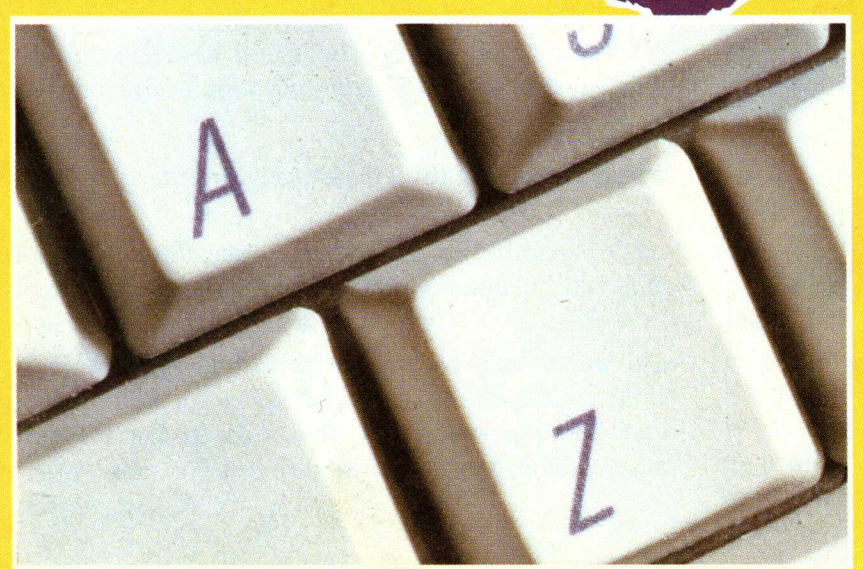
1

Introduction to Microcomputers



Computers: Concepts, Implications, and Applications with DOS 5.0, WordPerfect 5.1, Quattro Pro 4, and Paradox 4.0

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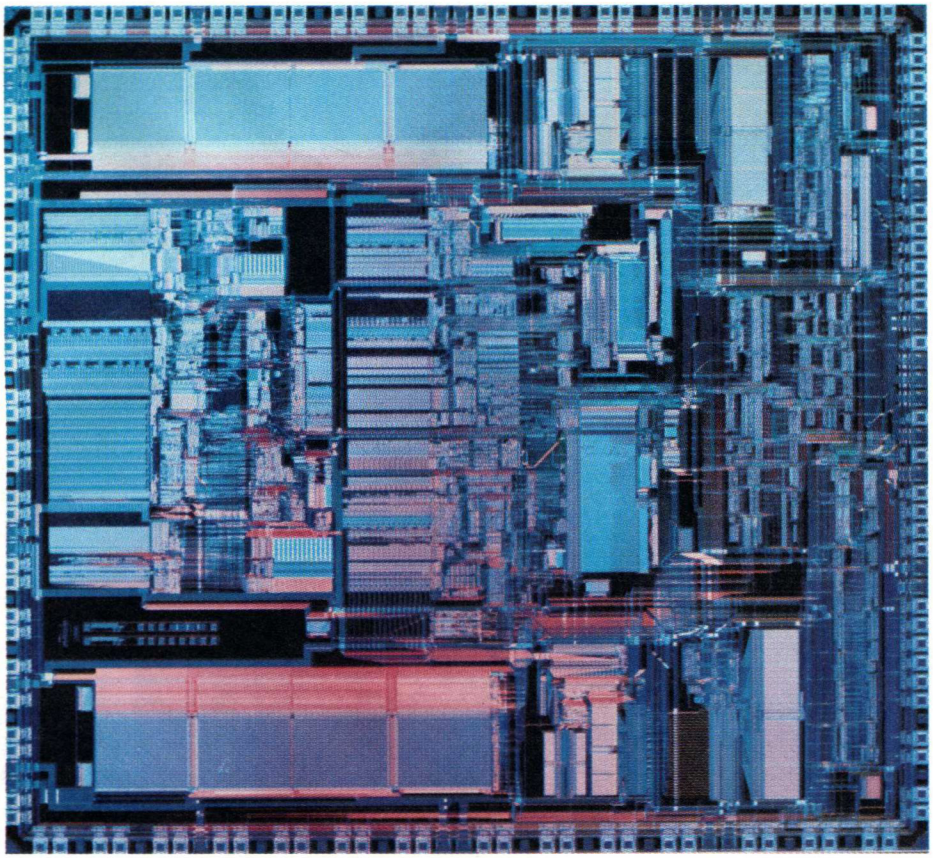


Figure 1-1
The microprocessor lies at the heart of every microcomputer. The invention of a complete "computer on a chip" has not only revolutionized the industry, but allowed computers to permeate modern society.

WHAT IS A MICROCOMPUTER?

There are many different kinds of computers in the world today. Computers are operating at the bank (Figure 1-2), in your car, and at the grocery store. Many of these computers are **special-purpose computers;** that is, they serve specific functions. There are also **general-purpose computers** in the office, at home, and at school, versatile enough to handle all kinds of tasks. The existence of all these different types of computers raises an important question: What *is* a computer? Simply put, a **computer** is a device that processes raw data into useful information. But from that perspective, a typewriter, a calculator, or even an abacus could be called a computer. What distinguishes a computer from other information-processing devices are three basic characteristics:

- A computer is completely electronic. That is, all its functions are carried out with electrical signals.
- A computer can remember information and hold it for future use. Computers do this on a temporary basis with memory circuits and permanently with storage devices such as magnetic disk and tape.
- A computer is programmable. Unlike other devices built to perform a single function or limited range of functions, a computer can be instructed to do whatever task we tell it to do. This opens up a vast realm of possibilities for computers to solve problems for us in everyday life: at home, in school, or at work.

