-4

Schoolbook

Schoolbook also has the sharp serifs of Bodoni. At the same time, it provides large circular drops called *finials* at the end of the *c, f, j, r,* and *y.* These knobs contrast with the serifs and give the font a livelier tone. Schoolbook's capital letters are also the same height as its ascenders, unlike Bookman's, whose capitals are lower. This feature further enhances readability.

Since Schoolbook is more compact, it's considered somewhat dark. It's also warm rather than elegant, and highly legible. Some feel Schoolbook is the most neutral of all body fonts, ideal for textbooks, hence its name.

The LaserWriter offers New Century Schoolbook, and other versions include Century Schoolbook, Schoolbook, Century Text, and Century Textbook. Baskerville is also available as a downloadable font.

Times. Stanley Morison designed Times New Roman in 1931, seeking to pack type into an even smaller space for the Times of London. The serifs of this font were tiny but sharp, and its ascenders and descenders were both short. It proved very clear and readable, and transformed the appearance of the paper to the general approbation. (Note: By including *Roman* within the name of the font, Morison made possible the interesting oxymoron *Times Roman Italic.*)

The laser font Times is modern-style, like Bodoni, and it closely resembles Times New Roman. It's even denser than Schoolbook, and it achieves this feat with two basic tricks: short serifs and thin horizontal strokes (see Figure 9-5). It simply uses less ink per character, and the savings in space is dramatic. Largely because of this, Times is the most popular body font in use today.

Figure 9-5

Times

However, *popular* in this case means *widespread,* not *well-liked.* Times is rather cold and harsh, without the comfort and appeal of Bookman and even Schoolbook. Nonetheless, it does lack the hairlines and extreme contrast of Bodoni. Bodoni is also available as a downloadable font, but it's horizontal strokes are broader, and it doesn't achieve the remarkable compression of Times.

Copied widely, Times is also known as London Roman and

English. The New York font on *MacWrite* is an offshoot of Times New Roman.

Palatino. The famed German designer Hermann Zapf invented this font in 1950 and named it after Giambattista Palatino, an Italian calligrapher of the 1500s.

Palatino answers the problem of font "personality." If you feel Bookman, Schoolbook, and Times are workmanlike fonts without special charm, you may find Palatino ideal. It is pleasant to read and distinctive, and almost goes so far as to call attention to itself, yet never quite does.

Some say the font is old style, others transitional, but Palatino doesn't quite fall into any of the three categories. It has bracketed serifs and moderate contrast, but also occasional distinctive touches like the capital *Y* with its "serifs" that merely swell the arms, and the capital *O* with its racy tilt. These bestow a note of the unexpected on the font and enhance its appeal (see Figure 9-6).

Figure 9-6

The Palatino Y

Palatino is perfect for prose that seeks to ingratiate itself, such as personal messages and reports that seek to persuade. It's a little too pleasant for prose that must look formal, such as stock offerings, or even for textbooks and other plainly informational work. However, it's otherwise quite socially negotiable, and you should not be afraid to use it in novel circumstances. A technical work, for instance, might profit from this engaging font, which could lighten an otherwise dry discussion. Nearly all COMPUTE! Books are set in a typeface that is a variation on Palatino.

Courier. Typewriter characters became so familiar during the heyday of this machine that the typeface lingers on, despite its grave limitations. The best known of these fonts is Courier, which derives from the Courier element in the IBM Selectric.

Unlike all the faces discussed so far, Courier is monospaced. That is, each character occupies the same area on the page, whether it's an *M* or an *i*. To prevent gulfs of white space between characters, the font grafts giant serifs onto narrow letters like *l* and *i*. Courier also completely lacks contrast. Its serifs are the same weight as its ascenders (see Figure 9-7).

Figure 9-7

Courier

A similar but more sophisticated face is ITC American Typewriter, available as a downloadable font. This font has proportional spacing and hence needs shorter serifs and far less room than Courier.

Courier rarely appears in quality publications except for special effect. For instance, it works with "late-breaking news" sections of magazines, suggesting information too fresh to be set in type. Courier also lacks pretension without appearing elementary, like Bookman, and hence may suffice for newsletters that want to look casual but still reasonably professional.

Display Fonts

Display fonts more or less began with lithography, invented by the frustrated Bavarian dramatist Aloys Senefelder in the 1790s. Lithography enabled artists to draw directly onto the plate that was later used for printing. Hence it made posters cheaper and sparked demand for bold, eye-catching typefaces. But as long as fonts were cast from lead, there were relatively few display fonts. For the number of times each would be used, they just cost too much time and money.

The computer has completely changed that. Now anyone can design a font, and since design occurs on the computer, it's tantamount to casting the font. Giambattista Bodoni had to forge metal, but you can play with pixels on a screen. There are now over 1500 fonts for the Macintosh alone, and display fonts have undergone a pyrotechnic explosion.

What kinds are available? The variety is astonishing. Typographers have long sought to devise systems to classify display fonts, but it's a vexing task, given the breadth of the field and the relative lack of natural demarcations. The taxonomy below seems reasonably sane and common, but, as you'll see, it ends with a helpless shrug.

Sans serif. Sans-serif fonts lack serifs. The best known PostScript example is Helvetica, created in 1957 by the Swiss designer Max Miedinger. Helvetica is a light sans-serif font now owned by Mergenthaler. The Macintosh version was first called Geneva, but

newer systems offer both it and Helvetica, so you can inspect them side by side and see just how similar they are. Other versions are Helios, Vega, Megaron, Newton, and Claro. Another PostScript sans serif is Avant Garde (see Figure 9-8).

Figure 9-8. Avant Garde, a Sans Serif Font

Sans Serif

Please don't use sans serif for body text—it's like staring into a light bulb—but don't ignore it either. It can be highly effective when set against Roman body fonts, as in headings, initial capitals, and other brief prose. In these cases it does indeed confer a crisp modernity, and the contrast with body text is likewise appealing.

Black letter. Black letter (sometimes confusingly called *text*) harks back to the Gothic typeface of Gutenberg. These fonts are attractive but complex, with their odd angles and decorative wisps. Despite its ancestry, black letter is dying out. It remains most prevalent in the Old English mastheads of papers like the New York Times and also appears on diplomas, and sometimes in church documents. Handle it with care. It conveys a hallowed grandeur that quickly turns pretentious in the wrong spot. Used shrewdly, however, as for comic pretentiousness, it can have singular effect.

Square serif. Square serif fonts have blunt, slablike serifs. The first square serif appeared in 1815 and lacked contrast, but a later version called Clarendon had a little and has become quite popular. Perhaps because of a fancied resemblance to Egyptian architecture, these fonts are sometimes called *Egyptian.* They convey a stout solidity and excel on posters. Other examples are Lubalin Graph and Glypha.

Cursive. Cursive (or *script*) fonts frankly seek to emulate handwriting. They usually slope to the right and often connect, or try to. Before phototypesetters, these fonts were very difficult to cast, because of the slanting overlap and linkups. Hence almost no cursives were invented before 1930.

Today, the world abounds in them. They come in myriad forms, from the elegant to the brushlike to the calligraphic. Indeed, their variety seems limited only by the variety of handwriting itself. English Round-Hand cursives are suitable for wedding invitations and other announcements that fuse the formal and the personal.

Cursives also commonly grace logos, not just of Kellogg's, Ford, and Johnson & Johnson, but also beauty parlors, florist shops, jewelry stores, and other businesses all across the nation. The bitmapped Venice is a cursive, as is the PostScript Zapf Chancery (see Figure 9-9).

Figure 9-9

Cursive

Special. Here lie the stunners: the fat fonts, the three-dimensionals, the stencils, the outlines, the carved stones, the ivy-trellises, the balloon-stems, the flute-pillars (see Figure 9-10). Novelty sells fonts, and any font that otherwise defies classification winds up here, in the grab-bag.

Figure 9-10. Special Font

Fat Fonts. Fat fonts boasted grossly enlarged aspects. The earliest, designed by the Englishman Robert Thorne around 1803, had swollen stems and, sometimes, fat serifs too. For instance, a small *n* was two wide vertical plates linked by a hairline curve. The capital *N* was two delicate uprights crossed by a broad diagonal slab.

Three-Dimensional Fonts. From a distance, the hairlines in fat fonts tended to vanish, making the face unreadable. Hence, three-dimensional fonts appeared in 1815. They resembled the Macintosh shadow style and not only increased legibility, but added interest and a sense of solidity.

Decorative. Decorative fonts are the other extreme, a potpourri where typography can merge with art in beautiful, ornate designs. Sarcastic printers call them *the hell box* after the bin for broken type in the corner of the printshop, yet they can be relatively subdued and discreet. They can also have wood grain on their stems, calligraphic brush strokes, CARE-package type stencils, cartoonish bulges, and any other feature you can imagine.

Like cursives, special fonts tend to appear in logos. For instance, a wood-grain typeface would suit a dude ranch sign, a masthead for an Old West newspaper, or a laundromat in a Colorado town seeking the tourist trade. It could even work for the logo of a software firm if it's seeking an unusual, friendly, memorable image. The bitmapped and apparently moribund San Francisco—kidnapper font—falls in this category.

One Macintosh program specifically lets you manipulate display fonts to create unusual effects. *LetraStudio* from LetraSet permits point sizes up to 999 points, lets you flip type, slant it, change its height, vary the weight of strokes, insert colors into a font or shadow, use Pantone colors, and attach text to the inside or outside of a polygon or a Bezier curve.

Conclusion

Knowledge of typography is useful everywhere in graphics: in charts, in drawings, in page design. But it is paramount in logos and letterheads, and to these we turn in the next chapter.

10
Symbols of Yourself

In the First Crusade, knights rode off to the Levant encased in armor from head to toe. These carapaces protected them from medieval weaponry, but they also had drawbacks. Ironclad warriors grew hot, moved about awkwardly, and endured immense weight. Frederick Barbarossa actually drowned when he fell from his horse into a trickling stream and couldn't get to his feet again.

Armor caused one further difficulty. It made knights look near-identical, a source of deadly confusion in battle. But this problem was tractable. The Crusaders borrowed a trick from their Islamic foes and applied special emblems to themselves: coats of arms.

Intriguingly, coats of arms did not disappear with the Crusades. Instead, they evolved into symbols of lineage and proliferated, appearing on castles, coaches, pennons, garments, plates, and wineglasses. Esoteric terms like *gules* for the heraldric color red emerged to describe them, and heraldry commenced.

Why? Emblems have intrinsic power. They spotlight the individuality of a person, group, or thing, and thus proclaim its importance. Governments have recognized this effect for centuries, as witness the fleur-de-lis in France, the Hapsburg eagle in Austria-Hungary, and the imperial chrysanthemum in Japan.

Symbols also reduce a group to its essence, shrink its history, traits, and implications into a single image. Thus, much as distilling a liquid intensifies its color, so emblems can focus all one's feelings about a group, and hence flags often bear highly emotional connotations.

Not just governments but such diverse organizations as the United Nations, the Red Cross, local transit authorities, and Greenpeace have embraced emblems. But we most often see them in connection with companies.

Trademarks

Trademarks and logos are symbols of a corporation or product. Like coats of arms, they are ubiquitous, appearing on almost every

document issued in connection with a firm: ads, letterheads, invoices. Hence they deserve careful attention.

Technically, trademarks differ slightly from logos. A *logo* is a pictorial symbol, while a *trademark* can be either a name or picture. For this reason, the mark ™ appears after some brand names, declaring they are taken. (If a name is too successful and comes to denote a whole class of products—as *Scotch tape, Vaseline,* and *Xerox* threaten to do—the company loses the right to it. Hence, in ads, apparently normal people will say, "I'll have some of that Scotch brand tape.") We aren't dealing with brand names here, so this book uses *logo* and *trademark* interchangeably.

Trademarks are ancient and may have begun as stamps of authenticity. Archaeologists at Ur have found cylindrical seals made of precious metal or stone, apparently guarantees of origin. In the Middle Ages, guilds impressed their products with *hallmarks* (after the guild hall) or *trademarks* as certifications of quality.

In modern business, a logo can serve similar ends. The very familiarity of a trademark imparts a message about quality: The company's products have earned a certain prosperity and the firm will probably not fold its tent tomorrow. Thus, a recognizable trademark reassures buyers and is a valuable commodity.

It can also set a product apart. Logos establish instant visual communication, and in stores they can register quickly on the eye. This fact matters even for giants of commerce like Coca-Cola, but it's particularly vital for new and upcoming firms seeking that first link of name recognition.

Finally, logos can be powerfully descriptive. They can convey pleasant or impressive associations, subtle or direct statements. Indeed, a stylish logo can elevate a company instantly above its rivals. At the same time, in a world without logos, every company would state its name in the same way as every other. Logos let companies express themselves.

How to Design a Logo

Of all the graphics in this book, logos demand the most thought per pixel. A company reproduces it endlessly throughout its lifetime, yet the logo itself is usually small and may be fairly simple. It behooves you to spend time on it and get it right. Inspiration counts, and perspiration may matter also.

There are no absolute rules. But, in consultation with the firm, you would likely ponder these questions:

- How do I gain a striking image?
- How do I differentiate the company?
- Should the logo embody the firm's name or initials?
- Should it describe the firm's business?
- Should it convey a special message about the company?

Attracting the Eye

Mercedes-Benz has one of the best-known logos in the world: a three-pronged star within a circle, the hood ornament on these cars. What does it mean? Gottlieb Daimler, an early motorcar pioneer, designed it and said it represented the three realms in which his engines ran: land, sea, and air. Few would decipher this hermetic message.

So a successful trademark need not communicate anything explicit. This particular logo succeeds for other reasons: It has style, it's simple yet compelling, and it conveys a restrained flair ideal for these vehicles.

Hence, before all else, a logo should have certain visual qualities. It should attract the eye, through diagonal lines, white space, gestalt, or other techniques.

Diagonals. Why are asterisks such effective footnote markers? Their slanting lines attract the eye. We simply notice oblique lines more quickly, perhaps because they seem out of kilter (Figure 10-1). Diagonals are the secret of the Mercedes-Benz logo. They also lie at the heart of Exxon's, whose crossed X's are both visually striking and verbally singular.

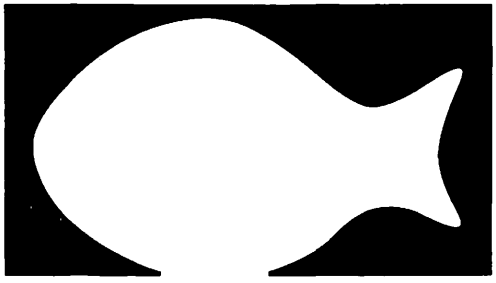
Figure 10-1. The Diagonal Difference

In fact, diagonals abound in good trademarks. For instance, the logo of the Beach Street Baking Company in San Francisco shows a plump baker in reverse silhouette, holding a steaming plate of muffins. But the designer has cleverly included a long-handled implement which angles straight across the image, plainly increasing its impact. When you come across an effective logo, check to see if it has diagonals. You'll find them everywhere.

White space. White space is also an optical magnet, as we see

later in the chapters on page layout. It looks especially good silhouetted against dark colors. For instance, the logo in Figure 10-2 is a fish in white against a black rectangle. But the fish almost totally occupies the black background, and the expanse of white makes it stand out. In the logo of the Beach Street Baking Company, the baker is also white, and his very corpulence draws the eye.

Figure 10-2. White Space



You need not surround white space to gain the effect. You can partly mark it off. For instance, in the logo of the Marin Swim School, a pair of steel rails arc down toward an unseen pool. Not only do the curved diagonals attract the eye, but they embrace much white space, and the impact is obvious.

Gestalt. The classic gestalt figure is the near-circle with a gap at the top. Experimental subjects report seeing a full circle, because the mind subconsciously completes the image. It's a major trick of perception. The brain is always at work interpreting the world. Thus, if you omit whole segments of an image but suggest its contours, the mind moves in. Because such an image requires subconscious intervention, it attracts the eye far more than one that doesn't. It's as though the brain keeps coming back to it, trying to decide what the image really is. In contrast, if you supply every detail, the mind remains content and distant.

This phenomenon is highly useful in logos. For instance, the original IBM trademark was three solid letters. The current one is the same letters broken by bars of white. The brain does a little work on this image, derives the initials IBM, and we feel—without quite knowing why—more drawn by the trademark. In fact, it almost seems to shimmer. The AT&T logo uses this trick, as do a growing number of others.

You can use gestalt to fill out almost any familiar shape. The

mind derives the outline of cups, cars, landmarks, trophies, animals, flowers, nations and continents on a map, and many other figures (See Figure 10-3).

Figure 10-3. Gestalt

Moreover, it works with lines as well as shapes. For instance, the logo of Desiree Goyette is simply the name Desiree, but the designer has removed most of the stems and cut back the lower loop of the S. The mind confronts a modest perceptual puzzle and feels the lure.

Color. Primates have color vision, and it helps them spot fruit in the trees. Bright color also attracts the human eye, especially against a subdued background, and a spectrum of hues can really set an image apart. The NBC peacock was a forerunner in the area, but the example most familiar to Mac owners may be the Apple logo itself. Its array of colors not only highlights the trademark but pleases the eye, an oasis of splendor in a monochrome world.

