A PARENT'S GUIDE TO

PERSONAL COMPUTERS & SOFTWARE

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WITH DANNY GOODMAN

BY THE EDITORS OF CONSUMER GUIDE®

A PARENT'S GUIDE TO
COMPUTERS & SOFTWARE

WITH DANNY GOODMAN

The prices listed in this book were accurate at the time of printing; however, due to market fluctuations and manufacturers' changes, both approximate retail prices and actual store prices may vary. Products were also checked to make sure that they would be available to consumers; however, product manufacture and distribution are beyond our control, and manufacturers may discontinue or modify products in the future without notice.

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Chapter 1

DOES YOUR FAMILY NEED A COMPUTER?

Like many parents today, you may be wondering whether the time has come for your family to own a computer. The question is one for which many parents are not prepared. Your school-age children come home with tales of wondrous computer experiences at school or at a friend's home down the block. They chatter about mysterious RAMs and bytes as comfortably as other generations carried on about baseball cards or the Beatles.

And your children certainly aren't the only ones talking about computers. The news media frequently remind us that the 1980s is the dawning of the personal computer age. Television ads show young people working all kinds of wonders on video screens attached to computer keyboards. We see these children practicing math skills, learning foreign languages, and fighting battles in outer space. We see adults figuring out their taxes, balancing their checkbooks, and writing letters—all done more quickly and easily with a home computer.

Why all this excitement about home computers? A major reason is, of course, that the prices of home computers have dropped dramatically. Advances in technology and strong competition in the marketplace have made computers affordable for many families. Today, for under $100, you can hold a remarkable amount of computer power in your hands.

Another reason for all the excitement is that computers are becoming easier and easier to use. Operating today's home computers does

not require any technical knowledge or typing skills. You don't need to know how to program a computer in order to use one. Hundreds of prewritten programs—called *software*—are available. Just as you can buy cartridges to run a video game, you can buy software to run your computer for you. Software comes in the form of plug-in cartridges, cassette tapes, or disks. When connected to a computer, software tells the computer what to do. It can make the computer perform any of hundreds of different tasks—like computing mortgage costs, teaching long division, giving a spelling quiz, or playing a game. In most cases, instructions for using a program are provided for you right on the screen. Every year, more software becomes available. This software allows you to use a home computer in more and more ways. Soon the computer—as an educational, entertainment, home management, and time-saving device—may become as basic an appliance in the home as a television is now.

Despite all this, many parents have legitimate concerns about making the decision to buy their own computers. There is, however, one important use that many families feel alone justifies buying a computer: *education*. A computer can be one of the most valuable educational tools that you can give your family. The computer is useful not only for learning the three "R's" of elementary education, but also for high school and college studies, for adult self-education, and for learning how to master the com-

puter itself. And besides all this, learning with a computer is fun.

Perhaps the greatest incentive is to think of a computer as a modest investment in your child's future. This investment can realize significant returns in later life. You will be furthering your child's education now. You will also be preparing your child with the basic computer knowledge needed for the life and the careers of the future.

The computer in your child's future

Already computers in one form or another are creeping into most workplaces. Businesses use computers for word processing and for keeping track of their budgets and cash flow. Computers give doctors quick diagnoses of their patients' conditions. Farmers keep up-to-date records of their livestock and their crop production. Engineers check stress factors. Homemakers keep inventories of household items and manage the family budget.

No matter what career your child chooses in the future, some computer skills will almost certainly be needed. The use of computers is rapidly expanding in business and finance, accounting, scientific research, industrial engineering, architecture, structural design, education, and communications. The field of computer technology and programming itself can only continue to grow. Most futurists and leading educators believe that basic computer knowledge will

eventually become a requirement for jobs in nearly every field. Computers will be used to perform tasks perhaps beyond our present imaginations.

Even outside the world of work, computers may become an important part of your children's everyday lives. That is why it is so important for even young children to become "computer literate." *Computer literacy* simply means a basic understanding of computers and computer terms—including what computers are, how they work, and how they can be used.

The younger the age at which a child learns about computers, the easier it is to accept and use computers as helpful tools. Once children see the potential of computers, they often exceed all adult expectations in developing their individual

interests. Some youngsters write poems or stories or even publish club or neighborhood newspapers. Others have been inspired to develop highly marketable programming skills on their own. Some write computer music or create computer art. The knowledge and skills they are gaining now could take them far in the years to come.