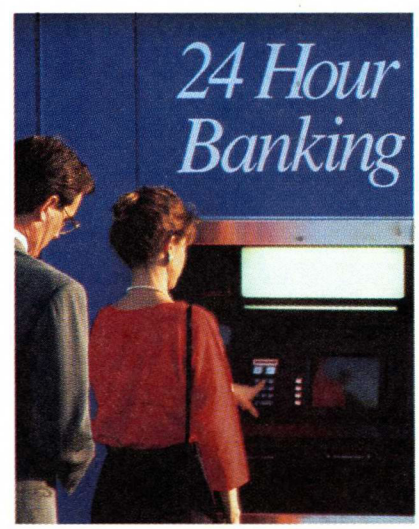
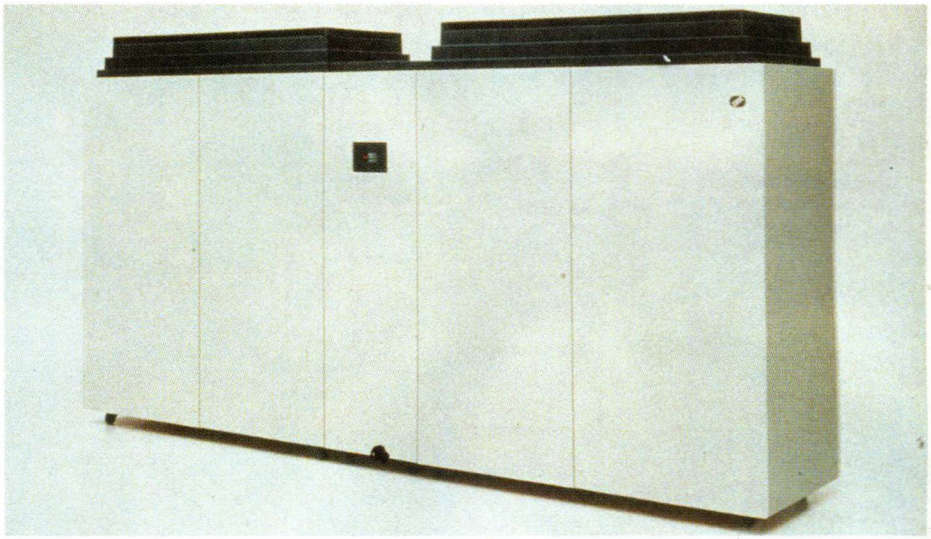


Figure 1-2
An automatic teller machine is an example of a special-purpose computer; it is controlled by computer circuitry that communicates with the bank's account database, giving you access to cash and banking services.

a



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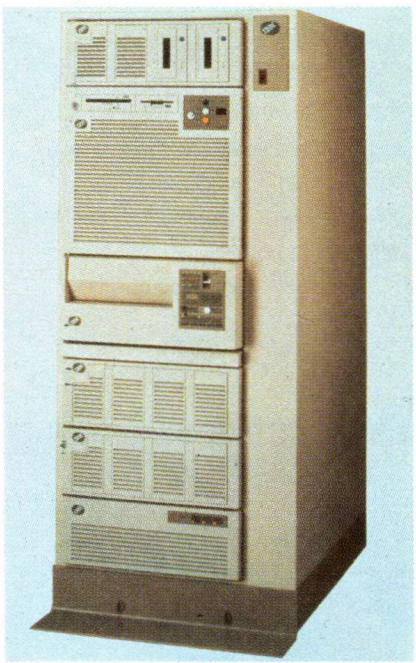

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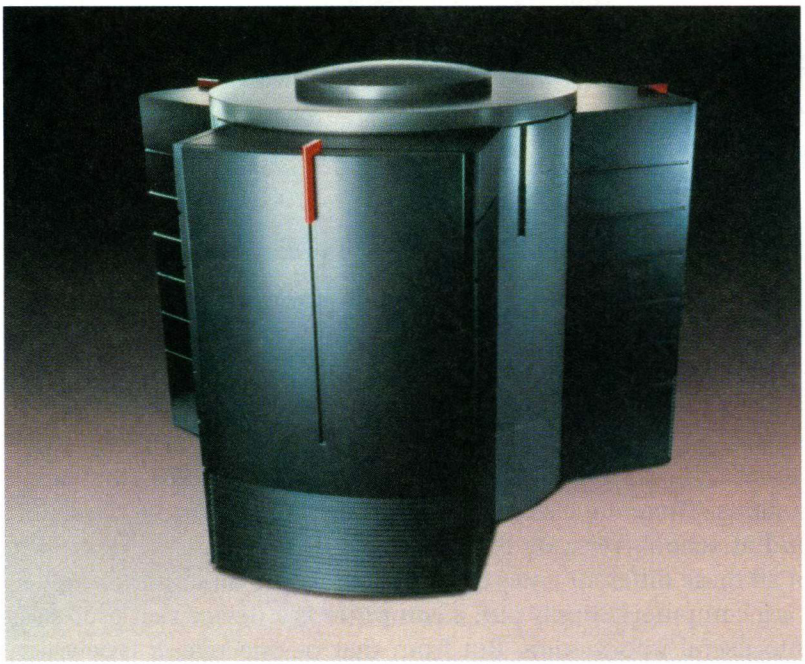

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Figure 1-3
The four types of computers find use in different working environments. (a) Microcomputers are most often found at home, school, or on the desk at the office. (b) Mainframes are typically used in large business, academic, or scientific settings with huge amounts of data where many users need access to the computer. (c) Minicomputers are often used as multiuser computers in business and academic environments. (d) Supercomputers, designed for maximum computing capability, are most often used for research and simulations such as weather prediction, wind-tunnel simulation, and weapons systems simulation.

The most common kind of general-purpose computer in use today is the personal computer or microcomputer (Figure 1-3a). It gets the name **microcomputer** from the tiny electronic device, called the *microprocessor*, that does the actual processing. The use of personal computers has grown greatly during the last ten years. Only a few million personal computers were in use in 1980, so they were a relative novelty. Now there are almost a hundred million in this country alone.