Second-level meaning. In general, a logo should appear clean—crisp, small, and manageable—since it goes everywhere. But just because it may look simple doesn't mean it is. Some of the best trademarks yield little secrets on inspection, such as the abstract design that resolves into initials or a stylized object. Such trademarks are almost optical illusions. They convey not only subsurface energy but an extra layer of subtlety, desirable in a symbol meant to be pervasive. They can also create a pleasant tension, since the mind senses more to the emblem but must concentrate to grasp it. Finally, such logos suggest sophistication in the firm, a capacity to see deeper meanings and thus unite it with viewers who can do the same.

Singularity

Like a coat of arms, the logo should distinguish the firm from other companies. Ideally, people can see the logo a few times and quickly recognize it on later appearances. It may even be memorable.

You can make a logo distinct in numerous ways, some already

mentioned. For instance, a striking image may lodge in the mind. Bright colors tend to be unusual in trademarks, partly because they must be reproduced in so many media. A logo with hidden meaning involves you actively as you decode it, and thus is often memorable. Moreover, it reinforces itself on later viewings, since you may deliberately seek out the underlayer.

Puns can be distinctive. For instance, a proprietor named Rivers might work a river into the logo. The image would engage the mind for a moment, as it makes the connection between logo and name.

Unexpected images can also set a firm apart. A logo that seems a little puzzling tends to remain in the mind. For instance, the software dealers Beagle Bros. employ antique, country-store trappings in a high-tech business, and the approach stands out. The brain automatically seeks some connection, and the fact that none exists here makes it labor even more. The image works.

Lettering

Should the logo have the firm's name or initials? It depends. Lettering can link name and logo indissolubly, but there are so many successful trademarks with no characters at all that plainly they're not essential.

In terms of lettering, logos come in three kinds:

- Pure image
- Part image, part lettering
- Pure lettering

Examples abound of all three.

Pure image. Pure-image logos appear either alone or with the company name lurking discreetly nearby.

If the image is the name, it can stand in solitary grandeur. Notable examples include Apple's apple, Greyhound's greyhound, and Shell's shell. These are also highly promoted logos, however, and if your firm lacks a high profile, you might discreetly append its name.

If the image is not the name, you normally place the name nearby unless the logo is exceptionally well known. For instance, the CBS eye needs no explanation.

Part image, part lettering. Some of the strongest logos fuse a simple picture with a name, such as those for Del Monte, Kodak,

and Pepsi-Cola. Often, they simply superimpose the name atop the image for ready identification.

Gray zones are the bane of the taxonomist, and a big broad swath of one separates this category from the first. For instance, logos tend to migrate from part lettering to none at all. Take the CBS trademark. Invented by William Golden in 1951, it began as a stylized eye blazoned across a sky of drifting clouds, with *CBS Television Network* on the pupil. The image conjured up video signals crossing thin air, but was a bit complex. As it grew more familiar, it shed baggage. First the sky disappeared, and the legend within the pupil shrank to *CBS*. Then the initials vanished altogether. Because of the well-established link between CBS and its logo, it remains instantly identifiable and highly effective.

The Shell trademark has repeatedly jumped back and forth. It began in 1900, as an ordinary banded shell, loaf-like and mundane. By 1904 the more interesting scallop had replaced it, and this device evolved into further versions, with and without the name *Shell*. By 1961, there was a single general logo, with *Shell* and a schematic scallop. Today, the image is even cleaner, and the name is generally omitted.

Trademarks in this category can also move in the other direction, toward pure lettering. For instance, you can place name or initials on a three-dimensional object, like a sphere. For instance, the logo for NeXT, Inc. appears on a cube. The three dimensional aspect of such a trademark confers depth and draws the eye.

Letters can also emerge from a diagram or drawing through selective darkening. For instance, a video company might fill certain pixels in a grid to form the corporate name, or a music company might thicken the lines in sheet music.

Finally, you can shape name or initials into an image, and the more abstract the image, the closer you approach all-letter logos. To take a borderline example, First Federal Savings and Loan in California begins with two monoweight *F*'s, turns one upside down, and fits them together like matchboards. Then it surrounds the whole with a rounded square and, to create diagonals, tilts the logo so it stands on one corner. At first glance, the image looks abstract, almost like an ideogram, but scrutiny reveals the hidden initials within.

Pure lettering. Many logos have nothing but type, such as those for 7-Up, DuPont, and RCA. This kind of logo is the most common and has a number of virtues: It's simple, easily appre-

hended, and durable. It offers less chance of straying into the wrong image. It permits evolution, since you can alter the contours of the type if they begin to seem dated. On the other hand, pure lettering narrows the range of expressiveness and may even fail to make the logo distinctive. These trademarks can be highly recognizable, but if you pick a font that looks too common you may face trouble.

The basic dichotomy here is between the cursive and the noncursive.

Cursive trademarks generally seek to show the hand of the founder or communicate a personal touch, often both. For instance, the Ford logo, modeled after Henry Ford's signature, has proved durable and effective. Coca-Cola, whose flowing, ribbonlike script leans right and is partly underscored by an extension from the first *C*, is another famous example.

The Kellogg's logo appears as a script rising up to the right, and suggests friendliness, lack of pretension, a sunrise optimism. We recognize a name in the Kellogg's style as Kellogg's, no matter what the word actually says.

Noncursive fonts are far more common, perhaps because of their sheer variety. One such logo is that of IBM. Paul Rand, its designer, began in the late 1950s with a square-serif font called City Medium. This typeface actually took square-serif one better, squaring the spaces within the loops of letters like *B, C, D,* and *O*. Overall, the font had a solid look to it, and in *IBM* the internal corners of the *B* contrasted intriguingly with the angles in the *M*. Rand realized at the time that this design was basic and stable enough to evolve, and so it has. It first appeared in stripes in the 1970s.

One common approach to this kind of logo is simply to display the letters or acronym of the company in a novel way. For instance, you can fuse initials into a larger entity. The initials can be twisted around each other, streamlined, or superimposed atop each other.

For instance, the Huntley Hotel uses nothing but its initials, yet its logo seems at first like a three-dimensional object. The tips of the stems in one *H* drift toward those in the other, the eye follows, and the mind leans toward a gestalt whole.

You can also warp existing fonts to shape a very individual trademark name. An image processor like Digital Darkroom performs warping, and a program like *LetraStudio* lets you manipulate fonts directly, allowing for even greater variations.

Nature of the Business

Trademarks commonly show the nature of the business, to define the firm and set up a mental link to buyer demand. It's a venerable approach, and at some point you must decide whether to use it. Don't be cowed by its widespread use, especially if the enterprise may branch out into new fields. You don't want a logo that anchors you to the past.

If you decide to indicate the firm's nature, you can take at least two tacks. One is schematization of a significant image. For instance, if you're designing the logo of a lumber company you might reasonably deploy a tree. But you wouldn't draw an individual tree, with its own shape, location, and background—you want to express the general, not the particular. Hence you would reduce it to its basic lines, schematize it, and it would become all trees. Schematization turns individuals into symbols.

Apple illustrates this principle. When first formed, the company issued a logo of Isaac Newton under a tree with a glowing apple on it, apparently ready to drop on his head. Soon after, the company hired a professional public relations firm that junked the image for several reasons. First it was far too detailed and specific. It showed a real tree rather than a schematic one. The logo had other problems, too: 1) It emphasized Newton more than the apple. 2) It was clichéd. 3) Its message misfired, since Newton harks back to the past and computers are rarely sources of inspiration. The new trademark solved all those problems. It was spare and symbolic. It stressed the apple, and was novel, small, and apt.

A second technique is to highlight part of the basic object. With a timber company, for instance, you could depict a bough or a pine cone or even a leaf. The Marin Swim School uses a pool ladder, which suggests the whole pool. A charter boat service might use schematized sail or steering wheel.

Third, you can depict an item associated with the object. A charter boat service could display stylized waves. A winery might use a cluster of grapes, a goblet, a wine press. A publisher could use an inkwell. All of these images conjure up the business and yet lend a particular, romantic cast to it, and thus verge on special messages.

Special Message

The logo offers an outstanding opportunity for an organization to purvey a particular message about its service, to characterize itself in a nutshell.

For instance, a logo can convey a purpose. The logo of the United Nations shows a polar map of the world cradled by two olive branches, suggesting its mission of unifying the world in peace. The image is slightly complex, but its radial lines and interstitial white space make it striking, and its distinctiveness makes it very effective.

Logos can also convey the particular thrust of a company. For instance, the trademark of the Marin Swim School in California—two stylized rails—communicates an instant message: "We're like these rails. We help your child safely into the water."

And, of course, logos can have a commercial message. Again, Apple's logo is revealing. Before personal computers, high-tech companies typically chose modernistic images that connoted advanced engineering. Apple's trademark, the chromatic apple with missing bite, is not high-tech at all but it was wildly successful. Why? It's not only vivid and distinctive, it has a message: "We aren't aiming these computers at specialists in dust-free rooms, but at you, the consumer. Our product invites you to take a bite (byte?) out of it. It's an everyday product, like the fruit you might buy at the grocery store." The logo helps fight computerphobia.

What Not to Do

Plainly there is latitude in devising trademarks. But there are also two specific pitfalls to avoid:

- **Going out of date.** Entrepreneurs generally intend their firms for long life, and the trademark should not lag behind, huffing and puffing. Hence, it should avoid fashions, which fade, and explicit depictions of technology, which can change. One firm used a logo of a secretary at a typewriter. That logo is lost today, in a world of word processors. It's not always easy to determine when an image is based on trends or transient technology, but if you have doubts, you might search further.
- **Restricting the audience.** If the logo makes sense only to a certain class of individuals, it may face trouble if the business ever

expands. For instance, if the firm is or hopes to serve a polyglot clientele or become international, the logo should be comprehensible to speakers of any language.

A clever logo can do great things for an enterprise, and it may appear most often on the correspondence it sends out: the letterhead.

Letterheads

A *letterhead* marks mail as deriving officially from the company. It can have great significance, especially where only few people have access to it, as in a law firm. In any case, it conveys an immediate message about your business, and merits close attention.

Most letterhead contains the name, address, phone number, and sometimes telex number of the company. It may also display the logo, names of officers, special graphics, and other items.

The formal letterhead is the easiest to devise, since it follows simple, rigid rules. You center name, address, and remaining information at the top of the page, in a small and restrained font. This symmetrical layout is de rigueur in some professions, such as law, and in other situations may prove useful and effective.

If the letterhead is less formal, the possibilities fan out. For instance, you can place the logo and address together in top left or right corner. Either breaks the symmetry and lends interest to the page. If you normally place the date in the upper right, you might put the logo and name in upper left—or vice versa—to achieve a bit of balance.

If you wish to add extra information, such as the names of corporate officers, you can trail it down the left or right margin, beneath the logo. The combination frames one corner of the page. Alternatively, you can place these names in the opposite corner, for balance.

On much stationery, the logo and address appear at the top, but they don't have to. You can center them at the bottom of the page. This letterhead conveys an effect of restraint—"we don't have to shout"—and can work well in some situations, though you should probably avoid it if your logo is large or it unpleasantly weights the page toward the bottom.

There is no reason why you need to set the logo beside the address; you can break them up. For instance, you can place the logo

top center and the address bottom center, or upper left and lower left, though unless both logo and address are fairly long, the latter may look off balance. Again, these letterheads suggest restraint.

You can also put logo in upper left and address in upper right, in a two-headed arrangement. However, if you take this path, try to avoid symmetry, and retain some central white space. If the logo is dark or colored, symmetry may not matter, as the logo then outweighs the address. However, if logo and address creep toward each other in the middle, the letterhead looks cramped.

You can also add numerous graphic elements to letterhead. A straight rule or wavy ribbon across the top or bottom can help unite the page, which is especially important if you place the major elements plainly on one side or another.

At the extreme, letterhead can become almost baroque, with intricate designs completely framing the writing area and cutting it down to pad size. By this point, however, we're venturing into a much more varied realm: page layout.

Part 6
Page Design

11
The Foundation of Page Design

A good publicist calls attention to the client while remaining invisible himself. Likewise, a good page design enhances the material on the page without itself dancing about in the klieg lights.

Page design is the art of arraying graphic elements—type, white space, pictures, rules, and many other items—on the printed page. It's normally camouflaged by content, hence unnoticed by the reader.You simply don't pick up a publication to scrutinize its layout. You read the prose, look at the photos, and are utterly unaware of the structure behind it.

Yet page design has a deep subconscious impact. It conveys the tone of the publication, unites the page, directs the eye, creates a sense of crowding or elbow room, and affects us in many other ways. Indeed, a well-designed report or newsletter can afford us much pleasure without our quite knowing why.

Page design has the gleam of dark magic about it. Yet many beginners approach it with grinning confidence, perhaps thinking it resembles typing, with its innocent demands of linespacing and margin size. Unfortunately, a typed page is not laid out at all. It's all raw data and, except for the prose, contributes nothing to page design. Layout requires high finesse, and without some awareness of it your efforts may be coarse and gasping.

Like most art, page design presents you with subtler and subtler decisions the deeper you go. You confront apparently negligible points that you cannot ignore, for people sense the overall impression of the page and details are its only building blocks. If you, say, leave too little space between columns, readers realize it, even if they can't articulate the problem. You don't have to know music to tell the difference between Tchaikovsky and Little Richard.

Actually, part of the pleasure of page design lies in working just beneath the reader's level of perception. Almost all page de-

sign involves sleight of hand, and the more care you devote to it, the more the audience appreciates it.

The sheer number of details in page design can be a bit overwhelming. Hence, let's begin with the groundwork, the basic guidelines which have held true over time and which enable you to marshal the details to your purpose. They are:

- Format Follows Function.
- Keep It Simple.
- Use Variety.

Basic Principle Number One: Format Follows Function

Every publications has a specific nature, and page design should reflect it. A market analysis of the latest developments in CD-ROMs should look spruce and dignified, while the newsletter of a homebrew club can appear casual and even gaudy.

This principle has a corollary: The rules of page design are fine as long as they serve your ends; otherwise, they're just obstacles. We're not dealing here with Newton's three Laws of motion or the Napoleonic Code, but with guides to good results. Though specific rules may sound carved in granite and addressed to the witnesses of eternity, they're all flexible and you should bend them to your purpose.

How do you identify the nature of your publication? For the purposes of page design, it's mainly a matter of formality level. All documents fall somewhere on a spectrum between the highly formal and the loudly flamboyant. To determine formality, look to your subject matter, your audience, and what your audience wants.

Formal Layouts

A *formal layout* assumes both preexisting interest in the topic and a sophisticated readership, such as one of scientists, executives, or lawyers. Formal layouts stress the contents of the prose. They don't go hallooing for attention, since they don't have to take this tack. Their readers are busy, text-oriented individuals who want a clean, attractive layout with the highpoints suitably underscored.

You can achieve a formal look through

- Large blocks of text
- Fewer graphics
- Fewer typographic tricks like callouts

- Justified columns
- Fewer fonts
- Less space between lines and in margins

You need not use all these elements, but together they create an impression of dignity.

Informal Layouts

Informal layouts presuppose a need to engage the reader and are appropriate for a variety of readerships. A reluctant audience, such as one for ads, demands a bold effort to seize and hold the reader's eye. An ad layout must therefore convey the message fast, spotlighting its major elements. Children have mercurial attention spans and low text tolerance, and hence require far more graphics. Even newspapers and magazines must tempt the reader. Though the reader's very perusal shows some involvement, it doesn't indicate interest in every single article. Most editors want the reader to linger over the publication as long as possible.

You can achieve informality through

- Smaller blocks of text with greater variety in size
- More illustrations
- More subheads, callouts, and sidebars
- Ragged-right columns
- Greater font diversity
- More headings
- More space between lines and in margins
- More white space

In general, you can also play around much more and employ the wealth of layout programs more exuberantly.

Of course, the nature of a publication is not solely a matter of formality. You may seek a fairly specific tone, such as fireside warmth or chatty authority. To achieve these, you must often transcend pure layout and seek out particular fonts, mastheads, and pictures. But the key point is that a cracker-barrel tone would sound pretty strange in a document that looks like an investment newsletter.

Basic Principle Number Two: Keep It Simple

Layout software offers great luxuriance. You can easily succumb to the temptation to try all its features out at once, creating pages that look like ads for Ringling Brothers. It's a natural reaction to the sudden power, and perhaps the best approach is to get it out of your system with a few rococo efforts before you settle down to real business.

Good page design doesn't normally bedazzle the eye. Too many attention-getting features wind up competing with each other and create an impression of clash. Instead, design should make the page easy to grasp and pleasant to scan. It should be discreet, a matter of background.

Of course, some kinds of page design cry out for attention. But the layout that attracts attention is very different from the layout that attracts attention to many parts of itself at once. The first is doing its job; the second is carving itself up.

A good layout is not just free of clutter but well-ordered. Articles occupy well-defined areas, separated cleanly from each other so the reader doesn't confuse them. Photos and graphics relate clearly to their articles, as do headlines. Two headings do not abut each other since they would tend to fuse into one, even if they're of different fonts and sizes.