The computer as tutor

Computers—even the less expensive ones—are ideally suited for the teaching role. A computer is a patient, attentive, willing tutor. It never tires of presenting the same material over and over—as many times as the student wants or needs. It can also move on quickly or jump ahead to whatever subject,

problem, or drill the student wants to use. Learners can progress quickly in subjects that are easy for them. They can also slow down or repeat in subjects that are more difficult for them to learn.

A computer is also a versatile teacher. It can teach almost any subject—ranging from the basics of reading, spelling, mathematics, science, social studies, and foreign languages, to advanced subjects like calculus and accounting. It can teach any age group, from preschoolers through adults.

Furthermore, a computer can use a variety of teaching and learning methods. A student can be given drill and practice in subjects like math and spelling. In reading, the computer can present a short story and then ask the student questions about the story. In some programs, a child sharpens up logic skills by solving mysteries and puzzles. The computer can play these different teaching roles thanks to the wide variety of educational software programs available.

Most important, the best of the educational software programs make learning fun. A correct answer may be rewarded with a fanfare, a cartoonlike scene, or flashing stars. The child may get to play a game as a reward for a high score on a quiz. Many software programs develop learning within a game. The child must solve a problem or demonstrate a math or verbal skill to succeed in the game.

Good educational software holds the interest of children and keeps them coming back for more. It challenges children to solve problems— to think and learn quickly and accurately. The many types of educational software available are discussed more thoroughly in Chapter 4, "Looking at Educational Software," which offers guidelines for choosing high-quality programs. Specific software packages are recommended in Chapter 5, "Buyer's Guide to Personal Computer Systems and Software."

Computers at school

Excited by the computer's potential as tutor and learning partner, educators are rallying around the computer. Despite budget limits, a large number of school systems are investing as heavily as possible in computers for use in the classroom.

There is, however, a common misunderstanding among parents about what children are doing with computers in schools. Parents often assume that if a child uses a computer at school, the child is learning computer programming or some other highly technical computer skill. This is not necessarily so.

To be sure, there are schools that teach computer programming, either as a regular course or as an after-school activity. However, not all schools are equipped to teach computer programming. This instruction requires the ready availability of many machines. It also requires teachers who are trained to teach computer programming. Only now are larger numbers of teachers receiving training in computers and programming

so that they can pass the information along to their students.

In the meantime, many schools are using the computer as an aid for teaching the basic school subjects. In these cases, students are using prewritten educational software, much of which is now produced by respected educational publishers.

Computer education, therefore, may mean two quite different kinds of learning. It may mean using the computer as a tool to learn specific subjects. Or it may mean learning programming and learning about the computers themselves. The type of computer education going on in any school depends on the money available for buying computers and software and on the computer experience of the teachers involved.

School systems with only a few available computers often emphasize drill-and-practice lessons, primarily in mathematics and spelling. These drills may be combined with multiple-choice quizzes. Each child may have as little as 5 or 10 minutes of computer time each day.

In school systems that have been able to buy more computers, each child can spend more time with a computer. The children may apply the computer to a wider variety of subjects. Learning games can be used to teach basic concepts in mathematics, social studies, and science. English composition classes may use computers for writing and correcting papers or for learning about language structure.

Schools lucky enough to have several computers in each classroom are instituting computer literacy classes, sometimes beginning in the early grades. In these classes, the children learn how to use the computer, how to type on the keys, and how to start writing simple computer programs.

Many schools are pooling their computers in "computer learning centers." A number of computers are concentrated in one location, along with a variety of learning materials and software. An adviser is available to help the students. Sometimes the adviser offers classes on how to use the computer. At other times, students are free to come and use the computers in any way they wish. Some students use the computers to write papers or do science projects. Students may also spend their free time playing problem-solving games or experimenting with computer programming on their own. It is not uncommon for students to spend every available minute fine-tuning their programs, which might be anything from a sophisticated video game to a lesson in spelling for fellow students.

Bringing the tutor home

What is most exciting today is that you can have this remarkable educational tool—the computer—in your own home. With new software appearing on the market every day, you can actually have a better

library of educational software than the school has. You can have more programs on a wider variety of subjects. But most important, the educational software you have at home can be chosen specifically for your own child's interests and skills. You and your child can choose software not only to brush up on school studies, but also to help your child pursue other interests. And, of course, your child will not have to compete with all the other children at school for time at the computer.