Microcomputers form the most common of the four classes of general-purpose computers; the other three classes are minicomputers, mainframe computers, and supercomputers. Microcomputers, besides relying on a microprocessor, are the smallest and are generally designed for a single user. Minicomputers, mainframes, and supercomputers all use processors built from a large number of components. **Minicomputers,** larger than microcomputers (up to the size of a refrigerator) are generally intended for small- to medium-

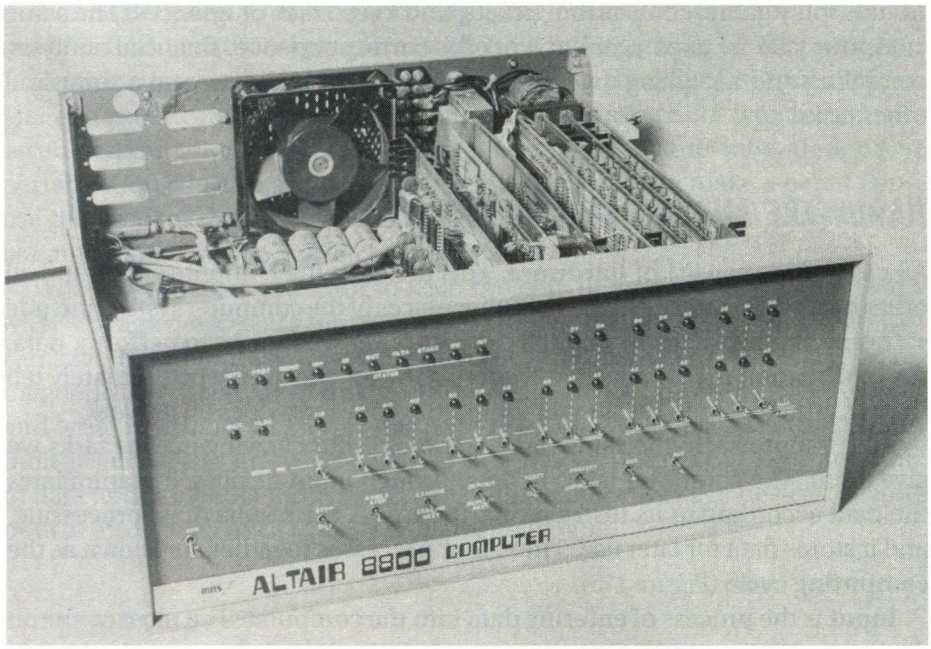

Figure 1-4
The MITS Altair 8800 was the first microcomputer, announced on the cover of the January 1975 *Popular Electronics*. It was based on the Intel 8080 microprocessor and was sold as a kit.

sized groups of users in businesses and other organizations (Figure 1-3b); their processing abilities are more robust than those of microcomputers. **Mainframe** computers (Figure 1-3c) can take up a whole room and can handle the needs of many simultaneous users while processing large volumes of data; they are most often used in large organizations and institutions. **Supercomputers**, the most sophisticated computers (Figure 1-3d), are designed for extremely high-speed processing of huge amounts of data, often using multiple processors working together. They are most often used for performing complex computations by the government, research organizations, and large industrial groups.

WHY FOCUS ON MICROCOMPUTERS?

Fifteen or twenty years ago, most books on computers described mainframes, because mainframes were the most common. Today, though, you are more likely to use a microcomputer. The first micros were sold to computer hobbyists in 1975 (Figure 1-4). In 1977, Apple entered the market with the Apple II, and in 1981 IBM joined the race. Apple released the Macintosh, the cornerstone of its current computer line, in 1984. During the 1980s, literally hundreds of manufacturers began making microcomputers. The competition kept prices down, and millions of people and businesses bought micros.

As the microcomputer industry grew, computer makers constantly tried to lure new customers with more powerful machines. The typical microcomputer sold today can work with more than 50 times as much data as the first IBM PC, and it can work with that data at least 50 times as fast. In fact, many of today's laptop (Figure 1-5) and desktop microcomputers are more powerful than the minis and mainframes that dominated the market only fifteen or twenty years ago.

The power of the modern microcomputer enables it to be used for all kinds of tasks. For a couple of thousand dollars, you can buy a computer and use it to write papers, perform mathematical computations and analyses, and conduct research. At home, you can use the same computer to communicate with

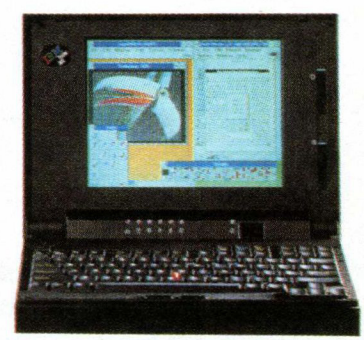

Figure 1-5
It's a long way from the Altair to modern laptop computers based on the latest microprocessors: these have more processing power than many mainframes of 15 or 20 years ago.

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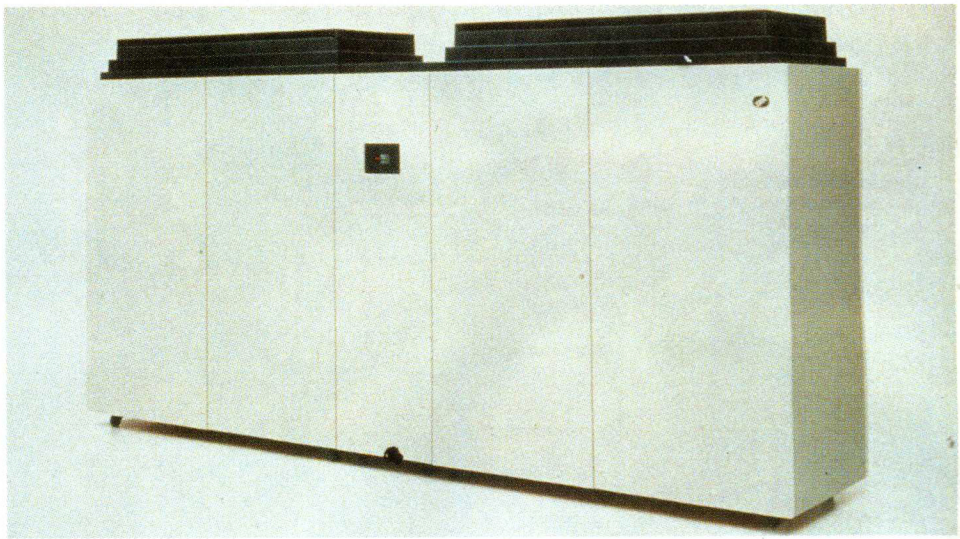

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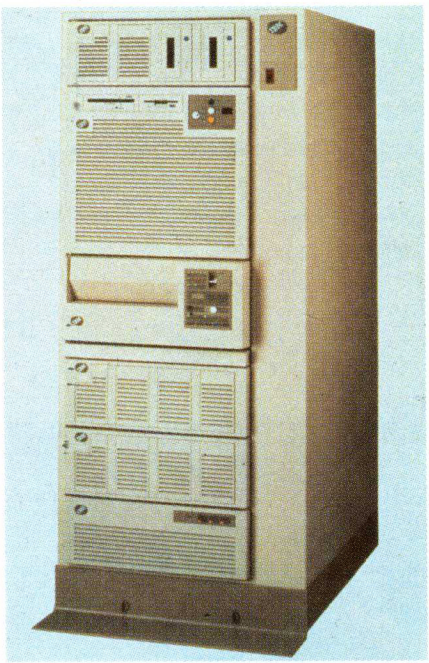