But the key to simplicity is the *central focus.*

The eye approaches a page looking for a peg to latch onto, around which it can order all else. If the page has more than one major focus, the reader hesitates and must consciously decide where to proceed. If the page has a single focus, the eye moves to it automatically, and the page attains unity. It's a subtle but powerful phenomenon, and the good page designer takes it into account.

There are a number of ways to achieve a dominant visual focus. The best known is the *major headline.* For instance, the front page of newspapers commonly gives one story paramount emphasis, whether it deserves it or not. The layout is simply more pleasing. To see the alternative, look at the front page of the New York Times. The Times generally emphasizes stories in proportion to merit, and often a gaggle of headlines compete for the reader's first glance. This approach evinces greater integrity but also makes weaker design.

A large, well-placed picture can also act as the central focus. For best effect, it should lead into an important story on the page.

If the graphic is an island unto itself it confers only a superficial unity, since once you assimilate it you must sort out the remainder of the page.

Where should you place the central focus?

With a single-page layout, you can exploit the predictable course of the eye known as the Z *pattern.* The eye first moves to the optical center of the page, that is, slightly above and left of the geometric center. Hence, you can set a single major element, like a heading or picture, near the optical center and be sure of central focus.

From the optical center, the eye moves right, then diagonally down toward the bottom left, then across to the lower right, forming a rough Z. The end-point is significant also, for here you often find the table of contents in newspapers, and order forms or dog-ear tags in ads; it's the natural place for them.

Principle Number Three: Use Variety

The simplest layout is the one-column block, like the prose that rolls out of the typewriter, but that's not page design—it's actually too simple. Like most virtues, excessive simplicity is unpleasant. You might do better to emulate Thoreau, who said, "Simplify, simplify," and went out to Walden to spin forth a complex philosophy. In page design, simplicity is important, but don't take it too far. Readers like variety.

In fact, simplicity and variety complement each other. Simplicity makes the page clean and comprehensible, while variety lends it interest and emphasis.

Symmetrical layouts show the importance of variety. They just look dead. Though appropriate for highly formal documents like wedding announcements, they otherwise convey a sense of page design by the Coneheads. Asymmetry, on the other hand, sparks visual interest. A certain imbalance suffuses the page with pleasant tension, and makes it more lively. Hence, most good layouts place the central focus somewhat off-kilter, the way newspapers tend to shift the lead headline to the upper right. Once again, don't take asymmetry too far. A central focus on the edge of the page ceases to be a central focus.

Don't be afraid to vary your layout within the document according to its sections. For instance, if the whole report is two-column and you have a preface by an important individual, you can emphasize it by using a single column with one wide margin.

Footnote and bibliography sections seldom receive as much attention as the text, so you can place lines closer together.

You can gain variety in numerous other ways. To see some of them, we need only look at the layout of an article in an average slick magazine. It normally shows at least two elements: opening and body.

Opening

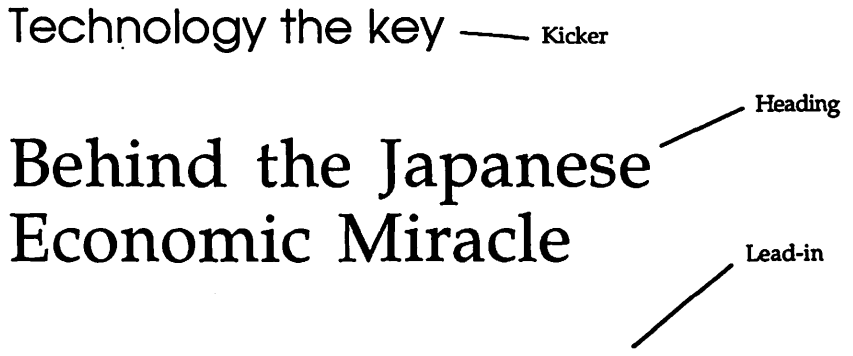
Editors realize they have to coax readers into an article. It's a little tricky, like inducing a plunge into water of unknown temperature. Hence, major articles commence with an assortment of lures, on up to three different levels.

First, the story must attract the reader's attention. Thus an article may open with lush, imaginative graphics that beckon the reader into the world beyond. Likewise, the first letter may be a huge florid capital, swathed in vines and almost unreadable.

Once the attention has alighted ever so briskly on the article, the next trick is to engage the understanding. The basic tactic is to feed the reader the nub of the piece as fast as possible, before he or she is quite aware of it. The reader with some notion of a story's direction is more likely to pursue it, especially if it seems tantalizing. The heading is the most familiar device here, of course, but it has many offshoots. For instance, often a lesser heading called a *kicker* sits just above it and provides larger context. In addition, a *lead-in* (a full sentence summing up the article) may lie below. As these all appear in large and conspicuous type, the reader assimilates them simply by scanning them (see Figure 11-1).

Third, you must lead the reader down into the depths of the text itself. The method is to make the start of the story more accessible. For instance, the first few words of the article may appear in all capitals and boldface. In addition, the first paragraph or two may stand out in larger type, and form one column instead of two.

Figure 11-1. The Opening



Body

Once readers venture into the story, a major problem has ended and the expensive graphics tend to diminish. Yet readers can still bail out, and the layout can help keep them reading. Four common tools in this regard are the *subhead, drop cap, callout,* and *sidebar.*

Subheads. Subheads break up the prose and thus provide breathing room, rather like chapters in a book. Like chapters, too, they serve other ends. They can clarify the organization, abetting the reader's understanding and interest. They can also tease the reader on, by dangling foretastes of the prose to come. At its worst, the subhead is merely an alluring quote unrelated to the brunt of the piece. This trick can indeed spur the reader on beyond the decision to dismount, but it also tends to forfeit credibility and lower the class of the publication.

Drop caps. Drop caps are enlarged capital letters at the start of a new section. They supply the breathing room of subheads without specifically announcing a new part, and they can also break up a gray field of text.

Callouts. Callouts (or *pull quotes, decks,* or *readouts*) are phrases lifted from the text and reprinted in much larger type, often within a box. Callouts break up text, as do subheads, but they typically stress an important or provocative point made by the author. Like subheads, they can tend toward sensationalism.

Sidebars. Sidebars are substories related to the main article but detached from it, and they're often boxed or even shaded. Again, they serve several purposes. A sidebar can be a repository of dense, reference-type information that's otherwise quicksand to the reader. For instance, a list of manufacturers or a detailed technical explanation properly belongs in a sidebar, where only those interested need read it. A sidebar can also perform the opposite service and showcase an intriguing aspect of the story. In addition, it can solve organizational problems. Suppose you're writing an article on music synthesizers and also wish to highlight the life of Robert Moog. The story would have two separate thrusts and flop around unpleasantly. But by detaching the Moog profile and shunting it into a sidebar, you attain unity again, or, rather, two distinct unities. Finally, sidebars that chase tangents, like the Moog piece, vary the content of an article and often prove more satisfying to readers.

These three basic principles form a general guide to laying out pages, but they don't address other broad, important matters. There are two more in particular that require mention: *control of the eye* and *white space.*

Control of the Eye

Here's a nice piece of legerdemain. It not only gives pages unity, but it also makes for highly effective emphasis and is almost invisible. It involves directing the reader's eye, and it's done through pictures.

Most pictures point the eye naturally in one direction or another. For instance, a photo of an individual staring left causes the eye to drift left and focus attention on whatever lies there. So if you place a left-facing picture on the left edge of the page, the eye wanders off into space, and the layout seem awkward and disjointed. But if you place a left-facing graphic on the right side, to the immediate right of a story you want to emphasize, the reader's eye gravitates to that story at once. If you consistently place left-facing pictures on the right and right-facing pictures on the left, your layouts have a harmony that readers appreciate without quite understanding.

The first step to recognizing a picture's direction is becoming alert to the phenomenon. If you look carefully at pictures in news-

papers and magazines, you'll see exactly how they move the eye. Pay special attention to:

- **The direction of gaze.** If you're walking down the sidewalk and see someone staring up at the sky, you'll probably glance up, too. Likewise, if a person in a picture is looking left, you look also. It's a reflex. Maybe something's happening there.
- **The direction of lines.** Most of us are familiar with the effect of perspective lines; they pull the eye toward the vanishing point. Hence, a photo of a tilled field with the furrows leading to infinity causes us to gaze at the horizon, and beyond to the prose above. Likewise, a picture of half a corridor with the hallway disappearing to the right moves the eye toward the right. The effect of lines is not solely a matter of perspective. The eye simply shifts to follow lines, and if your graphic has several leading in a particular direction, the reader tends to notice the prose beyond.
- **The direction of motion.** A train moving left takes the eye with it. A baseball player leaping to make a catch lifts the eye upward. A photo can freeze an action, but the mind seems to follow it through.

Not all pictures have direction. For instance, a full-face portrait doesn't shift the eye at all, and you can place it anywhere on the page.

White Space

Consider this layout: The entire page is blank, except for three or four words in the center extolling a product. The designer has simply disdained the bulk of the page. Yet the splendid white expanse frames the tiny message and calls attention to it magnificently. There is also drama in the apparent profligacy of the display. Moreover, it conveys a sense of ease and kindles a pleasurable response in the reader.

White space is the great delphic element in page layout, and it behooves you to contemplate it. Though utterly blank, it has powerful and mysterious effects. Not only does it emphasize, but it lends an air of generosity and grace to the page.

Contempt for white space is the mark of the absolute novice, yet it's understandable. The temptation is to view white space as wasted space, since there's nothing there. This perception gains

thoughtless urgency with the realization that you or someone else almost certainly must pay for it. Hence, even individuals who know better must sometimes resist the tendency to trim that "empty" space back. White space is an active graphic element, a block, not a leftover, and it almost always improves a page.

But not quite always. Its use depends on several factors. One is the nature of the publication. A newspaper, for instance, does not generally benefit from white space among the stories, for several reasons. It's not the custom. Readers expect papers to provide maximum news. Display ads and photos generally prevent the gray unpleasantness of unbroken text.

Certain newsletters, too, are chary of white space. If subscribers are hungry for facts and analysis, and if you wish to convey a serious, businesslike image, you will likely minimize white space. However, you should still use it, and in no event should you assume that a sardine-can layout conveys a businesslike image. Businesspeople like a crisp, clear presentation with a minimum of excess. They don't like layouts straight from the compactor.

In display ads, white space is often essential. The eye happily skips a packed rectangle but feels the lure of one with white space. An airy look is also more appealing and may go well with pictures of people such as models.

You can abuse white space. For instance, be careful to avoid the impression that your white space is inadvertent. A three-column page with a few lines at the top of the third column and nothing but white space below just looks clumsy. The reader cringes, keenly aware that a modest problem has defeated the capacity of the layout artist. You can convey a fine sense of largesse and style by making it clear that white space is intentional.

Finally, white space really has two roles: *block* and *matrix.* As a block, it's vital to page structure. But it also forms the backdrop for prose, and hence, under the guise of linespacing and letterspacing, is crucial for legibility.

White space is thus the most pervasive factor among the many elements of layout.

12
Elements of Layout

Consider this layout: Tiny type is crammed into a block stretched out to the limits of the page. The designer has filled every bit of space, and perhaps reduced the number of pages in the document and saved a little money. However, the tradeoff is disaster. Words swim before the eyes and reading them becomes a chore. The mind seeks an exit, as though in some layout Black Hole of Calcutta, and wafting over all is the affront of parsimony and insensitivity on the part of the publication.

The ultimate tragedy in page design is a well-written document that repels readers because of its layout. It can happen very easily, through such a simple decision as choice of typeface. If the page is unreadable, not much else about it matters.

Of course, page layout can do much more than enhance legibility. It can make the reading experience itself a delight. Also, if you have a sense of composition, the act of page design can be pleasurable, particularly if you approach it one step at a time.

First Step: The Dummy

As authors compile outlines before sitting down to write, so page designers sketch out *dummies.* A dummy is just a rough draft of the layout, but it has an array of benefits:

Easy Visualization. A dummy gives you a feel for the ultimate appearance of the page. It reduces the components to a skeleton so you can more readily visualize the impact of the layout on the reader. Dummies are particularly useful if you lack a full-page screen.

Speedy Restarts. You can sketch in a dummy very quickly. Hence, you can easily chuck it and start over again. If you make a complete page design on a layout program and then decide you don't like it, rearrangement is harder, even in the best software. As a result, you've wasted time and effort.

Reduced Computer Time. A dummy also speeds your work once you get on the layout program itself. There, you can concentrate

on the details of design without the trouble of launching a layout from scratch.

You work fastest if you sketch the dummy on a piece of paper. You can indicate columns by boxes with wavy lines down them and picture blocks by large X's. If you do many dummies, you may want to draw up a basic page form, proportional to the page you use, with, say, eight column lines drawn in. You can then make numerous copies of the form and use them freely.

Okay. You're poised above the dummy, pen in hand. What now?

The Basic Text Page

Pages in text documents come in two kinds: *basic* and *special.* Basic text pages are the ordinary ones that form the bulk of the document. Special pages include the cover, the first page, the first page of each section, and those in such parts such as preface, acknowledgments, footnotes, and bibliography, which you may want to cast in a different layout.

Let's start with the basic text pages, the core of the document, and return to the others later.

Here, the dummy should consist of two pages to show the *spread,* or the look of the opened publication. The left is almost always even-numbered and the right, odd-numbered. Readers perceive both pages as a unit, and if you don't treat them as such, you can encounter problems, as we see below.

A single dummy normally suffices for all the basic text pages. Though each may differ—some may have charts, pictures, or readouts—the dummy provides the fundamental, repeating format. Though you should have some idea where sidebars, photos, and similar items go, you can usually insert them later by breaking up text blocks. The main goal of the dummy is a basic structure for all text pages.

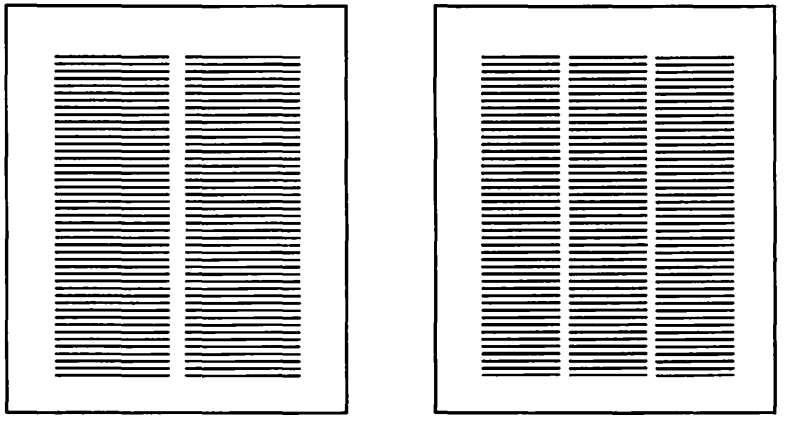
The building blocks of that structure are columns and margins. They form a yin-yang of the page, complementing each other and often creating balance and tension.

Columns

Columns are the backbone of your layout, and one of your first decisions is how many to use per page. The rules here seem at first pretty straightforward. The most legible columns have between 20 and 60 characters per line (with the optimum around 39). If the

line is any narrower, you may gain weird effects with line breaks and spacing, and the eye has to swing up and down the columns of a prose colonnade. If it's much wider, the mind may stray. This dictum translates into either two or three columns for a page 8½ inches wide (see Figure 12-1).

Figure 12-1. Two- and Three-Column Layouts



Now, that's the rule. In practice, columns are often wider, especially in books. In his *Graphic Arts Encyclopedia,* George A. Stevenson announced that columns should as broad as an alphabet-and-a-half, or about 39 characters. He uttered this edict in columns over 60 characters wide.

Moreover, the rule itself is not always right. In page design, nothing occurs in isolation, and you must always contemplate the overall interaction. Here, optimal column width expands with the space between the lines. That is, the more space, the easier each line is to read, and the wider you can make columns.

Don't be afraid to vary the number of columns from one page to the next. For instance, if the first page of a newsletter contains the most important information in a story, you might display it in two columns. Subsequent pages with less important information might have three columns. You can also mix columns of different width on the same page, spreading, say, one column across two-thirds of the page and a second across the remainder. The more you play with column width, however, the less formal your publication appears.

Margins

In school, you may have learned certain rules about margins for term papers, such as leaving a larger margin at the top than the bottom and allowing about one inch on either side. Forget about them. In the world of page design, margins are a powerful tool, and you don't want to be restrained by a manual-of-style mentality.

Margins act as frames for the page. Hence, you should favor large ones, if you have the latitude. Narrow margins are actually more hazardous. You can easily err by making them too slender, destroying the frame and creating a noisome, cramped feeling. It's much harder to ruin a layout with wide margins. In fact, some say they should constitute at least 50 percent of the page. Of course, you don't have to go that far, and it's a rare novel indeed that frames the prose so luxuriantly, yet there's no question such margins make the page look more attractive.

Margins and columns interact closely with one another, and you cannot really consider one without the other.

Let's take a look at some of the options:

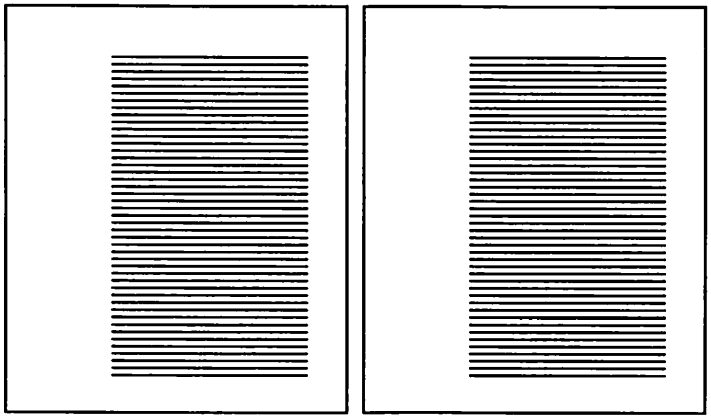
Progressive margins. These are the conventional margins for a bound work. The inside margins nearest the binding are the smallest. The top margin is larger, the outer one larger still, and the bottom largest of all. They're called *progressive* because their size grows in this manner. In fact, the inequality is deliberate and lends interest. If they were all the same, the hush of monotony would spread across the page.

Progressive margins feature a large block of text in the middle. You can make it all one-column—you probably will if the document falls into a traditional single-column category, like most books—or you can use two, three, four, or even more columns.

One wide margin. A wide margin on one side of the page and a normal margin on the other can be a highly effective layout. It adds white space and an attractive asymmetry, and also lends itself to variations based on the spread.

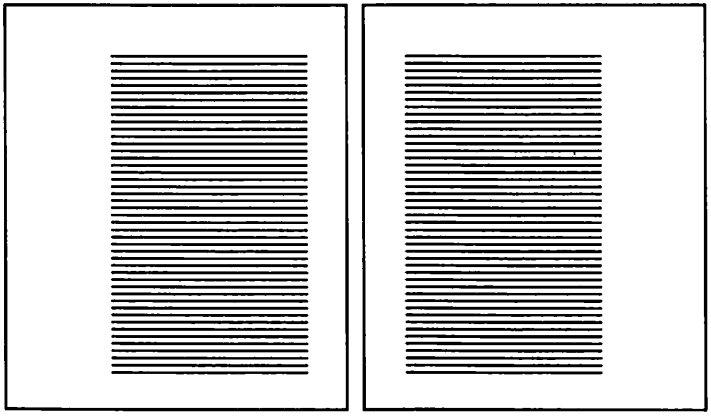
For instance, suppose you use a one-page dummy and make each page identical, with a wide margin on the left side. It may look pleasing and asymmetric, but in fact you're now in something of a pickle. On the lefthand even-numbered pages, the prose lies near the stitching, while on the righthand odd-numbered pages, it's out by the edge. Hence, this layout forces the eye to jockey from center to edge to center to edge, disorienting the reading process and calling attention to the page design itself (see Figure 12-2).

Figure 12-2. Asymmetric Spread



A far better layout exploits the spread as a single entity. If you place the wide margin on the left of the left page and the right of the right page, you wind up with white space on the outer edges of both pages. It frames the prose and creates a pleasant sense of space. Though it's symmetrical, you can tilt the balance by placing readouts and graphics here and there in the margins. It's hard to go wrong with this layout (see Figure 12-3).

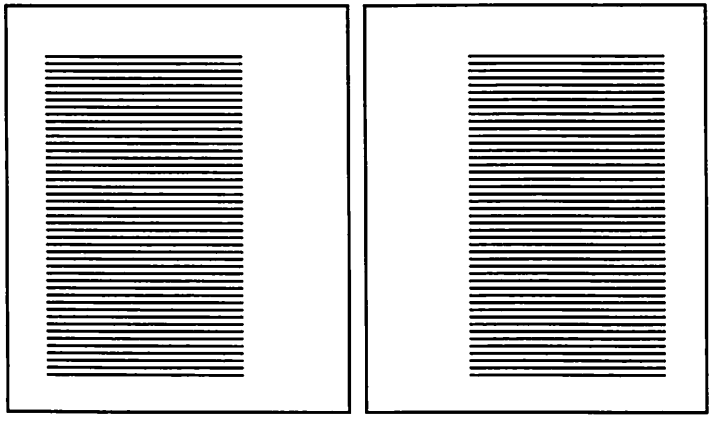
Figure 12-3. Wide Outer Margins



Finally, you can place wide margins on the inside of each page, bringing the prose out to the edge and cutting a large white groove down the middle of the spread. This layout is rather splayed, but it may work in special circumstances, particularly if

you can unite the prose blocks through pictures or other devices (see Figure 12-4).

Figure 12-4. Wide Inner Margins



In most cases, a wide margin works well with a single column. It is thus well-suited for reports on 8½ × 11 inch paper, where you might otherwise have to use two columns.

Setting Up the Software

Once you have the rough page design, you're ready to open the layout program and go to work. As you do, you can experiment mixing different features like chemicals in a retort, seeing how blends of, say, line spacing and type size affect readability and appearance.

Layout programs differ, but most have two basic items you confront at once: *master pages* and *grid.*

Master Pages

Master pages do two things. First, master pages let you create different formats for odd and even pages. As you've seen, this capacity is important for reports and other documents which will be bound and printed on both sides of the page.

More important, master pages let you set up a format for successive pages, so you don't have to stoop and place the grid on every single page. The master page acts as a template for all successive pages, so sometimes you must be careful. For instance, if you wish a page rule to appear on all pages but the first, you must generally lay out the first page in a different document.

Grid

The *grid* lets you place items on the page more accurately. It provides visual orientation and *snap-to*, an option which automatically aligns blocks with the corners of the grid boxes. The grid is usually expressed as one number times another, so 2 × 2 yields four large blocks, 5 × 5 yields 25, and 8 × 8, 64. You can normally define your own grid, and the denser you make it, the greater control you have over the page.

The grid doesn't define anything—it's a convenience. Hence, the area outside the grid is not at all the same thing as the margin, though at first glance they look similar.

Readability

Text layout is a futile exercise if the reader winds up struggling with the prose. Readability is the most important single goal of text layout, next to which appearance is just a pleasant sidekick.

Prose on the page should register quickly and easily on the eye. You want to pamper the reader, removing every mental effort to divine the letters on the page. The task of deciphering characters has a cumulative effect like jogging, and while your readers may easily read a paragraph or two of badly laid out prose, eventually they become fatigued, lay the publication down, and seek more congenial activity.

A readable layout has three components, all of which are critical:

Letters. Characters should be easily recognizable and clearly distinguishable from nearby letters. That is, they should appear in a pleasing and legible typeface.

Words. Make your words distinct and apparent, not lost in excessively long lines or odd formats. They should stand out prominently in the column.

Lines. Separate lines plainly, not pressing them together plywood-style. There should be enough linespacing so the eye doesn't stray from one line up to another.

The Clarity of Letters

Anyone can master the use of legible PostScript fonts; it just calls for a little study and a touch of discretion. The precepts include:

Select Readable Fonts. As we have seen in Chapter 11, the best fonts for body text are the old, transitional, and modern styles developed solely for this purpose. Sans serif and most other styles work best in headings or readouts. Pay attention also to the personality of your font. Bookman, Schoolbook, Times, and Palatino have markedly different darkness and style. Bookman looks somewhat round and elementary, Schoolbook pleasant and neutral, Times a bit sharp and dark, and Palatino warm and ingratiating. With downloadable fonts, you need not examine the details of every letter. For sheer readability, just take a look at several fonts in block type and see which feels easiest on the eye.

Use 8- to 14-Point Type for Body Text. Smaller sizes are hard to read and smack of the classifieds. Bigger ones devour space, suggest reading glasses, and make the reader impatient. Of course, you may want to begin an article with larger type or use it for special purposes.

Avoid All Caps. Most capital letters look rather bricklike and the eye needs greater effort to distinguish them. Hence prose written solely in caps strains the retina, and even headlines have the same effect. Don't shun all caps entirely, but use them with discretion.

Avoid All Italics, Boldface, and Reverse Type. These devices all work fine for emphasis, but in long stretches they tax the reader's mind. It's like shouting everything.

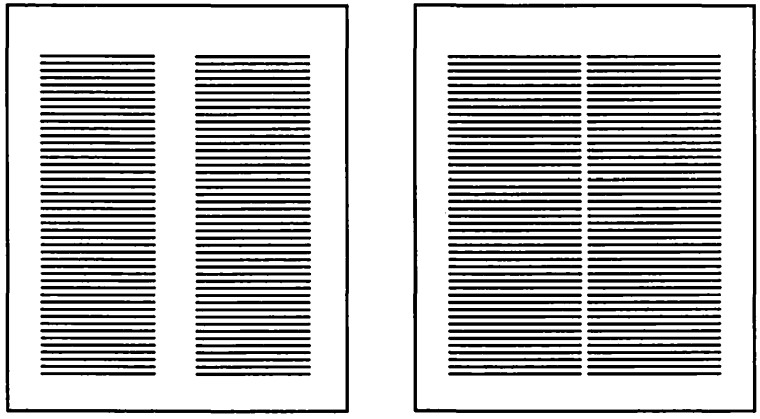
Use Fonts Discreetly. Avoid using more than three fonts in one publication. Too many font changes alert the reader to their existence and weaken their impact.

The Clarity of Words

The width of columns is the prime factor affecting the clarity of words, and we've dealt with it above. However, there's a second, post-dummy aspect to consider if you have two or more columns. It's *intercolumn space.*

Here you face a balancing act. You must provide enough room between columns to clearly separate them, yet not so much as to let them float autonomously. Generally two picas (14 points) is standard, and one pica (7 points) is the minimum. To let more air in and lighten the tone, you can increase this amount a little (see Figure 12-5).

Figure 12-5. Improper Intercolumn Spacing



If you must have narrow spaces between columns, you may wish to use a hairline rule to separate them. This usage tends to make the page look more blocklike but it's hardly fatal, and if you must squeeze columns together, you probably don't care.

The Clarity of Lines

Here's a topic that seems simple and innocent enough, but has enough barbed wire underfoot to snarl anyone who ignores it. In essence, you keep lines clear and distinct with linespacing, paragraph spacing, indention, and the avoidance of widows and orphans.

Linespacing. The art of linespacing (or *leading*, from the days when it was created with thin strips of lead) also involves a certain balance. You can't press lines of prose too closely together or the reader starts searching for a way out. Even moderately tight linespacing can cause the eye to flip from one line to another and mix the thread. On the other hand, too much leading makes the lines appear to drift apart. The lines must cohere, must ultimately form a block.

The rule of thumb is to insert linespacing equal to about 20 percent of the size of the type. Hence, if you have 10-point type, you want 2 points of linespacing; if 14-point, 3. Most layout programs have an Auto Leading feature that automatically spaces lines by 20 percent.

Don't accept this gift too quickly. Linespacing is more complex than that and interacts with a series of page elements.

First, as you've seen in Chapter 11, type size is an approximation. It measures not the actual height of a font but the height of metal blocks on which fonts came in days of yore. Hence, if your typeface is especially small, you may need less leading. If it's relatively large, you may need more.

There are other factors:

x-height. A font with a small x-height has proportionately longer ascenders and descenders. These force open extra white space. Hence, a small x-height normally calls for less linespacing, a large x-height, more.

San Serif. Sans serif fonts don't cap off the ends of ascenders or descenders, and consequently they lead the eye further above or below the line of text. If linespacing is particularly tight, ascenders can almost fuse with descenders above. These fonts require more linespacing.

Very Small Type. Minute type, around 6-point, requires more than 20-percent linespacing. At that size, type challenges comprehension unless you open it up a bit.

Column Width. The wider the column, the more effort the reader requires to cross it. Hence, the more linespacing it needs. One observer recommends amounts as high as the following on standard 8½ × 11 inch paper:

Columns	Leading
1	7 points
2	5 points
3	4 points
4	2 points

Formality Level. A smidgen of extra leading makes prose both more readable and less formal.

Paragraph Spacing

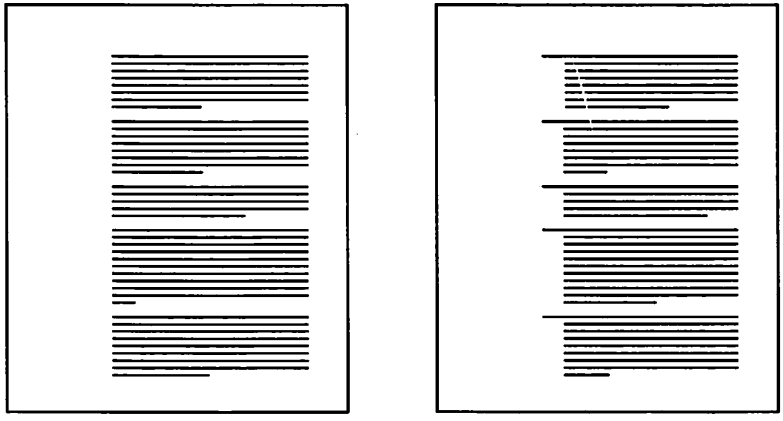
Paragraphs often call for extra leading, as they're distinct segments of the prose, and a good layout program provides it automatically.

The space between paragraphs partly depends on the kind of indention you're using:

Normal Indent. A normal indent usually requires no extra spacing at all, since the indent itself marks the paragraph off.

No Indent. With no indent, you need a little more spacing to show the break. This approach also lets air into the document and makes the contents leap out. (Some say you should never indent after a heading or subhead, though this stricture may be more a matter of fashion than imperative.) See Figure 12-6.

Figure 12-6. No Indent (Left) and Negative Indent

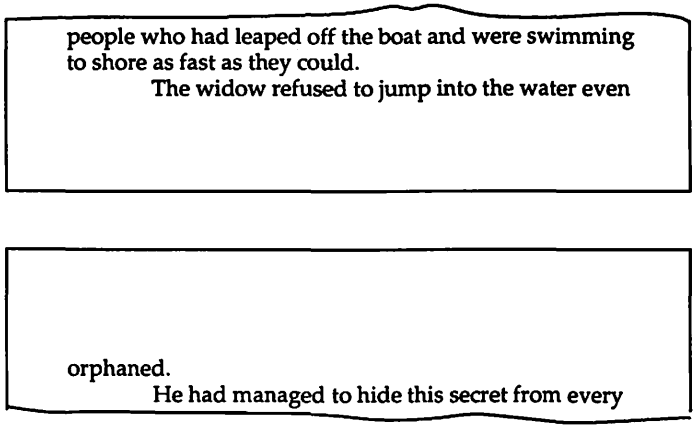


Negative Indent. A negative indent (or *hanging indent* or *outdent*) is the reverse of a normal indent. The first line begins at the left margin and all subsequent lines are pushed in. Why use it? It highlights the first few words in a paragraph and is extremely helpful when the reader's searching for footnotes, bibliography, lists, and other prose. This section is set in negative indent. Negative indents are unusual in body text, as they tend to create a clumpy effect, but with short items like, say, paragraphs in a list, they can compel attention. Their striking impression derives not only from their unconventionality, but also from the extra white space they mete out.

Widows and Orphans

Here is the sob story of page layout, the single line bereft of its paragraph. A *widow* is the first line of a paragraph at the bottom of a page or column. An *orphan* is the last line of a paragraph stranded at the top. You can help keep them straight by thinking of the paragraph as the "family." The widow engenders it and comes first. The orphan is the offspring and comes last (see Figure 12-7).

Figure 12-7. Widow (Top) and Orphan



Avoid them both. They break the flow. A widow commences a paragraph and often holds its topic sentence, yet its distance from the paragraph can have the reader flipping pages back and forth. Orphans are worse; they leave the reader hanging. A thought may be almost finished, yet the reader must hold all in suspense till the top of the next column. The reader may even supply the end of the paragraph, only to turn the page and see something different. The one-word orphan looks particularly dismal, as it may not even cover the paragraph indention below it.

Some programs automatically prevent widows and orphans. Others give you the power to keep selected blocks of text together. Sometimes you can also eliminate these isolates by editing, by altering the justification or letterspacing, or by other techniques. In the latter cases, you must simply be on the lookout for widows and orphans, and act to reunite them with their paragraphs.

Alignment

Like philosophers, page designers have many disagreements. One of the best-known arguments addresses how to line up text on the right. Some favor a flush-left/ragged-right look—*ragged right* for short—where text ends more or less where it happens to end, as on a typewriter. Others think text should align vertically on both sides, as in most newspapers. This flush-left/flush-right arrangement is called *justified.*

Note that both have a straight left edge. A straight left edge looks good and, more importantly, it provides a dependable starting point for the eye as it seeks each new line.

Ragged Right

Ragged-right columns have certain plain advantages. They place uniform spacing between words. They provide a consistent color across the page, hence forestalling the *rivers-of-white* phenomenon: bands of empty space that wind down the page like large, fluid cracks. Ragged-right columns involve fewer technical challenges. Some people believe these factors make ragged right easier to read, though proponents of justified prose claim it compensates through its pleasingly straight sides.