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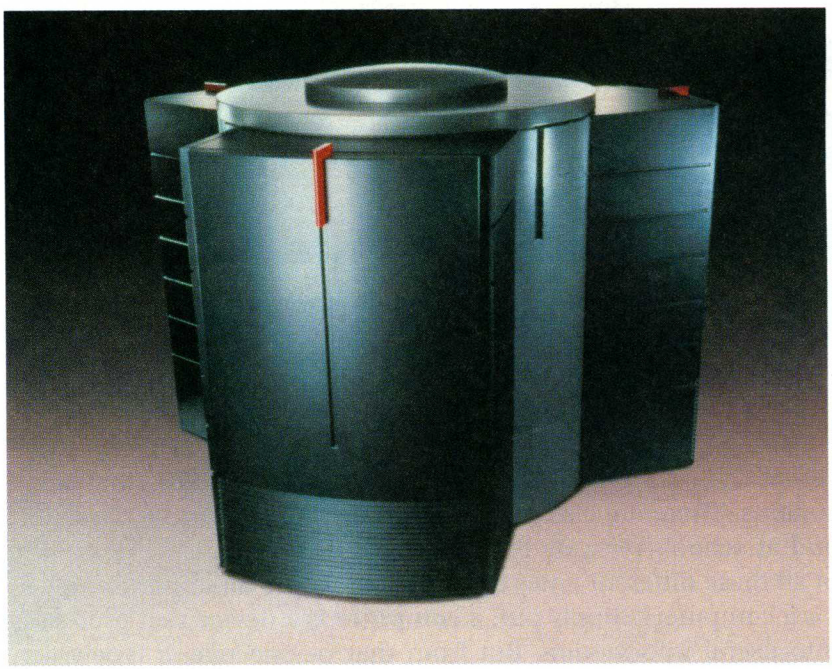

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Figure 1-3
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mation. Associated with the processor is the computer's memory, which is used for storing data and programs while they're being used by the processor.

Getting processed data out of the computer is the job of **output** devices. The computer can display the data on a monitor screen, of which there are several types: color or monochrome, flat-panel or picture tube, desktop or portable. You can also send data to a printer or plotter to make a paper copy, use the modem to send the data over a phone line to another computer, or use any number of specialized output devices.

What do you do if you want to keep the data in a permanent form? That's what **storage** devices are for. Storage devices hold data permanently, so you can save it and retrieve it later. All microcomputers use disks to store data magnetically. Each type of disk is used by its corresponding disk drive to read and write information. Floppy disks are used for easy, portable storage, and built-in hard disks are used for more permanent storage of larger amounts of data and programs for fast access. Other common storage devices include optical discs (such as CD-ROM) and magnetic tape.

SOFTWARE

A **program** is a group of instructions that tells the processing devices what to do. **Software** can be a single program or a set of programs that work together. Because their meanings are very similar, the terms *software* (or *a piece of software*) and *program* are often used interchangeably.

Two types of software are necessary to make the computer capable of performing useful work. They are the operating system and application software. The **operating system** contains basic instructions that tell the CPU how to use other hardware devices, where to find programs, and how to load and keep track of programs in memory. Because it includes basic instructions that are vital to the internal functioning of the computer, the operating system is the first program to be processed after the computer is turned on, and it remains in memory until the computer is turned off.

For the computer to perform useful tasks, it needs application software (Figure 1-7) in addition to the operating system. An **application** is a job that

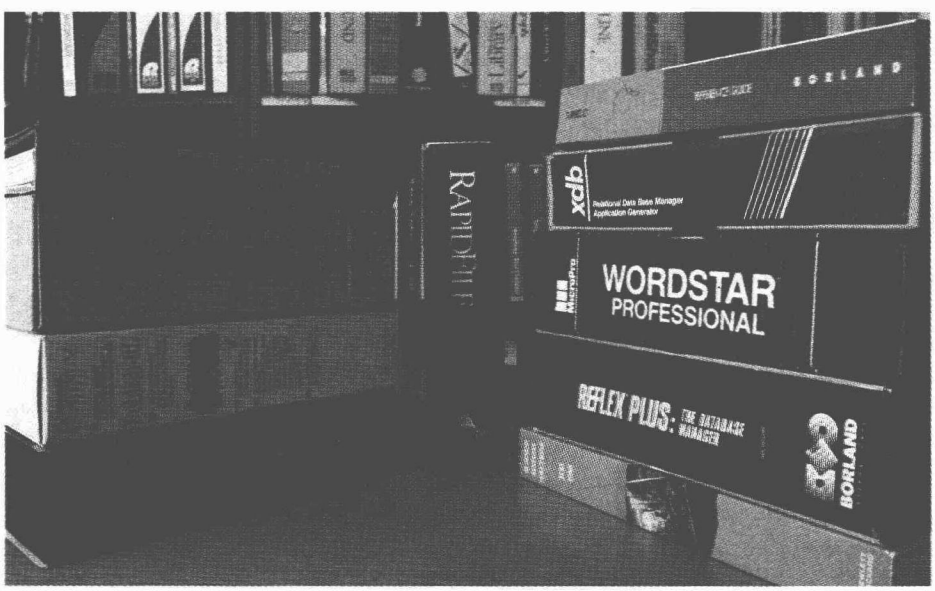

Figure 1-7
The microcomputer's versatility has enabled it to replace many traditional tools.

The Language Barrier

One of the most difficult hurdles facing multinational companies is the language barrier. But software companies face an extremely unusual challenge with the Japanese language because of its complex alphabet. English uses only 26 letters. The Japanese written language uses over 6000 separate symbols. Also, it takes twice as much memory and storage space to hold each Japanese character as it does to hold each English character

The difficulties of translating such a complex language into computerese have been both a help and a hindrance to the Japanese computer market. Their software market has developed slowly because the first computers used English ASCII code. But the Japanese have been way ahead in graphics displays, largely because of the problems associated with displaying complex characters clearly.