In any case, ragged right is normally preferable where you have:

Narrow Columns. The concern here is an excessive numbers of hyphens. A justified column needs more hyphens than a ragged-right column, and as it narrows it demands more and more. Hence, the hyphens can stack up on the right like a string of high-rise balconies. Ragged right greatly cuts the need for hyphens, though it still requires some to prevent long blank caves in the prose. Ragged right also enhances the esthetic appeal, through its irregular line and extra white space between columns.

Less Formal Documents. Ragged right simply looks less formal, more like typed than typeset prose.

Desktop publishers with inexperience or limited software should also consider ragged right, to avoid the pitfalls of justification.

Justified

Readers have favored justified text for centuries. Its clean verticals on left and right are formal, yet appealing. Also, for many people justification contains a touch of magic: Just how do they line that right side up, anyway?

It's done by:

- Wordspacing
- Hyphenating
- Letterspacing

Wordspacing. Many word processing programs use only the first method of justification. Inserting spaces between words alone does indeed justify prose, but it can create lines with large spaces

between words. With several such lines in a row, some wordspaces inevitably match or almost match, and the eye fuses them into a wriggling whole, like snakes crawling up the page. White space, as we've said, is a very real graphic element.

Hyphenation. Most Macintosh layout programs, as well as the better word processors, have automatic hyphenation to help mitigate this problem. Hyphens break up the long words that often create this distress in the first place.

There are two fundamental way a computer can hyphenate: *algorithmic* and *dictionary.*

Algorithmic hyphenation (after *algorithm,* a step-by-step formulaic procedure for solving a problem) works by applying the laws of hyphenation to words. For instance, one rule states that you hyphenate between two adjoining consonants bookended by vowels, as in *mar-ket* or *pub-lish.* The program seeks out such letter combinations and breaks words there. Unfortunately, the laws of hyphenation are full of loopholes. For instance, if you rely on the principle above, you get *bet-ray* for *be-tray, ret-read* for *re-tread,* and, indeed, *hyp-hen* for *hy-phen.*

Dictionary hyphenation, in which the program checks the word against the contents of its dictionary, is more accurate. However, it also takes more time.

The most practical hyphenation features integrate both, using algorithms for speed and also consulting a list of exceptions to the rules. It takes slightly longer than pure algorithmic hyphenation and lacks the accuracy of dictionary hyphenation, but benefits from both. And you can always add hyphens yourself—preferably soft hyphens that disappear if the word wraps around.

Hyphenation prevents the worst-case scenario: the line with a smattering of words separated by great gobs of white. But even hyphenation cannot create the impression of regular spacing between words that go on to meet perfectly at the right. For that, you need the true hero of this feat: letterspacing.

Letterspacing. Letterspacing is fairly simple. It lets you insert tiny spaces between letters, thereby swelling out words and narrowing the patches between. Many programs let you set letterspacing to a minimum and maximum number of points, and with this feature, you can almost always maintain well-spaced words.

Does justified text look good? Most people think so, but ultimately it's up to you. Even if you like it, you should note that it in-

creases the word count per page and hence darkens the look, since it reduces white space.

Other Margin Alignments

There are three other kinds of alignment: *ragged left, centered,* and *runaround.*

Ragged left. For display text you may occasionally want to use ragged left and flush right. Its novelty attracts attention and its wavering left line gives it visual interest. Like ragged right, it also provides uniform wordspacing. However, you should confine this configuration to short bursts of text. Long tracts of prose arrayed in this way are exhausting to read.

Centered. Likewise, you may now and then wish to center each line as if it were a title. Centered text can yield nice special effects, but if you center more than two or three lines, pay attention to the shape you're creating. It should be pleasantly irregular, neither too symmetrical nor too erratic. Again, centered text is for display. A whole magazine article laid out this way would quickly cause the eyes to twitch.

Runaround. A fifth kind of alignment arises only briefly in special situations. It's the *runaround,* in which type follows the irregular contour of a graphic. Some page layout programs make much of this feature, as it is technically advanced, but you may not actually use it very often. If you do, avoid placing the text too close to the graphic. You don't want to crowd it. If you give it a little white frame, you highlight it.

Others. Of course, this survey does not deplete the field. There are numerous odd kinds of alignment, such as *parallelogram,* where the left and right sides slope parallel to each other; or text arrayed as a picture, like the rat's tail in *Alice in Wonderland.*

Special Sections

When you have the basic pages sketched in, you're ready to look at the special pages. The easiest to handle are those in discrete sections, such as the bibliography.

In general, it's a good idea to vary the layout in such sections. It provides relief for the reader and can greatly enhance the look. It also gives subtle notice that one is in a different section, where new rules apply.

Such variations can serve important purposes as well:

Footnotes and Bibliography. Here, the reader is often hunting through long, formal columns for a specific entry, usually denoted by the first few characters or words. Hence you should highlight footnote numbers and authors' names with negative indents. You may also want to condense the linespacing and reduce the type size. Both of these sections typically have one column, but you can render them in two.

Index. An index is a set of references to topics in the document by page number. The entries are usually a word or two, occasionally with subentries. Hence they're much too brief for negative indents and look very strange indeed unless they're in multiple columns. You should set the index in smaller type, since not everyone consults it and only the proofreader reads it consecutively like normal prose.

Prefatory Remarks. The preface and foreword face a slightly different problem. To the chagrin of authors, some people skip them. You can subtly draw attention to them by using a different number of columns or negative indents or both. If it really matters, you can step over the line and add full-fledged pictures.

Table of Contents. In many tables of contents, items nest within each other, somewhat like negative indents. Avoid more than one or two levels of nesting, however, or the table looks amateurish. You may also want to string dots out from entry to page number. It's attractive and it aids the reader.

Initial Pages

Initial pages, like the first page and the first page of a section, have very special functions. They show a break in the flow, introduce the upcoming material to come, and often seek to lure the reader on.

Breaking the flow is important. It gives the reader breathing room and adds variety to the otherwise gray expanse of text. It also helps organization, since often a heading or lead-in sums up the section it presides over.

The heading. Everyone looks at the heading. That's what it's there for, and you should approach it as carefully as if you were painting your house.

First, consider the font. You can use the same typeface you use for body text, but the heading often looks better with an alternative, especially a sans serif. For instance, Palatino is set off well by Avant Garde.

Some people warn against all caps for headings, since it's less readable. However, if the headings are brief and infrequent, this drawback ebbs and you can fully exploit the attention-getting prowess of all caps. All caps can also help set off major headings from lesser ones. A newsletter with many heads, however, would look terrible if each were all caps.

You can align headings in several ways. Centered headings look good at the top of sections in reports or where headings are relatively uncommon. Flush-left headings work best where several of them compete for attention. Flush right may even work too, but avoid justifying heads. It's a strain, it destroys white space, and it may require hyphens. Never hyphenate a heading if you can help it.

Since the heading breaks up the flow of text, you should warmly invite white space into this neighborhood. A block of white beside a heading calls attention to it, enhances the layout, and provides a clear break. Such white space is sometimes called a *sink.*

Kerning. The opposite of letterspacing, *kerning* is the reduction of space between letters rather than its expansion. Why use it? It helps fit certain letters more snugly together, thus compressing slight but detectable gaps between them. For instance, in the unkerned word

W ASH

you could draw a vertical line between the *W* and *A* that would cleanly separate them. Hence, there is a slanting gap between the letters. They look better if you fit them together, so the *W* overlaps the *A*. Kerning gives you that little tuck:

WASH

Kerning is particularly important with headings, where the gaps are more noticeable. A good layout program lets you perform this feat, though few as yet can match the range and sophistication of a typesetting program.

Other heading devices. As you've seen in the last chapter, the heading comes marching in with two clever assistants, the *kicker* and the *lead-in,* and they can be invaluable.

The kicker. The kicker sits above the heading and adds depth to it. It should be set in smaller type that contrasts with the heading, such as bold, italic, or even reverse type (white on black). The kicker can be an excellent way to entrance the reader with perspective on the article.

The lead-in. The lead-in is a brief explanation of the story, appearing just below the heading and in smaller, different type, often italics. For readers, it often performs the function of the toe-in-the-water before diving into the pool. It helps answer the question: Do I really want to spend time on this piece? Hence, it should be brisk and tantalizing, and you should give it much thought.

Teasers. A final device to plunge the reader into the document is the front-page *teaser.* It can be as simple and dignified as a table of contents, which both helps the reader locate articles and highlights the offerings within. It can also be a provocative quote, or a mention of a topic or author followed by the page number. In either case, the teaser should be set off by a box, and you may want to shade its contents. It can also be a small triangle at the top corner of the page, often with type at an angle.

White Space: A Summation

Before we go on to some of the special features you can use to spruce up your layout, let's pause for a moment and again contemplate white space. (It's possible page designers would not go on at such lengths about white space if others understood it better, but given the general inexperience with the device and its inscrutable nature, one can hardly overstate its importance.)

White space gives a page contrast and tension, frames text, and provides a place for the eye to rest. We've seen plenty of examples of its use, and here's a list of some of them:

Margins. The white space in margins frames the prose and makes it look more appealing.

Between Columns. White space opens up the layout here and prevents the reader from gliding from one column to another. In general, the wider the column, the more white space you need.

At the End of Ragged Right. Ragged-right alignment adds extra white space, and may thus be valuable in multicolumn layouts.

Linespacing. The area between lines on a page is white space, and a generous amount of it enhances readability, making the prose jump out at you.

Indents. Normal indents open up enough white space to distinguish between paragraphs. Negative indents create much more on the left, interrupted occasionally by the first lines of paragraphs.

Paragraph Spacing. White space between paragraphs can greatly enhance the look of a document.

Beside Headings. White space near a heading can emphasize it better than increasing the type size. It also helps break the document.

Special Features

Text layout abounds in little tricks to make the page livelier. Some of the most effective are mere lines, such as rules and boxes. Other are typographic, like lists, subheads, callouts, and drop caps, or semipictorial (like dingbats and decorative borders). Finally, of course, there are the blocklike screens, charts, and pictures themselves.

Rules

Rules are among the subtlest, commonest, and most powerful design tools you have. They're strikingly simple, yet they can achieve graceful effects. They are simply lines, either horizontal or, less often, vertical.

Yet, as we've seen in the previous chapter, lines are potent graphic devices. They can lead the eye in a certain direction and also mark off separate zones, compartmentalizing the page. Hence rules are key tools for controlling page layout.

Their width can vary substantially, from hairline to thick black bars. They also come in certain styles, such as Oxford. Oxford rules have parallel thick and thin lines and can come with the thick line above or below the thin. Rules may also be thin parallel lines of the same size or dotted lines.

How do you choose? In general, the rule should jibe with the material nearby. If you have thin line art, a hairline rule might work. If the rule sets off sans serif, you should use single-line rules about the same size as the width of the type. If the rule adjoins Roman type with a fair amount of contrast, you might favor an Oxford rule, to resonate with the contrast in the type.

Dotted lines, however, have the effect of letting air through them, of reducing the set-off effect. They are thus useful for situa-

tions where you want to separate parts of the page, but not too drastically.

Rules are typically used in these situations:

Page rules. These are commonly laid horizontally across the page, at the top or bottom. Why? It instantly gives unity to a page and can add a pleasant tension.

For instance, if a page has two columns, a page rule goes far toward joining them into a conceptual whole.

The page rule is almost essential if you have wide outside margins. Why? The answer involves the page number. You can't really place it above or below the text, since it would look awkward and suggest inadvertence. White space would stretch bare and uninterrupted from the prose all the way to the edge, as though someone had printed on the wrong size of paper. On the other hand, if you place the page number far away from the text, alone in a distant corner of the page, you strand it in a sea of white.

The solution is fast and elegant: run a rule from the castaway page number across the entire page. The transformation is remarkable. Suddenly the layout has both coherence and a pleasing tension. The white space seems deliberate, a generous overflow. You not only bring the page number into the design but the white space as well.

Callouts. Generally, you place a rule the width of the column above and below the readout and indent it on both sides. The rule effectively separates the quote from the material above and below, allowing the reader to skip it easily. At the same time, it calls attention to the quote.

For callouts, you can, of course, simply deploy single rules above and below, but Oxford rules are often more effective. If you use them, place the heavy bar farther away from the quote, that is, on top above and on the bottom below. This arrangement leads the eye into the quote between.

Column separators. Vertical rules can also separate columns, so the eye doesn't pass across from one to the other. Usually these rules are hairlines, but you can make them larger if they're light gray or if they serve some special purpose. In general, however, you want to be delicate here and avoid breaking the page into vertical blocks.

Sections. Rules can also separate discrete sections of the page, and thereby help organize it. For instance, rules inserted halfway

across the column between certain crucial points can both emphasize and separate them. Dotted rules may work especially well here, if you don't want the separation to be too disjunctive.

Chapter headings. Rules also work well beneath chapter numbers and titles, and, in general, to set display text off from body text.

Lead-ins. Rules effectively mark off a lead-in from the heading above and text below.

Other uses. Rules are versatile elements, and in general you should feel free to use them where they can unite diverse elements of a page and make it look cleaner and tighter.

Rules are lines. Link several lines at 90-degree angles, however, and you get another useful entity: the border.

Borders

Borders come in two broad categories: boxes and decorative borders. Of the two, boxes are more common by far.

Boxes. A box is a rectangle pulled out by your software, normally to surround and set off special material. It almost always acts to separate this material, but it has other functions as well. It emphasizes it, calling it to the attention of the eye, as if to say, "Here! Look at this!" It also livens up the page, by providing variety and reducing the page to more immediately comprehensible blocks.

Boxes are very useful for surrounding tables, charts, sidebars, photos, and line art. They add zest both to the page and the items they enclose, which in themselves may be rather dreary. However, beware of them where you really don't want the isolation they confer. They're not appropriate, for instance, around callouts, since callouts relate directly to prose on the page.

Boxes come in many varieties. In general, as with rules, you should deploy the kind that best mirrors your content. Hence, a box with rounded corners tends to go with rounder fonts like Bookman and Avant Garde, or pie charts, or pictures with curves like portraits. Square corners more often accompany angular fonts like Times, bar charts, or rectilinear pictures like those of cityscapes.

Note: Follow this dictum only if the result appeals to you. If you have a table or bar chart or sidebar in Times and you think a rounded box looks good, use it. Goblins won't descend.

You may also find "boxes" shaped like circles or ovoids. These are mainly used to achieve special effects with pictures. For in-

stance, an ovoid around a portrait creates a cameo effect. In general, avoid circles around text, tables, and charts.

Most layout programs let you stylize boxes, and you can pretty much match style to the effect you want. For instance, a shadowed border gives depth to the enclosed area, adding a dark, detached layer behind it. As a result, it both emphasizes the material and reduces the formality.

Decorative borders. Decorative borders are mainly available on clip art and should be reserved for special circumstances. They're often elaborate, even gaudy, and call attention to themselves much more than normal boxes. You can use these patterns for rules, boxes, or to surround an entire page, as if you want to create an impression of floral ornateness.

Lists

There are several purely typographic ways to break up a page, and of these, lists are among the most common. They convey information quickly in summary form, and they may attract the eye before it actually travels down through the prose.

You can mark off list items in two main ways, according to your purpose:

Bullets. Bullets are:

- Repeated graphic devices
- Often solid black circles (option-8 on *MacWrite*)

Bullets are particularly useful for strings of items of roughly equivalent value. They provide quiet emphasis for each one and can tolerate paragraph-length descriptions. If description goes on too long, the list loses its identity as a list and subheads should replace the bullets.

Numbers. Numbers (or letters) perform two services:

1. They show rank order.
2. They tally items up.

In the first capacity, they indicate priority—of importance, chronology, or some other factor. In the second, they stress the sheer number of items in the list. For instance, if you're arguing in

favor of sending men to Mars and wish to highlight the multiplicity of reasons for doing so, you would generally number them rather than bullet them.

Note that when at least one item in a list forms a complete sentence, you should follow each list item with a period. If the items are all single words or incomplete sentences, no period should follow.

A list can extend all the way across the page and otherwise look very much like normal prose. However, you can also call attention to it with the layout. For instance, if you have one column of text, you can provide two columns for brief bullet items. Or you can place the list to the left and exploit the white space. Independent lists also work well in boxes.

Subheads

Subheads pepper the text to break it up, to help organize it, and often to pique the curiosity and lead the reader on. They're usually set in type that differs from the body text, often boldface or sans serif. Most subheads are one line deep and use almost telegraphic prose. You can use more than one line, but if you do, try not to vary the number of lines too much. In general, subheads should be brief and evocative, not explanatory.

Callouts

Callouts (or *readouts* or *pull quotes)* are usually quotes from the text. They need not be, however. They can resemble epigraphs and cite thoughts of others to illuminate the work.

Callouts can appear in several places. Usually they appear within a column, breaking it up, or nearby in a wide margin, lending asymmetry to the spread. If you're quoting the text, you should place the callout before its actual occurrence there to avoid anticlimax, but you need not place it too far ahead. The reader usually scans the callout long before he or she actually reads down to it. You may have to add these tidbits last, so you know exactly where they are to go.

Like good quotes, callouts should be pithy. Garrulous pull quotes disrupt the column and make the reader wonder what you're trying to say.

Drop Caps

A *drop cap* is the enlarged first letter of a segment of prose. This item goes back to the scribes of the first century, who used it to illuminate manuscripts that may have taken many months to copy.

Historically, drop caps have shown baroque detail: vines and flowers twining about, cherubs peeking out from behind a letterform, Adam and Eve interviewing the serpent in the Tree of Knowledge. There's really no limit to specifics you can apply here, and the reason is that the letter does not have to be comprehensible. The reader can usually deduce it from the rest of the word.

Most drop caps today are more subdued, but they are still a good way to announce the start of a section and spice up the page. They generally work best in a contrasting typeface, such as sans serif. However, there's only one basic rule: Always follow up with several words in normal size but capital letters; it eases transition. A drop cap followed by lower case letters creates a rather sudden break.

There are several kinds of drop cap:

Raised Initial. You can simply inflate the letter from the baseline. It rises above the prose and works simply and effectively (see Figure 12-8). You should make it at least twice the size of the prose, preferably more, though not so large that it opens up a great gulf of white space. This kind of drop cap is the easiest to make on Macintosh software. However, it can cause problems. For instance, a *P* or *V* may create a serious need for kerning which some programs are unable to handle. Be careful, too, that automatic linespacing doesn't shift to accommodate the giant letter.

Basic Drop. You can also drop the capital into the text below. This approach and its variants are the most common, hence the name *drop caps.* It too can look attractive, but once again you must move the text to fit the shape of the letter (see Figure 12-9).

Boxed Drop. You can sidestep the problem of fit by placing the capital letter in a box (see Figure 12-10). Once it's inside, you can play around with the box itself and add border elements and patterns to the white space inside, creating a little object of art. You can go farther and wind vegetation around it or otherwise make it exceptional.

Figure 12-8. Raised Drop Cap

IT WAS THE BEST of times, it was the worst of times, it was the

Figure 12-9. Basic Drop Cap

TO BE OR NOT TO BE, that is the question. Whether 'tis nobler in the mind to suffer the slings and arrows of outrageous fortune, or to take arms against a sea of troubles, and by opposing, end them. To die, to sleep, to sleep perchance to dream. Aye, there's the rub!

Figure 12-10. Boxed Drop Cap

TO BE OR NOT TO BE, that is the question. Whether 'tis nobler in the mind to suffer the slings and arrows of outrageous fortune, or to take arms against a sea of troubles, and by opposing, end them. To die, to sleep, to sleep perchance to dream. Aye, there's the rub!

Margin Drop. You can also place the drop cap in the margin, completely outside the text block. It doesn't look as good, but it may be simpler to execute. Avoid the margin drop if you have too many initial letters like *A* and *W* that angle away from the text.

If your software lacks a drop-caps feature, you may do best by treating them as graphics. In the latter two cases, you can simply create blocks for graphics right on the page. With the first two, you may be able to exploit wraparound.

There are two final considerations regarding these devices. First, they are commonly used to start large sections like chapters, but they can also commence shorter segments. If you use them in the latter context, avoid placing them at the top of the page. The reader would think they introduce a new chapter.

Second, watch out for regular patterns they may create. If you have several per page, they should appear scattered and random. Otherwise, again, the reader may notice the pattern, thwarting the subliminal purpose of the drop caps.

Dingbats

Dingbats are little pictorial devices—arrows, stars, pencils, pointing fingers, triangles, snowflakes, squares, and other symbols. You can

find them on clip art, but they also appear in Zapf Dingbats, which is a font and hence at your fingertips.

The watchword here is *simplicity.* Dingbats come in such profusion and sometimes just seem so cute that it's hard to resist tossing them in everywhere. In fact, you should use them discreetly or your layout will seem self-indulgent. In particular, don't use dingbats to fill up white space, since you could well be replacing a powerful graphic element with jingle bells. Dingbats should serve a purpose.

But they do have many legitimate uses:

Bullets. Bullets need not be tiny black circles. They can be squares, asterisks, or dashes, and dingbats expand the range dramatically, allowing arrows, circled numbers, stars, checks, and almost anything else. Zapf Dingbats alone allows a remarkable range of bullets.

Punctuation. You can achieve fancy effects with stylized exclamation points or quotation marks.

Numbers. Circled numbers, either white on black or vice versa, can add a touch of elegance to your work.

Miscellaneous. Symbols like the club from a deck of cards, a Valentine's heart, a star of David, scissors, a telephone, and the nub of a pen can have an array of decorative uses.

Dingbats are remarkably versatile and you should never forget them. At the same time, however, you should march into this territory carefully. Dingbats are fun, but they aren't always dignified.

Screens

A *screen* is a shape shaded gray. It can have any contours you like and serves as a powerful graphics element, uniting different areas of the page or emphasizing sections of it. For instance, you can fill a box with a light screen to emphasize its contents. This technique is common and effective with sidebars. You can also create a dark screen and place letters inside it in white, in reversed type. If you do so, be sure the letters are relatively large and thick, or the screen overwhelms them. Sans serif is a good choice for reversed type, as the dark background tends to make serifs disappear anyway.

Pictures

The pictorial layout is a somewhat different creature from the text layout. It's the sort of thing you usually find in display ads, and its purpose differs greatly from the text layout.

A text layout usually centers on text, though it may have plenty of graphics. Books are the extreme text layout, but most pamphlets, newsletters, reports, and so on, also involve text layout. They exist to impart fairly lengthy information.

Pictorial layouts, however, are usually one-page or less. They're also butterflies, seeking to attract attention through beauty, special startling effects, or other devices. The considerations which apply to text layouts may be totally inappropriate for pictorial ones. For instance, ragged left, almost unheard of in text layouts, may work fine in pictorial.

A striking photo or picture quickly draws the reader's eye, but you may wonder what makes a picture striking. Part of the secret, of course, lies in the content of the photo, but you can often add drama to it by cropping.

Cropping is to photos what editing is to text. You elide the surplusage. Most layout programs have a cropping tool, but the art here lies in determining what's extraneous and what isn't. For instance, photos almost always improve if you crop out excess material lying all around the main feature of interest, since this act clarifies the focus. You should also cut anything that distracts the eye from the heart of the photo. However, you may want to keep apparently irrelevant material on the "directional" side of the picture. For instance, you can give real impact to a picture of an individual gazing out over countryside by including a great deal of the countryside, far more than you need to convey the key idea.

Be sure to give the picture in your layout a *frame:* It needs enough white space to set it off from the rest of the layout. This caveat can be especially important with runaround type, where you make text follow the contours of the image. It's easy to get entranced with this power and follow the graphic too closely.

Captions

Captions (or *cutlines*) are the brief pieces of prose that describe a photo or piece of artwork. Captions should be closer to the graphic than to the surrounding text, to avoid mixups. They often appear in italics, especially if there's danger of confusing them with body text. They can also work well in sans serif.

Captions normally lie beneath the graphic, where they either extend to its full length, as though justified, or line up to its left or right edge. Captions that poke beyond the graphic look clumsy.

You can also place captions to one side of the picture, at its upper left or right, for more striking effect. If the graphic lies at the bottom of the page, you may also put the caption atop it.

Part 7
Output

13
The Final Product

An artist may make many sketches and versions of a painting before setting down to apply the final oils. In a sense, most of this book has likewise been pure design. With computers, you don't apply ink to paper until the final stage: output.

It's a vital stage. Yet, for reasons noted, it has tended to lag behind the rest of the technology. Printers still may not give you the output you want at the price you want. But the field is changing fast, and new breakthroughs could happen at any time.

Let's begin with the printers commonly used with black-and-white output. The main categories are the daisywheel, dot-matrix, thermal-transfer, inkjet, and laser.

Daisywheel

The *daisywheel printer* is like a computerized IBM Selectric. It works by driving a metal spoke with a bossed character against a ribbon, which in turn presses ink onto the page. As with the Selectric, the letters and numbers reside on a single piece of steel called an *element.* However, the element in the daisywheel resembles, instead of a bumpy globe, a hub with flat spokes sticking out—a *daisy.* (This printer may also have a cup-like element, in which case it's called a *thimble.*) The daisywheel printer is sometimes called a *letter quality printer* because it yields clean, solid characters sufficient for the most important correspondence. It also lets you change the element to gain different fonts.

But the daisywheel has major drawbacks:

- It's extremely slow, the koala of computer printers.
- The printer makes an urgent buzzsaw whine, since the bossed spokes are constantly striking the paper.
- It yields wretched graphics or none at all, since its basic units are usually alphanumeric characters.

The daisywheel printer really isn't a factor in Macintosh graphics.

Dot-Matrix

The prince of the non–laser printers is the *dot-matrix* (or *impact dot-matrix) printer.* This popular, versatile machine still drives a ribbon against the page, like the daisywheel, but instead of striking with preformed characters it uses pins. The pins make tiny black dots that the eye fuses into whole images. Since the dots can accumulate into any shape, the printer renders letters, fonts, styles, and graphics with equal ease.

A drawback to the early dot-matrix was quality. The first dot-matrix printers came with printheads of 7 or 9 vertical pins. A 9-pin printhead yields a resolution of 72 dpi. This was tolerable, but the dots were still visible and letters look porous. An improvement occurred when printers began making two passes over a line, one to the right and a second, slightly shifted, back to the left, filling in the gaps. Such 144-dpi printers are called *near–letter quality printers,* and they heighten the caliber of text even as they slow the speed of printout. But the real advance came with the 24-pin head, which yields characters whose dots are indistinguishable except on close examination. These are called *virtual–letter quality printers.*

Except in the matter of letter sharpness, the dot-matrix humbles the daisywheel in every way. It's significantly cheaper and faster, and its versatility matches that of bitmapped computers. On the other hand, it makes the same irritating noise as the daisywheel. The ImageWriter is an example of a dot-matrix printer.

Thermal Transfer

The *thermal-transfer printer* exploits the pointillist principle of the dot-matrix, but it creates the dots differently. Instead of driving pins into a ribbon, it briefly heats them. The heat is transferred to a special ribbon, with waxy ink that melts onto the page. These machines have several noteworthy virtues. One is silence. They make a slight whir as they print, but nothing like the banshee cry of the daisywheel and dot-matrix. Another is price, often surprisingly low. A third is the quality of its color, which almost glows.

Unfortunately, the thermal-transfer is also a prodigal. It eats up $6 ribbons extremely fast, so you would be buying them constantly. A black-and-white ribbon might last for 75 pages of text, while a color ribbon used for graphics (which require more ink) might be gone after 8–15 pages. In addition, most thermal-transfers require a special smooth, shiny paper.

Inkjet

Inkjet printers work by firing bursts of ink at the page through tiny nozzles. They're swift, silent, and they render graphics very well. In addition, since they have few moving parts, they tend to last longer. However, they generally cost more than dot-matrix printers, though the price of a few has dropped to $500. In addition, the ink can dry in the spouts and clog them if you don't use the machine for a period of time.

Laser Printers

The laser printer goes back to Stanford University in the late 1970s. Professor Donald Knuth had just written the typesetting program T_EX, and people were trying to figure out uses for it. Some theoreticians felt it could help develop inexpensive page proofs without resorting to a phototypesetter, though of course it would need a special kind of printer.

Then Canon announced an inexpensive print engine using lasers. It wasn't a complete printer, but several Stanford engineers believed they could build one around it and exploit T_EX more fully. By 1980, they had invented the first model, the forebear of all laser printers today.

In January, 1985, Apple announced a high-grade model for the desktop: the LaserWriter. This machine came with plenty of ROM and RAM, increased speed, lower cost, and, perhaps most important, the PostScript page description language in the printer's ROM. Since then, laser printers have proliferated.

These devices can print up to one page per eight seconds. They do graphics as well as text, can be almost silent, and render fine detail: 300 dpi or more. Moreover, they can smooth out the steps in curves, rotate prose, perform gradient fills, and offer numerous other qualities unthinkable on conventional printers.

What accounts for this rich capacity? First, let's look at how the laser printer gets its keen resolution. Laser printers use an electromagnetic approach that exploits the principle that positively and negatively charged particles don't mix.

Laser printers start with a print engine. This device works by shooting a laser beam at a rotating drum. A laser beam can be exceptionally thin and fine; as the beam creates the image, that fineness makes for high resolution.

The laser beam has an interesting effect on the drum. The drum has a negative charge, and the beam neutralizes it wherever it strikes. These neutral areas quickly fill with an inky powder called *toner,* which also has a negative charge. The toner is repelled by the rest of the drum and driven into the neutral zones. At this point, there's an image of the page on the drum.

The drum continues to rotate and soon touches a piece of paper with a positive charge. Since positive and negative attract, the toner jumps from drum to paper. The paper slides between hot rollers, and the heat and pressure fuse the toner to the page. A moment or so later, the printed paper emerges from the machine, still a bit warm.

Most Macintosh programs have drivers that support PostScript. PostScript is used in the LaserWriter and numerous other laser printers, as well as the phototypesetters. There are several non-PostScript machines, and most of them are much cheaper than the LaserWriter. However, the latter machine not only works very well with the Macintosh but remains among the best around regardless of the computer driving it.

When you first turn it on, the laser printer warms up like a copier, conducts a self-test, and emits a slip of paper showing the number of pages the machine has printed so far. It's important to keep track of this data, since you should change the cartridge about every 2,000 to 3,000 copies.

When the Macintosh commences to print a file on the LaserWriter, it first resorts to two pieces of system software: *Laser Prep* and the *LaserWriter Driver.*

The Macintosh downloads Laser Prep into the LaserWriter, where it blows reveille for the printer and tidies it up for work. Laser Prep augments PostScript, helping it mimic the QuickDraw routines found in the Mac's ROM. Since all Macintosh software is compatible with QuickDraw, Laser Prep makes it compatible with the LaserWriter as well.

Laser Prep also contains a dictionary of shorthand PostScript commands. The LaserWriter Driver translates code and moves it to the LaserWriter, where the printer can look up the translation of the shorthand in the Laser Prep dictionary. This approach helps shrink the size of applications, since it lets them use the shorthand.

As part of this service, Laser Prep sets up a scheme within the LaserWriter for naming PostScript fonts. The LaserWriter Driver thus sends the fonts to the machine, and if it recognizes them (that

is, if they're in the printer's ROM or if you've downloaded them into its RAM) it prints them out.

If the machine doesn't recognize the fonts, the LaserWriter Driver performs a little trick of its own: It makes substitutions. For instance, if you try to send a document in New York, it turns it into Times, which New York resembles. If the LaserWriter Driver can't make such a correspondence, it simply prints out the bitmapped information from the screen as if it were a plain graphic.

You can easily hook the LaserWriter up with an AppleTalk cord to the printer or modem port. Thus, you can connect both a LaserWriter and an ImageWriter to the computer at once. When you're ready to print, you pick the one to use by selecting the Chooser desk accessory and clicking the proper icon. Then you select *Print* in the File menu and *Font Substitution* in the ensuing box. Font Substitution induces PostScript to replace those fonts on the display with its own. If you don't click Font Substitution, you wind up with characters as you see them on the Macintosh screen, at 72dpi.

Of course, you aren't limited to the LaserWriter. There are numerous other laser printers available, most of them less expensive. But few can match the LaserWriter, and all feel its cool, broad shadow.

Phototypesetters

One of the many boons of PostScript is that it doesn't restrict you to laser printers, but it lets you work on numerous other systems. Hence, you can take your files to phototypesetters like the Linotronic 200P or 300, for printing of high resolution and dazzling quality.

The phototypesetter (or *imagesetter*) was developed in the 1930s and first sold commercially in 1946. At first, it simply grafted photo-technology onto the old hot-type model of the Linotype. Eventually, however, these machines became computerized. They've proved so quick and versatile at setting type that they've almost driven the old Linotype to extinction.

Computer phototypesetters generate images on *cathode ray tubes* (also called *CRTs* or *screens)* and pass them from there directly to photosensitive paper by one of two means. In the first, the light passes from the CRT through a lens to a movable mirror; the mirror, always shifting, relays the image to its proper place on the paper. In the second method, light passes to thousands of pieces of fiber optics material, which convey it to the paper.

These phototypesetters have great virtues. They work at up to 1,500 characters per second—that's 90,000 characters per minute, a phenomenal speed. They can make 200 fonts or more available at any one time, and sizes can vary from 4 to 120 points. They print pictures as easily as type, producing high quality output of more than 1,600 lines per inch. These machines need less floorspace and require much less training than their predecessors, and they can take direct electronic input.

The two phototypesetters you're most likely to use are the Linotronic 200P and 300. (You may also see the L100, an earlier 1270-dpi model, which the faster 200P replaced.) Both use a helium neon laser and a 68000 microprocessor, the central chip in the original Mac line. They're also compatible with PostScript. The 200P prints at a resolution of up to 1,693 dpi on film or paper which can be 12 inches wide. The Linotronic 300 prints up to 2,540 dpi. These devices cost from about $30,000 to $58,000, far too much for most individuals to buy. However, you can rent these machines at service bureaus, as you'll see below. You may also run into similar phototypesetters by Compugraphic, Varityper, and Monotype.