Computers and Natural Disasters

Scientists at Livermore Labs in California used computerized wind and weather data to guide Air Force pilots through volcanic ash clouds as they evacuated people from the vicinity of erupting Mount Pinatubo in the Philippines. Over 20,000 people were evacuated. Every 12 hours scientists sent their predictions—which later were confirmed by satellite photos—to Air Force pilots. Earlier, the scientists had computed the path of clouds of radiation released by the explosion of the Soviet nuclear reactor at Chernobyl, which sent plumes of radiation up to 50,000 feet into the atmosphere. More recently, the same team of scientists provided forecasts of the dense clouds made by oil wells set on fire by the Iraqi army as it began fleeing Kuwait during the Gulf War.

friends, play games, buy airline tickets, and keep track of finances. The same computer can be used again at work for correspondence, financial analysis, compiling and analyzing data, communicating with clients, and a thousand other tasks.

HARDWARE AND THE COMPUTING PROCESS

All computers consist of **hardware.** This includes the computer itself and all other related physical devices. The other pieces of the computer system include software, the instructions that tell the computer what tasks to perform; data, the information the computer works on; and you, the user, who ultimately tell the computer what to do, and for whom the computer does all its work.

All computers use the same basic techniques for carrying out the tasks we give them. The computer takes in data through input devices, it manipulates the data according to its instructions, it outputs the results of its processing, and it stores data for later use. These four processes together are known as the **computing cycle** (Figure 1-6).

Input is the process of entering data into the computer. The most common device used for input on microcomputers is the keyboard. Computer keyboards include many special command and function keys to perform specialized input tasks as well as the usual typewriter layout. Other input devices include a mouse, which manipulates a pointer on the computer screen for giving commands and entering data; a scanner, which reads graphic images and pages of text and sends them to the computer; a modem, which receives data over phone lines; and several other devices.

Once data is in a microcomputer, it is **processed** by the microprocessor and its associated integrated circuit chips. Microprocessors perform all calculations and manipulations necessary to transform data into meaningful infor-

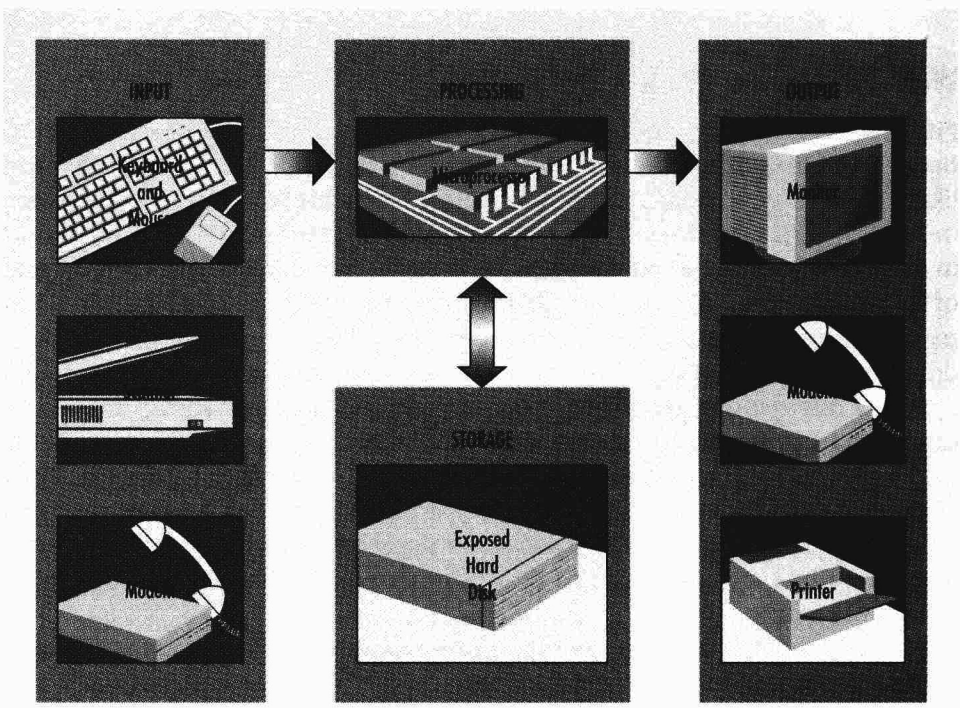

Figure 1-6
The computing cycle. The microprocessor (CPU) receives data from input devices, processes it, and sends the data to output devices for display, printing, or communication. Along the way, the CPU stores data temporarily in memory or permanently on a storage medium such as magnetic disk, tape, or optical disk.

Worksheet3

	A	B	C	D	E	F	G
1			Book Production Costs				
2							
3		Manuscript Development		8,500.00			
4		Marketing		2,150.00			
5		Acquisitions		975.00			
6		Copyediting		1,100.00			
7		Proofreading		1,100.00			
8		Art Rendering		3,780.00			
9		Composition		5,500.00			
10		Text Design		650.00			
11		Cover Design		500.00			
12		Paging		1,500.00			
13		Alterations		8,500.00			
14		Indexing		750.00			
15		Permissions		1,200.00			
16		Output Services		6,500.00			
17		Offset Press Time		18,000.00			
18		Binding		5,200.00			
19		Packaging		9,500.00			
20		Distribution		11,750.00			
21							
22							
23		Total Book Costs		87,155.00			
24							
25							
26							

Figure 1-8
Creating a budget for this book was as simple as entering the numbers in a budget template and having the budget automatically calculated by the spreadsheet software.

Research

With contracts in our hands, we were ready to get to work. Time was of the essence, and we had a schedule to keep. But you can't just sit down and write a textbook off the top of your head. You need to do some research. Fortunately, you can do a lot of research in your home or office with a microcomputer, a modem, and a piece of communications software. A **modem** is a hardware device that lets your computer communicate with another computer over the phone lines. The communications program is the application software you use to control your modem.

We used Crosstalk for Windows to control our modems. With these tools we accessed information services and bulletin boards (Figure 1-9, p. 10), where we could ask questions of other microcomputer users and gain valuable information. If we found information that might be useful to a third party, we used the modem of the holder of the information to send directly to the third party's computer. Not only did we save a lot of time this way, but we also saved a good deal in mailing costs.

The piece of database software called Paradox also saved us time in our research. The only way to keep up with the ever-changing computer industry is to read a lot of newspapers and magazines. Every time we found an interesting or useful article, we entered data about the article in a database. When it came time to write about, say, graphics software, we were able to search our database for all the articles on the subject.