Phototypesetters differ in several ways from laser printers. They don't use dry toner but rather create the final copy photographically. This process entails chemical development and simply takes a little longer. In addition, since they print far more dots, they need extra time to position them. Hence, an average page without bitmapped graphics can take from three to five minutes.

Moreover, their output looks somewhat different from that of laser printers. It's more extreme: Phototypesetters print light grays lighter and dark ones darker. Hence, it's a good idea to avoid, say, 90-percent screens on a phototypesetter, as they would print pure black. You want to hew much closer to 50 percent. What causes this difference? It's a visual illusion caused by the dot density. The machine prints dots in the same ratio as the laser printer does, that is, a 90-percent screen still has 90 percent black dots. But because they're tinier, they appear to fuse together more tightly. At the same time, dots in a 10-percent screen are sparser and vanish more readily.

Another difference involves the *hairline*—the thinnest possible line you can demand. On the Macintosh screen, a hairline is 1/72-inch wide, the width of a single pixel. On most laser printers, it becomes 1/300 inch, and on the Linotronic 200P, 1/1693 inch. The

latter is almost invisible, so if you want to do hairlines on a phototypesetter, you may want to make them a little thicker.

The machines also print grayscale much, much better. Why? As we noted at the outset of this book, a grayscale monitor suggests much sharper resolution than black-and-white, because for a monochrome monitor to achieve the same effect, it would require exceptional finesse. The phototypesetters actually provide such resolution in the realm of print. We can see more clearly how it all works by looking at the halftone.

Printing Photos: The Halftone

To reproduce photos, you have two choices. You can scan them, place the digitized image in the document, and print. Or you can simply give the photo to the offset printer, who then creates *halftones* from them and strips them directly into the plate. What are halftones?

Normal photographs show what printers call *continuous-tone images.* That is, they convey shades of light and dark by varying the amount of chemical reaction on the negative or print, showing a near-total range of grays. But early printing was an either/or affair. Printers inked a part of the page or they didn't, and they needed an either/or technique to reproduce photographs as well. Hence, in the nineteenth century most graphics were rendered by *photoengraving*—essentially line art—which conveyed the essence of the picture but not the full-flesh life of it.

The halftone was a major breakthrough in the printing of pictures. Invented by Stephen H. Horgan, it debuted in the *New York Daily Graphic* on March 4, 1880. The paper printed a halftone of shacks atop some snowy rocks called "A Scene from Shantytown." It proved a sensation.

The halftone is basically a photo of a photo, shot through a screen. The result is an illusion, in some ways like that of the Macintosh screen. The halftone, too, employs a grid of evenly-spaced dots. However, instead of simply varying their number, it varies their size. In dark gray areas, the dots grow so large they overlap, crowding out almost all the white. In off-white areas, the dots shrink almost to pinpoints.

Like computer screens, halftones differ in their sharpness, or *resolution,* and again the difference is a matter of dots per inch. The denser the dot grid is, the finer the picture. With halftones, the fineness of the screen determines resolution. A screen with 85 lines

of dots per inch yields a resolution of 85 *lines per inch*, or *lpi*. (Just think of lpi as dpi, and you won't be confused.)

Most newspaper photos use halftones with 65 or 85 lpi. You can see the dots easily, though you don't notice them at a casual glance. Newspapers emphasize fast delivery of news to readers and use a coarse wood-based paper that would make denser dots run together. Magazines, on the other hand, stress quality over speed and use better paper. As a result, they generally have screens with 120, 133, or 150 lpi, or even more, and their pictures are much finer. Top quality printing allows halftone images of up to 300 lines per inch, a resolution so fine the dots virtually disappear.

For the highest quality reproduction of photos, it still makes sense to go to an offset printer, for halftones of the photograph, and then strip it into the rest of the page. It's also usually cheaper. Computer technology is advancing in this area, but it hasn't fully arrived.

Of course, the difficulty with this approach is that you leave the desktop. For smaller runs and less formal documents, what do you do?

You can resort to *digital halftones*. PostScript sends signals to the printer to create halftones, or rather halftone substitutes. Laser printers cannot render real halftones, because they can't vary the size of the dots—they can only aggregate dots in different numbers to mimic halftones. But phototypesetters can give you halftones. What's the difference?

It's a matter of resolution. With laser printers, the resolution isn't high enough. Here's how the laser makes halftones: It first sets aside a series of squares made up of dots. If the square measures 4 × 4 dots, there are 16 places for dots, and 16 possible numbers of dots per square. Hence, you can get 16 levels of gray. If you now expand the square, you get a greater number of grays but less resolution. Why? The larger the square, the fewer squares on the page. A 4 × 4 cell yields 75 lpi, newspaper resolution, but only 16 grays. A 6 × 6 square gives 50 lpi, which is noticeably grainy, but 36 grays. An 8 × 8 cell produces 37 lpi, an extremely coarse resolution, but 64 possible grays.

In general, of course, you should choose the combination that best suits your purpose. But if the image has fine detail and little contrast in shade, it would probably look better with high resolution and a low number of grays.

Plainly, the key limitation here is the 300 dpi. As the dpi of the printer increases, digital halftones become more feasible. At the level of the phototypesetters, the problem almost vanishes. An L100 with a dpi of 1,270 permits halftones of 133 lpi and 92 grays, good enough for a great many purposes though still slightly inferior to traditional halftones. An L300 with 2,540 dpi allows 150 lpi and 256 grays.

Printers are currently in the works to render grayscale directly by varying the size of dots. Moreover, some companies are at work on thermal-transfer printers that actually vary the intensity of gray of each dot. These machines remain on the cutting edge so far, but it could be that fairly soon they'll become one more tool on the workbench of the graphic artist.

Color Printing

Then there is color. Color printing is far more complex and difficult than black-and-white or even grayscale, which just involve the presence or absence of ink. Color entails at least three different kinds of ink added together.

It's also impossible to get true color correspondence between the screen and printout. Why is there no WYSIWYG? For one thing, color printing involves a different color scheme than color monitors. As we noted at the outset, RGB monitors work by mixing red, green, and blue; but most printing works by mixing yellow, magenta, and cyan (and usually black). There are thus inherent problems in translation.

Moreover, the image on the screen ultimately defies pinning down, so we're forever somewhat uncertain of the material from the start. For instance, you can easily increase the screen's brightness but the image on paper is fixed, and hence some differences creep in no matter what happens.

Finally, there's the problem of resolution. To match the 300 dpi of the black-and-white LaserWriter, say, a color printer must have far greater resolution because it uses dithering. It creates colors by placing varicolored dots next to each other and letting the eye fuse them together. Hence, one dot of color actually needs several dots to create it. (It's analogous, in some ways, to the dots each pixel on a computer screen needs to render color.)

Currently, as with grayscale halftones, the more colors you wish to print, the more dots per color you need to create them, and hence the more resolution you lose. Thus, a 300-dpi color printer

does not give at all the same resolution in color as in black-and-white. The film recorder offers one way out of this difficulty, but it's a fairly specialized machine. Let's look first at the printers.

Dot-Matrix

Impact dot matrix printers can render color by providing different bands of color on their ribbons and making several passes. For instance, the ImageWriter II uses a color ribbon with blue, red, yellow, and black stripes. It can print only seven colors—a meager palette—and hence is none too accurate. For instance, where the color onscreen is, say, magenta, the printer yields a dark pink. It prints at 144 dpi and can extract color from the most basic Macintosh model because the original QuickDraw provided for seven colors (blue, cyan, green, magenta, yellow, red, and black), with the nonblack colors appearing as white onscreen. You can create other colors as well, with programs that do dithering such as MacDraw II. Color ribbons may not last long, since darker ink tends to rub off the pins onto the yellow stripe, and, if you don't use color much, you may use up the black band before the others. However, dot-matrix printers are relatively inexpensive, as is the ribbon price of about $15. The ImageWriter LQ renders up to 216 dpi, and its ribbons cost about $30.

Dot-matrix color printers are most useful for adding one-color highlights to documents or printing in monochrome, such as all blue. The narrow range of colors and low resolution limit these machines's use for most other purposes, such as color proofs, and they don't print well on transparent film.

Thermal Transfer

Most of the color printers now used are thermal transfers. They generally have resolutions of 200–300 dpi and employ dithering to achieve their spectrum. They yield proofs of sufficient quality for slides from a film recorder, though dithering makes them inappropriate for camera-ready art. However, they require a special slick paper, which may make them unsuitable for some jobs. They can still be used for some low-volume publishing. They issue a page in about a minute, and cost around 50 cents per page.

Some of these machines support PostScript. The QMS ColorScript 100 does, and since it yields 300 dpi, it rivals the LaserWriter in black-and-white. It gives fairly good proofs for the phototypeset-

ters, though because of dithering the colors still don't match. Unfortunately, this machine is very expensive, costing around $22,000.

QuickDraw-based thermals are compatible with a much wider range of software, though that situation is changing. The QuickDraw machines are also much less expensive, selling for around $9,000 at the high end.

Inkjet

Inkjet printers may be the wave of the future. They currently embrace a wide range of printers, some equivalent to the ImageWriter, others more expensive proofing devices.

A low-end, color inkjet printer like Hewlett-Packard's HP PaintJet can print at 180 dpi, a bit higher than the 144-dpi of the ImageWriter II. In general, such machines lack the resolution and range of color for proofing or camera-ready art, though they render transparencies better than the dot-matrix. Their ink can bleed in newsprint, so they normally require a special paper. On the other hand, ink does not become contaminated as in dot-matrix ribbons. The cost of printing a page is similar to the ImageWriter, and the pace is about as slow.

At the high end, these machines change their nature quite pleasantly. They can render color well enough for proofing, transparencies, low-volume publishing, and moderate-quality camera-ready art. The Iris 3024 from Iris Graphics can even change its dot size, à la halftone. It yields up to 300 dpi, and each dot can be one of 34 hues. The machine can print on almost anything, including cloth, and its output approaches that from high-quality, four-color process printing. Per page, it's also very inexpensive. Why hasn't it conquered the world? It costs around $75,000 and weighs 400 pounds.

Nonetheless, inkjets seem to offer the best capacity for evolving into reasonably priced, good-quality color printers, and they could be well worth watching.

Film Recorders

Film recorders offer one way around the bottleneck of color printers, since they work by actually photographing the Mac display. These shoebox-like machines produce 35mm slides and can yield up to 4,000 × 2,700 lines on a single slide, a fantastic increase in resolu-

tion over the Mac screen. Unlike most forms of color printing, film recorders actually improve on the Mac image.

However, they have drawbacks. It takes a few minutes to create each frame, and even then you must process the slide before you can actually see it. Since processing may take 24 hours, there's a significant delay in feedback. The devices cost around $4,000, and slides themselves have limitations. Though you can turn slides into photos, the process itself is costly and time-consuming.

At least one company, Presentation Technologies, has announced a color transparency camera to work with film recorders. This device, which sells for about $900, yields both instant color overheads and instant photos, and may well enhance the popularity of film recorders in general.

Color Separation

The term *color separation* actually refers to two distinct processes: *spot color* and *four-color process.* The first is simpler and easier to understand but suffers some severe restrictions. The second is harder to understand and to effect, but it yields excellent quality.

Spot Color

Spot color separations (also called *overlays* and *mechanical separations*) usually involve the mere addition of one or two colors to the printed page. For instance, a red logo printed in the upper right of a page of black-and-white text would constitute spot color.

These are simple to carry out. To obtain the red logo, for instance, you would print out the page once (with a laser printer or phototypesetter) to show only the black text and a second time to show only the logo. Both printouts would be black and white. Then you'd pick the colors you wanted from a book of Pantone Matching System (PMS) colors, the standard in the field, and trot them down to a printing establishment. There, the firm would make two separate plates and print out, pressing each sheet of paper first to one plate and then the other.

Spot color is sometimes called *custom color,* because it works in the premixed ink of the color you select rather than creating colors by fusing four basic colors. Since the method is simpler, fewer things can go wrong with it and it's much less expensive. It does, however, restrict you to one or two colors in additon to black and white.

Four-Color Process

Four-color process separations are the route to some of the best color available. The color photos in slick magazines are usually printed with this method, and it can yield virtually any color in existence, with the exception of a few, like silver, which require special dyes. How does it work?

Intriguingly, this process also relies on the halftone. In fact, it's the color equivalent of halftoning. You've seen that halftones can capture most of the grays between black and white. In four-color-process separations, we use four halftones—cyan, magenta, yellow, and black (*CMYK*, with *K* for black)—and print from each onto the same sheet of paper. Why does this work? The halftone for cyan, say, can express almost any hue between white and very dark cyan. The other halftones can, too. Since each has remarkable range, you can mix them in any degree you want and gain almost any color.

Printed, the colors appear as separate dots in clusters or *rosettes* near each other. The ranks of dots must be angled precisely to each other for the effect to work. Otherwise, you get the interference patterns called *moiré*, and the viewer senses something amiss. Moiré appears most often in areas with a substantial amount of black (which makes the moiré more apparent), in scanned images, and in areas of graduated color, such as fountains.

As you saw earlier, fountains are zones of transitional color where one hue smoothly changes into another. The seamlessness of a fountain depends partly on the number of hues in the transition. With a few hues, bands are plainly visible; with enough, the change appears flawless. Hence, here you want to optimize the numbers of shades or colors you use. Since a low lpi, such as 120, enables a greater number of hues, you may want to use it in combination with a high resolution printer like the L300. You can also improve quality by shrinking the fountain's area, thus thinning the bands, and by reducing the range of transition from first color to last.

Moiré can also arise from the sheer inability of the output device to set the proper frequency. It's often highly difficult mathematically, so the machine makes its own adjustments, which can cause the problem. Moiré is more common in the lower resolution devices, because the higher the resolution, the more likely the machine can set the correct angles. However, even the L300 at 2,540 dpi can substitute some angles for those you specify and hence raise difficulties. On the other hand, moiré is also more common

with higher resolution halftones, since these make more demands on the machine. The lower lpi's, basically 120 or less, have less chance of showing moiré.

These color separations are difficult to do on the desktop. There's no desktop printer that renders top-quality four-color separations. Those available tend to give you somewhat grainy, jagged images. Normally, you take a disk into the phototypesetter, get four different halftones (each looking black, but in different patterns), and take it to a printer who can do four-color process.

Draw programs lend themselves best to color separations, because they specify colors by breaking them down at the outset. For instance, red is 40-percent yellow and 100-percent magenta. This approach is called a *tint build* by printers, and the information is obviously easy to use to create the separation.

Tint builds are extremely useful. Among other things, they go far toward letting you check color correspondence in proofing. You can purchase a book with charts of process color combinations, select your color, then enter the percentages that yield it. The color onscreen will differ, but it's not the important one.

Some paint programs can perform the same trick, though often the final result may look a little different from what you anticipated. They particularly have trouble separating color scans, and they may be prone to moiré. As the field advances, the software is improving in this area, but if you have qualms, check the manufacturer or software reviews in reputable magazines.

With true color separation, you may also want to pay some attention to black, especially if you're printing out a great swatch of it. Not all blacks look alike. A straight 100-percent black can look dull, and if it overlaps with other colors, particularly yellow, its color can change. For a richer, shinier black, add small amounts of the other primary colors, about 20 to 30 percent.

If you're printing with offset, you can specify too much color for the page. The result is disaster. When the presses apply excess ink to the paper, it can get too wet, dry incorrectly, and even be torn by the press. Moreover, the ink can shift from one cylinder to the next, and subsequent inks may not stick to the paper. For such reasons, if you ask for too much ink, the printer may simply refuse it.

The Specifications Web Offset Press Publications (SWOP), a printing industry group, recommends no more than a total of 300-percent color anywhere (which results in black anyway), and that

only one color be printed solid, usually black. For newsprint, which absorbs ink much more readily, the numbers are far lower. In any case, you should try to stay as far away from 300-percent as is feasible.

With paint programs, though, you may not even know you're exceeding it. There is a process called *undercolor removal* (UCR) which subtracts a particular portion from the three nonblack colors to prevent too much inking. The separation utilities program with *PixelPaint Professional* provides this useful capacity, as do a few other paint programs, but so far it remains uncommon.

Shortcuts to Color

Finally, there are a few shortcuts to color, even with the Mac SE and Plus. For instance, several graphics programs let you issue color commands for later printout. That is, you can tag shapes on the screen as certain colors, and though they still appear in black-and-white, the program prints them out in color. It's an awkward way to work, since there's little feedback, but it's better than nothing.

Kroy Color Plus allows you to apply color after the fact. It can color places on the paper where the laser printer or copier has applied toner. You place a color film sheet over those black areas you wish to color; run both through the Kroy processor, which applies heat and pressure; and remove. The color adheres to the black areas only. If you just wish to spot-color certain areas, you can use scissors to cut the film and self-stick notes to hold it against the paper.

Perhaps the least effective method is to purchase toner of a different color for the laser printer. Such toner is available, but it costs more than black and, of course, still restricts you to monochrome. Instead of black line art, for instance, you would get blue or green.