Development

With enough research amassed, it was time to start writing the manuscript. This is where we really put our word processing software to work. We outlined, wrote, revised, wrote some more, outlined again, and revised again. Whenever one of us finished a chapter, he used the modem to send the chapter to the other to check and revise the work. With the help of the word processing program, WordPerfect, we streamlined much of the writing process. For example, we checked our spelling electronically, thus avoiding the embarrassment of

Pedal While You Write

Steve Roberts decided to create a life out of his three passions: travel, technology, and bicycling. The result is the world's smartest bike, the 350-pound Behemoth (big, electronic, human-energized machine, only too heavy), which comes complete with stereo, refrigerator, solar power, and a word processor. The keyboard is built into the handlebars of the bicycle and doubles as a musical instrument. Actually, there are about a half-dozen computers on board, one of which allows Roberts to hook into the Navstar satellite system and pinpoint his location to within 50 feet. There is also a top-notch security system. If the bike is stolen, it can alert the police, and if anything is not functioning properly, it can alert Roberts. What else could a self-confessed "yuppie hobo" want?

Talking Books

Thanks to the rapidly increasing storage capacity of hard disks, as well as the expanded capabilities of CD-ROM, more and more reference books are being issued in electronic format, such as Grolier's Encyclopedia, which has over 33,000 articles and 10 million words. Many of the electronic reference books are more than just books to be read on screen instead of on paper. They utilize computer technology to enhance their effectiveness: *Webster's Ninth New Collegiate Dictionary* talks and can pronounce 160,000 root words. A complete edition of Shakespeare's works is available with texts in both Elizabethan English and modern English versions. Numerous style guides and collections of quotations, literature, and philosophy, as well as databases of historical events, can be accessed in a variety of ways. That's the good news. The bad news is that you still have to write your own term papers.

a computer can perform, such as creating text documents, manipulating sets of numbers, creating graphic images, and communicating with other computers. **Application software** is the term used to describe programs that tell the computer how to perform such jobs. The six most common types of application software are

- Word processing software
- Graphics software
- Desktop publishing software
- Spreadsheet software
- Database management software
- Communications software

Application software is what makes a computer a tool for performing the tasks we most often need to complete at school, at home, or at the office.

HOW APPLICATION SOFTWARE WAS USED TO MAKE THIS BOOK

Because of the variety of application software available, the microcomputer is much more than just a flexible tool. In many cases it can be integrated into every aspect of a complex endeavor. Take the making of this book, for example. Virtually every step of the way, we used microcomputers. To give you a better sense of how a complex process can be accomplished using microcomputers, we'll describe the four stages of making a textbook: planning, research, development, and production.

Planning

Like any other business, making books requires financial planning. Before officially launching the project, the publisher of this book had to project revenue and costs from the proposed book in a budget. Twenty years ago, budgets were created entirely by hand—an unpleasant task considering how many individual expenses had to be figured in. Even worse than creating the budget by hand was revising the budget. Usually, a budget has to be manipulated and fiddled with for quite a long time before the numbers are acceptable. And each time the numbers are changed, all the totals need to be recalculated. Doing budgets by hand was like getting an arithmetic assignment that took a week to finish.

When our publisher calculated the budget for this book, a spreadsheet program helped a lot. The publisher still had to estimate each cost, enter it into the budget, and then plug in the formulas that were needed. But the computer, with instructions from the application software, did all the math (Figure 1-8). If the totals weren't acceptable, the publisher decided where costs could be cut and then changed the numbers, and the totals were calculated again automatically. A recalculation that would have taken a person with a calculator an hour to figure out probably took the computer less than a second.

Once the budget was done, it was time for the publisher to draw up contracts for the authors. Here again, the publisher had application software to make the job easier: in this case, a piece of word processing software called Microsoft Word. The publisher didn't even have to do much typing, because most author contracts are similar. All the publisher had to do was edit a generic contract by filling in the names, some figures, and the dates.

the techniques of **desktop publishing**, or **DTP**. Desktop publishing is a process in which microcomputers, high-quality printers, and advanced text and graphics software are used to produce complex professional documents, such as books, advertisements, pamphlets, and magazines. The techniques of DTP have literally revolutionized the book-publishing industry. Books such as this one can now be produced in far less time and for less money than is required by traditional book-making practices.

As production began on this book, a production manager took over the job of coordinating everyone's efforts and keeping everyone on schedule. To help her in her work, she used a piece of project management software called Microsoft Project (Figure 1-11). Project management software keeps track of schedules, budgets, and vendors. Not only does it help the manager, but it also helps the vendors get paid on time.

The first group of people to be hired by the production manager were the copy editor, the input editor, and the proofreader. The copy editor wrote corrections on the manuscript to make it logical, consistent, and grammatically accurate. The input editor entered the changes into the word processing files, and the proofreader checked the input editor's work.

While the copy editor, input editor, and proofreader were working on the text, an illustrator and a photo researcher were making or finding all the illustrations you see in this book. The illustrator worked with a graphics program called Adobe Illustrator to create the line drawings and another program called Hijaak to create the screen captures. The photo researcher used a database of photos, listed by subject matter, that she created with a program called FoxPro.

When the proofreader, the illustrator, and the photo researcher were done, the manuscript went into page makeup. In this stage, the word processor files and the electronic illustrations were imported into another type of application program, known as desktop publishing software. DTP software is a powerful tool for formatting pages that will be used in books, pamphlets, ads—anything that needs to look professional (Figure 1-12, p. 13). Word processing software contains some of the same features as DTP software, but the latter

A Street Map for the Whole Country

Not all databases are filled with information about companies, business transactions, or scientific research. Some are filled with graphic images, and one new application for such graphic databases involves maps. Street Atlas USA from Delorme Mapping Company comes on a single CD-ROM and has street maps for the entire country—over one million maps in all. The maps include the address ranges along each street, ZIP codes, and area codes, as well as names of mountains, rivers, lakes, and other geographical features, all in full color. Users can search all this data for specific geographical names or street addresses, use a zoom feature to display various levels of detail, and even copy sections of maps onto other documents—all for only $99.

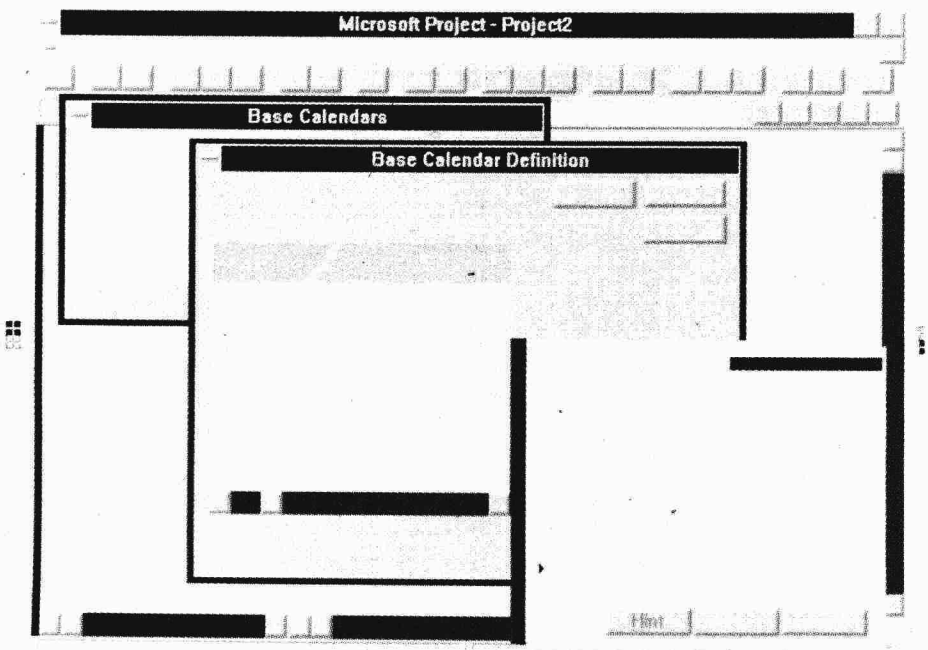

Figure 1-11
Keeping track of all the little tasks related to producing the book was made a lot easier with project management software; we used Microsoft Project.

Intel and the Birth of the Microprocessor

In 1969 a Japanese firm called Busicom was working on a new low-cost, desktop printing calculator. Looking for a custom chip manufacturer, Busicom approached one-year-old Intel, a company that had spun off from Fairchild Semiconductor. It was only one of the new companies that had sprung up dedicated to the idea that the future lay in semiconductors, not in the magnetic core memories then in use.

At the time, Intel had no in-house expertise in random-logic design and was in no position to bid on the project, which would involve approximately 10 custom circuits. However, Ted Hoff, then manager of Intel's Application Research Department, thought the Busicom project was an opportunity to define a small set of standard components designed around the possibility of a central processing unit (CPU) on a chip.

Late that year Hoff and an application engineer named Stan Mazor defined an architecture consisting of a 4-bit CPU, a RAM to store data, a ROM to store program instructions, and several I/O parts to interface with such external devices as a keyboard, printers, and switches. Working with Busicom engineers, the two men also defined and verified the CPU instruction set.

By the following spring, Federico Faggin had joined Intel and begun designing a calculator chip set. While at Fairchild, Faggin had developed a new process, called *silicon-gate technology* for fabricating high-density, high-performance metal-oxide semiconductor integrated circuits. He set to work using this technology on the Busicom project.

With his silicon-gate technology Faggin had to develop a new methodology for random-logic design—something that had never been done before. Since the circuits had to be small, it was necessary to use bootstrap loads, which no one at Intel thought could be done with silicon-gate technology. Once Faggin demonstrated it would work, bootstrap loads were incorporated into the memory designs as well.

The chip set, which Faggin called the 4000 family—consisted of four 16-pin devices. The 4001 was the first chip designed and laid out. It consisted of a 2K ROM with a 4-bit mask-programmable I/O port, and when it came out in October 1970 it worked perfectly. But not until the end of February 1971 did the developers get all of the other chips working as well. In mid-March 1971 Busicom received the full kits of components and verified that the calculators now worked perfectly. The first micoprocessor was a reality.

The designers were full of plans for the chip set, but Intel's management decided that the 4000 family was only good for calculators. Management also pointed out that the product had been designed under exclusive contract to Busicom—it could not be sold, or even announced, to anyone else.

A little later, when the need for a production tester arose, Faggin decided to demonstrate that the 4000 family could, indeed, be used for noncalculator uses. He successfully used the 4004 as the tester's main controller. Intel negotiated with Busicom a lower price for the chip set in exchange for the right to market the 4004 for noncalculator uses. In November 1971, the 4000 family, known as the MCS-4 (for microcomputer system 4-bit) was officially introduced.

Meanwhile, Computer Terminal Corporation (now Datapoint) had asked Intel to integrate the CPU of the company's new intelligent terminal into a few chips and to reduce the cost and size of its electronics. Intel's Hoff came up with a more complex version of the 4004, an 8-bit device Intel called the 1201, later renamed the 8008. Although other companies, such as Texas Instruments, advertised that they had a central processing unit on a chip, none were ever marketed.

Intel introduced the 8008 in April 1972, and two years later the 8080—a vastly improved chip that allowed several applications not possible before—was brought out. With the 8080, the microprocessor had come of age. ■