Essentially, then, it remains difficult to print out high quality color graphics from the desktop. As in most parts of the computer field, the technology here will almost certainly develop and prices will descend, but for the moment they are stratospheric. The technology is in its infancy.

Renting Printers

The phototypesetters are PostScript machines, so they can link up directly to the Macintosh via AppleTalk. Thus you could buy one

and use it like a LaserWriter. You probably won't—they cost tens of thousands of dollars, so there isn't much point in it unless you're typesetting constantly. You may even find a laser printer too costly, especially if you don't often need its services. What can you do?

The answer is that you can rent a printer, and very easily. A number of typesetting services, copy shops, and print shops are installing them and linking them to on-site Macs with AppleTalk.

Despite the general convenience, problems can arise. For instance, you may have to bring your application program along. If you own a Mac, you may have to take your system software down, too, as the version of the system can matter. In addition, sometimes difficulties occur when documents developed on Macs with the original 64K ROM are inserted into the firm's Mac Plus or enhanced 512K Mac with the newer 128K ROM. The earlier ROM uses whole pixel spacing, the newer one fractional, and this distinction can cause headaches. Be sure to call the firm in advance to find out exactly what it can do and what you need to bring.

If you have a grayscale image, it can easily exceed 1MB in size, and you may find it takes up too much room to put on a floppy disk for transport to the service bureau. If you have *ImageStudio,* you can solve the problem by saving it in a RIFF format, which compresses the file. There's also a shareware program called *StuffIt* that compacts files. Otherwise, you may have to split the image and carry it down on separate disks.

A number of shops ask you to appear with PostScript files. You can generate PostScript code from Macintosh layout programs by pressing Command-F. Straight PostScript files sidestep many compatibility problems.

There are a number of things to keep in mind when renting a phototypesetter. A paramount concern is saving time on the machine. A typical charge is $7 per page, plus a rate of $10 per hour. Hence, you don't want to set the device spinning for hours. You can use several tricks to minimize time.

- Use draw programs instead of paint programs, if you can. The phototypesetters handle object-oriented graphics like those from *MacDraw II* and *Illustrator 88* much faster than bitmapped graphics from *MacPaint.*
- Avoid stacked images. If your draw program has multiple, hidden layers, the phototypesetter prints only what's visible on top, but PostScript still describes all the layers beneath, to no purpose.

- Proof the document as carefully as possible first on a dot-matrix. Time spent proofing at the service bureau is costly.

Finally, if you're using a phototypesetter for the first time, by all means avoid a deadline rush. Initially, it will be something of an experiment. It may take longer to finish than you imagined, and you may encounter odd glitches that sabotage the work. Give yourself plenty of time, and you'll soon be feeling like a master printer.

Telecommunications

You don't necessarily have to take your document physically to the print shop to use a phototypesetter or a laser printer. A number of firms now provide laser printing and phototypesetting over the phone lines. You send the document in over the modem, and the firm at the other end prints it out and mails it back. You should contact the company in advance to determine rates and method of operation, as some documents require special code and formatting. The turnaround time in some cases is as short as 24 hours.

Mass Print Runs

Mass reproduction is the difference between printing and publication. The laser printer is, of course, a printer and readily clones your pages. But there are a number of reasons why you may not want it for your printing needs.

One is inherent capacity. The laser printer works fine with, say, a few copies of a letter. But it's not designed for mass print runs, which may wear the machine down before its time and will certainly use up toner. Hence, if you must print, say, several hundred or more copies of your publication, you should turn elsewhere.

The laser printer is also relatively slow compared to a rotary offset press, and if your publication is time-sensitive, you may want the heavy-duty approach. Moreover, the laser printer doesn't handle 11 × 17 inch sheets of paper. In general, the laser printer gives good templates, but if you want mass runs of any scale at all, you should consider other methods.

There are three main approaches to larger runs: photocopying, quick printing, and conventional offset printing.

Photocopying is the simplest, and requires the fewest extra decisions after you opt for it. It's also approaching the others in quality, and can prove highly satisfactory. Quick printing is a fast form

of the more conventional offset, and both require decisions about the kind of plate, paper, and paper feed to use.

Photocopiers

The days of the blurred and odorous image from the library copier are long past. You can now print documents with photocopiers that rival those from offset. It's a startling development, and you can't assess it from the everyday copying you may do. You have to investigate the high end, where some models, particularly Kodak's, really shine.

Copiers have some significant advantages over offset. They are exceptionally fast. You can run off a few hundred 200-page books in two days, whereas on offset it might take 10 days or two weeks. They can automatically collate pages, whereas conventional printers must do so by hand. They can automatically bind pages, either side-stitching with staples or creating a perfect binding. They render halftones almost as well as conventional printers. And the cost has dropped fast. For a print run of over 10,000 sheets—fifty 200-page books—the per-page cost could hover around 2.5 cents, for a total of $250, or $5 per book.

Photocopiers have some disadvantages. Once you print over 20,000 sheets—one hundred 200-page books—they become much more costly than offset. They're still generally confined to the 8½ × 11 inch format, so they don't let you saddle-stitch 11 × 17 inch pages. And, though the quality of their print and halftones is good, it still can't equal that of an offset press.

Quick Printing

Quick printing is a booming field. Quick print shops have sprung up like mushrooms in business districts and shopping centers all over the country. They're popular because they offer a fast, convenient way to duplicate hard copies.

Here's how it works, in a nutshell: You bring in an opaque original image, such as a flier, that you may have created on the LaserWriter. The printer carefully positions it on a camera copyboard and takes a picture of it on a special photoemulsive plate. This plate has a hardened image area that accepts ink and an undeveloped nonimage area that holds water.

The plate is self-developing, like a Polaroid, and takes only a few seconds. Then it goes right to the rotary press. Thus, as the name suggests, quick printing can take place while you wait. More-

over, since the technique eliminates the intermediary of film, it's inexpensive.

Offset

We tend to think of photography as a way to take pictures. It is in fact a whole technology, and one of its greatest impacts has been in a field ordinarily hidden from the public eye: offset printing.

Before photography, printers used straight rotary presses. These featured two large cylinders that turned in opposite directions and between which paper slid. The setup resembled two rolling pins squeezing dough between them. The printer strapped cold relief type onto the cylinder, which inked and pressed against the paper to create the image. It was a bulky, complicated business.

Photography allowed the fast creation of plates that could be wrapped around the cylinder to be used as print masters. They proved so effective that they soon came to dominate the offset rotary process.

Offset printing begins with a camera-ready item, a final image—say, a page from a laser printer. The printer places this page on the flat copyboard of a large and elaborate process camera, and takes a shot of it. But the plate is much larger than a single page. Each page of a book may have a separate piece of film, but the plate may hold an entire *signature* of 32 pages. Hence, the printer joins together all pieces of film that go on one plate, a delicate and sometimes painstaking operation called *stripping*. Once the printer makes the lithographic plate, he wraps it around the plate cylinder of the rotary press, and the press run can commence.

If you want first-class work or if you have a longer job, offset printing is probably best for you. The printer takes your work; photographs it; strips it to make a plate of 4, 8, 16, 32, or 64 pages; and then runs it off. The printer can also insert halftones for you.

Paper, plastic, and metal plates are all available for the final image, and the one you select should depend on the kind of run you want. Paper plates are inexpensive but wear out after a few hundred copies. Metal plates last much longer but cost more.

Rotary presses have two kinds of paper feed, and you may have to decide between them as well. *Sheet-fed presses* take paper one sheet at a time. Most quick print shops do offset printing with sheet-fed presses, which can be relatively inexpensive. Sheet-fed presses are best suited for handouts, memos, and others items that lack halftones and require no more than several hundred to several

thousand copies. The higher-end sheet-fed presses are particularly effective for documents that require finer detail, higher quality, and better color, such as brochures and posters. Some sheet-fed presses print on only one side of the page at a time. Those that print on both are called *perfecting* presses. Perfecting presses are useful for printing over 2000 copies of books, reports, newsletters, and magazines. A sheet-fed press may be essential if you're doing embossing.

The other kind of press is the *web-fed press,* which prints on a long, continuous roll of paper. This device works much faster than the sheet-fed press and commonly prints on both sides of the page at once, a capacity called *blanket-to-blanket.* The web press may be a necessity if you're using lightweight paper, which tends to become ensnarled in the feed mechanism of sheet-fed presses. Web presses are also preferable for runs of over 5000 copies. If you've ever seen a newspaper printing press, it was almost certainly web-fed.

Paper

You may not have thought a lot about paper, but it's a realm all to itself. Paper comes in a remarkable variety of textures, grades, and weights, and some of the terms used to describe one type of paper may mean something else entirely when applied to another kind. Fortunately, you don't have to delve too deeply into this somewhat confusing field, but you should know a few things.

First, there are three basic kinds of paper of interest to you: writing papers, book papers, and cover papers. Writing papers include those used for correspondence and for copier machines. Book papers are used for almost everything else you read. Cover papers are usually thicker and sturdier; they're used to enclose such documents as booklets and reports.

Weight

Weight is a key feature of paper. It's measured by the number of pounds a ream—500 sheets—of a *standard sheet size* weighs. It may sound like a simple and useful measure, but in fact it's a maze. Different papers come in different standard sizes. For instance, writing papers are 17 × 22, book papers 25 × 38, and cover papers 20 × 26. Hence, 40-weight writing papers are thicker and heavier than 40-weight book papers, because the writing papers have less area to spread the weight around.

That's not all. Sometimes the weight isn't measured by the ream but by the double-ream, or 1000 sheets. In that case, you

usually see the letter *M* after the figure. For instance, *100M* indicates that the paper is 50-weight by the single ream.

Bulk

Another vital trait is the thickness of each page, called the *bulk.* Bulk is measured in pages per inch (PPI), so that the higher this number, the lower the bulk. If you had paper that was 2 PPI, it would be plank-size—extremely bulky. If it were 800 PPI, it would have very little bulk. Bulk matters a great deal in book publishing. If you have a relatively brief item like *The Metamorphosis* but want to make it look novel-size and charge novel rates for it, you would want a bulky paper. Conversely, if you have a hefty book like *Tom Jones* and wish to make it less intimidating and easier to tote, you would use a low-bulk paper.

Opacity

Opacity is critical, since it greatly affects quality. There are actually two ways to look at opacity. One is by the amount of light penetrating the page, which is called the *visual opacity.* Visual opacity is a measure of the likelihood that the next page in the book would show through. The other way of looking at opaciy is the depth to which the page absorbs ink, or the *printing opacity.* Printing opacity tells you how much of the print on the opposite side of the page would show through. You can gain this opacity even with very thin paper through special coating.

In general, you want both kinds, particularly in a book or a document with many illustrations. However, opaque paper is more expensive than other kinds, and for fliers or other inexpensive productions, particularly those with print on just one side, a low opacity saves you money.

Finish

Finish may be the single most important characteristic of all, since it controls what you can and can't print on a piece of paper. Overall, book papers are divided into two kinds of finish: *uncoated* and *coated.* The difference between them is that coated papers have been processed to absorb very little ink. They're also generally somewhat more expensive. Both kinds can be waterproofed for use on offset presses, in which case they're called *offset papers.*

Uncoated papers come in the following five varieties, in ascending order of quality:

Antique. Antique papers have the greatest bulk, the roughest surface, and the lowest cost. They sabotage halftones, since their unfinished surface absorbs ink unevenly and causes them to blur. In addition, they don't work well with modern fonts. However, because they resemble handmade papers, they can do quite well with oldstyle or transitional fonts.

Eggshell. Eggshell papers resemble antiques but have a slightly smoother finish and lower bulk.

Machine-Finish. Machine-finish papers are passed between polished steel rollers, a process called *calendering* (with two *e*'s). Calendering gives the papers a smoother finish and lower bulk than eggshells, allowing them to accept medium-grade halftones. It also tends to leave one side of the page a bit smoother than the other. Machine-finish papers are commonly used in certain magazines and books.

English Finish. English finish papers employ clay fillers, which were originally brought over from England. They have a smooth surface, don't absorb ink deeply, and are suitable for the finest halftones. However, they're often more expensive than the cheaper coated papers, and thus are falling from favor.

Supercalendered. Supercalendered papers receive a second calendering from the smoothest possible rollers and are the highest quality uncoated stock available. Like the English finish papers, however, their price is costing them popularity.

Coated papers are generally superior to uncoated. All of them are covered with a layer of fine clay, which is supercalendered to the page. This clay stops ink from migrating into the paper fibers so that it remains on the outmost surface, creating a fine, dense image. They generally come in four categories:

Film-Coated. The least expensive type, film-coated papers have the clay applied at their origin, within the papermaking machine. This approach reduces the brilliance of the coat, so you can easily mix halftones and text, the latter of which can be hard to read on brighter papers.

Conversion-Coated. Conversion-coated papers receive one coat in the papermaking machine, like the film-coated papers, and a sec-

ond one of higher quality later on. They can be treated to yield either a glossy or a *matte* (that is, lusterless) surface. Conversion-coated papers are used for topnotch photography and fine art reproductions.

Blade-Coated. Blade-coated papers are also coated twice but treated so as to leave a matte finish, which strains the eye less than a glossy finish.

Cast-Coated. Cast-coated papers are extremely expensive, so much so that they're often produced by the single sheet, to order. They appear in such high-profile spots as covers for the slickest annual reports and presentation pieces.

Color

The final characteristic of paper is also important: *color.* By color, I don't mean red, green, or blue, but rather shades of white, most of which you can scarcely notice unless you set one kind of paper next to another. Nonetheless, the color of paper influences not only its proper use but also subtler matters, like the effect of particular fonts on the eye.

Uncoated papers are always off-white and come in an array of tints, from warm cream to a chill, almost bluish hue. Generally, the *temperature* of the color interacts with that of the font, giving you great flexibility if you know in advance on what paper you'll be printing. For instance, Bodoni, normally somewhat icy, becomes much more approachable on a cream-colored page. At the same time, Caslon on a cold bright page can develop an odd sparkle.

The coated papers are pure white. Hence, they contrast more sharply with text and reduce the length of time one can read in comfort.

Binding

Once you've printed your material, you may not be done. If you're making a publication, you still have to bind the pages into a unit. Here again there are many options to choose from, and your choice depends upon the length of your document and the quality to which you aspire.

One of the first steps you may take is to have the printed paper *scored.* Scoring creates a slight ridge or indentation, so you can fold much more easily.

Saddle-Stitching

Saddle-stitching is one of the simplest ways to bind pages, and it's useful for booklets and other small documents. You print front and back on 8½ × 14 inch paper, fold it in half, and staple the pages together down the middle. Once saddle-stitched, a booklet opens almost completely flat. You can buy a saddle-stitch stapler for less than $50.

For larger documents like books, you need other kinds of binding. Three types are common: spiral, perfect, and edition.

Spiral Binding

Spiral binding links pages by spirals—helixes, really—of metal or plastic. This binding is not suitable for quality publications, as it suggests the grade school notebook, but it's highly desirable for manuals and other works that must stay open at certain pages for a while. For instance, spiral binding is a genuine asset for books with type-in computer programs. It's also inexpensive; it can run as little as 50 cents per book.

Perfect Binding

Perfect binding is the kind commonly used for paperback books. You fold pages into booklet-sized groups called *signatures.* Then you bring them together, shave the backs off, and apply a flexible glue to the spine. The cover goes on top of the glue. If you look closely at the spine of a trade paperback, you can see where the ends of the signatures have been lopped off.

Edition Binding

Edition binding is generally used for hardback books. It involves bringing the signatures together much as with perfect binding. However, instead of cutting off the ends, you sew them together. Then you apply glue to the spine, top it with a piece of gauze, and paste on the cover. If you look at the back of a hardbound book, you'll see the rounded ends of each signature, like a series of tiny scallops.

Output marks the end-point in the graphics process, and it's fitting that the technology here is in flux. For despite its prowess, Macintosh graphics as a whole remain a prodigy, growing and improving rapidly every year. Impressive as it is, this story isn't over.

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Mastering Graphics on the Macintosh quides you through every aspect of Macintosh Graphics including desktop publishing and presentation graphics. Author Dan McNeill explains the tools available and how to use them to the limits of their power to create attractive, interesting, and energetic Macintosh Graphics.

Though this book focuses more on the elements of design than specific software, it is not without an in-depth discussion of the uses of software packages like *MacPaint, MacDraw,* and *HyperCard.* Inside you'll find . . .

- Techniques to create scripts, charts, visuals, diagrams, and illustrations of any kind
- A thorough discussion of desktop publishing, including explanations of the best use of typography and page design
- Help in choosing the appropriate type and layout for your specific needs
- Information on importing art into your Macintosh via manual copying, clip art, and digitizers

With McNeill's help, you can literally capture reality through the use of perspective, shadow, texture, and color. Macintosh allows you to modifiy input as much as you want *before* producing hardcopy. You are limited only by the bounds of your own creativity.

In *Mastering Graphics on the Macintosh,* Dan McNeill has covered the skills needed to help you create memorable, effective graphics—whether you're a novice or seasoned Macintosh user. MacNeill is also the author of *COMPUTE!'s Quick & Easy Guide to Desktop Publishing.*

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