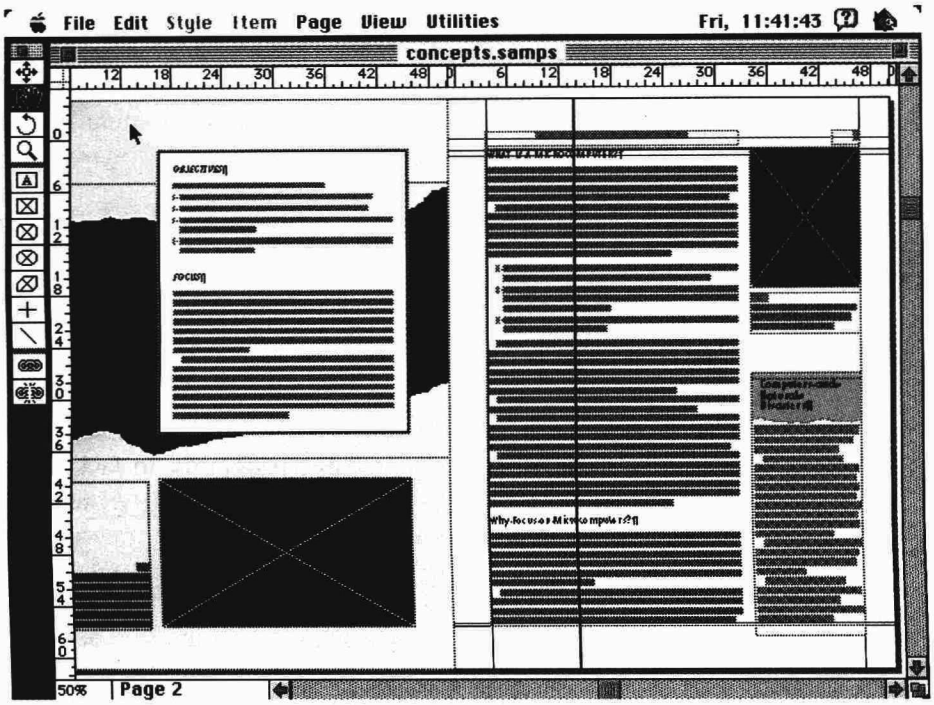

Figure 1-12
QuarkXPress is a powerful DTP program that integrates text and art electronically and prints the pages directly to film.

specializes in text formatting and the ability to combine text and graphics on the same page.

Page makeup was the last major phase of production before printing, although the phase includes several cycles before it is completed. Each cycle is called a *pass*. After the production team members finished each pass, they printed out copies of the book's pages on a laser printer. Different types of quality checks were performed each time a new pass was printed.

Finally, after the last quality check, the book was printed. Even this step involved computers. The laser printer that printed the different passes produced a print of quality high enough to check for errors, but not high enough to print books from. Book printing required projecting the electronic page makeup files onto photographic film. The film was then passed through an offset printer, the printed pages were cut, and the book was bound. Voilà! You see the result before you.

MANY USERS, MANY USES

Publishing, of course, isn't the only business that uses microcomputers extensively. If you look closely, you will find that almost every business has been, at the very least, affected by their use. Equally important are the effects the microcomputer has had on homes and schools. Let's take a look at some of the varied applications that computers have in these three areas.

In the Schools

You have undoubtedly seen a few of the ways in which computers are used on campus (Figure 1-13). For writing papers, typewriters are becoming a thing of the past. Most students find that using a word processor is much faster and far more convenient, especially when it comes to editing and revising. But besides the ubiquitous word processing program, what other types of application software do students use in their studies?

Figure 1-13
Students have found microcomputers to be very useful in nearly all academic disciplines.

Where in the World Is—Who?

Carmen Sandiego, that's who, a now-legendary crook who does things like attempting to steal the Taj Mahal or the original copy of the Magna Carta. She's glamorous, hip, and, thanks to the fact that children interact with her on their computer in a series of bestselling games (sales of over 1 million), she can travel anywhere in the world and visit any time. Oh, and yes, along the way children learn a lot about geography, history, and a variety of other subjects. And that's the real purpose of the games from Broderbund Software. Each player is a detective from Acme Detective Agency and must capture all of Carmen's gang to win. Each game comes with a reference book, appropriate to the storyline, which provides clues. Kids love the games, and parents love the fact that their children are learning—schools have even had Carmen Sandiego Day, complete with an actress dressed as the crook arriving by helicopter. No one is saying where the next Carmen Sandiego game will be set, but there are a lot of people who can hardly wait to find out.

In writing papers, another useful tool is hypermedia software, such as HyperCard for the Macintosh. Hypermedia programs are similar to database programs but less rigidly structured. HyperCard, for instance, allows writers to create a set of electronic note cards and then create links between them. Using such a tool, a writer can work out the structure of an argument or presentation before writing it.

The most widely used application after the word processor is the electronic spreadsheet. In addition to helping students keep track of finances, spreadsheets are invaluable as research tools. This is especially true in the sciences, where empirical evidence is often numeric. For example, if you are conducting a psychological study, the quality of your research depends largely on the number of people in your study. But as your sample size grows, the amount of math involved in analyzing your study grows too. Spreadsheet software is designed to make this kind of work easier. Most programs, in fact, have statistical functions built in. And not only does the software speed the numeric calculations, but with a few commands you can also generate graphs and charts that summarize your data or your analyses.

Another common application used in research is the database. In much the same way that we collected data about articles we read during the research phase of this book, students use databases to organize their own research. Whereas the spreadsheet is good for organizing numeric data, database software is excellent for collecting many kinds of data, including numbers, text, graphic images, and even sound. Once you have collected a large body of data, you can use the software to search through it, organize it, and pick out specific subsets of related data.

Computer graphics software is even used in the arts at school. Fine arts majors can create startling images using computers. They can even combine more traditional formats with electronically generated material.

At Home

The first place that microcomputers appeared was in the home. Today, applications geared for the home market are more diverse than ever (Figure 1-14). One popular type is software that helps you figure your taxes. For people who own a home, or work at home, or have outside investments, these programs can help identify items on which taxes must be paid and where deductions can be listed. These programs can save you incredible amounts of both time and money.

Games are also popular on home computers. Some of the best-selling types are adventure games, flight simulators, and sports games such as golf and football.

Databases have proven to be invaluable in the home. People find it very convenient to organize data about their books, their recipes, or their collections (such as stamps). Insurance companies encourage their customers to keep a careful inventory of their valuables in case of fire or theft, and database software is an excellent way to do it.

In addition, people at home use all the same types of software as they do at school or at the office. They use word processors to write letters, spreadsheets to keep track of finances, and communications software to access information services.

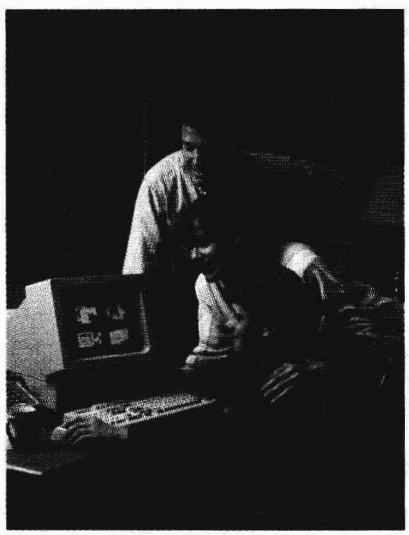

Figure 1-14
Microcomputers in the home provide both practical applications and entertainment value.