Having your own personal tutor is reason enough to have a computer at home. It truly gives children the chance to supplement and build on what they are learning at school. They can learn at their own pace and enjoy the fun a computer can add to learning. Yet studying school subjects and pursuing other favorite topics of their own is only the beginning. Here are some of the other ways your child can benefit from having a computer at home.

Typing

Knowing how to type is, of course, a useful skill for any student. Students who learn typing reap the benefits of faster production and neater, readable papers. Many schools teach typing in junior high or high school. But the computer makes it possible to learn typing at home, even at a younger age.

Several software programs that teach typing skills are available. If your computer does not have the standard typewriter keyboard, you may be able to use a keyboard overlay, which is available for many computer models. An overlay fits over the computer keyboard to simulate a standard typewriter keyboard. Learning typing with a software program has several advantages. The typing lesson can proceed at the child's own pace. The programs are designed to be challenging and fun. Some are even combined with games, complete with sound and pictures. The faster

and more accurately the child types, the higher the score on the game.

In addition, many educators believe that students often make tremendous overall gains when they begin typing at younger ages. Young children enjoy using their fingers on the keyboard. They often improve their vocabulary, spelling, and reading skills. Learning to type may be one of the biggest benefits of owning a home computer.

Word processing

Another related computer application that will aid school work is word processing. *Word processing* lets you use a computer as an advanced typewriter. You can see your words on the video screen and make any additions, changes, or corrections you want before putting your words on paper. You can correct spelling errors or rewrite sentences. You can move words, phrases, sentences, and para-

graphs around. If you take out a word or a paragraph, the spaces automatically close up. Once your writing is in exactly the form you want, you can press a button and print it out on paper. To do this, you need word processing software and a printer. But you and your children may decide that the money invested in word processing is well worth the time saved.

Students who need to write a lot of papers and reports will appreciate the easier, faster manipulation of a computer keyboard. The student is freed from the prospect of retyping the same work over and over. The student can first concentrate on putting that knowledge down. Then the student can rework the first draft on the computer, this time concentrating on organizing and perfecting the writing. With word processing, a student can produce a neatly typed, error-free paper in less time than it would take with a regular typewriter and correction fluid.

Shortcuts for science

Time spent working on scientific experiments can be reduced by setting up problems and equations on the computer. The problems can be typed into the computer for quick calculation. The computer can also help the student create graphs and charts that clearly show the results of experiments. High school students with a scientific bent often become fascinated by the ways that they can apply computer calculations and programming to their school labs or hobby experiments.

Sharpening thinking skills

Some of the most valuable educational software programs on the market are puzzles and games that teach logic and thinking skills. These are so entertaining that they draw children to use them again and again. Even very young children can have fun learning basic concepts: distinguishing shapes; classifying objects that are different or the same; putting letters or designs together; telling time. Older children can solve mysteries and puzzles that require careful thinking and logic. It is difficult to measure the effects of such games, unless we compare them to another creative use of the video screen—the television program *Sesame Street*. Children who watch this program at an early age appear to greatly expand their vocabularies and thinking skills. The best of the learning games offer the same type of stimulation. They may even have greater benefits, because they permit the child to participate fully.

Learning computer programming

Even though you can use a computer without it, many young people enjoy the challenge of learning programming. Students who are learning programming at school usually want to do some practicing and

experimenting at home. And many children—sometimes at surprisingly young ages—are learning simple programming on their own. They want to be able to make the computer do whatever they want it to do. And that's what a computer program does. It tells the computer how to perform a certain task—whether that task is computing numbers, giving a science quiz, or playing a game.

To help you understand what a program is, imagine that you are planning a trip in your car. Whether or not you consciously realize it, your brain is following a kind of program—a series of steps you must take to perform that task. If you wanted to send a robot in your place, you would have to *program* the robot's computer brain by listing every step of the process. You would have to break down the trip into very small, individual steps like "unlock car door," "unlatch car door," "open car door," and so on. You might even have a step in your program that says "If car won't start, yell 'Phooey' and exit car; otherwise continue." In other words, the program would have to include not only precise instructions to carry out the job, but also alternative instructions for what to do if certain things should happen along the way.

Learning programming is really just learning how to write instructions that the computer can understand and follow. There is no mystery involved. The student must master some basic terms the computer can understand—learn to speak the computer's language. The student must also learn some basic rules for giving instructions to a computer. Using these terms and rules, the student writes a step-by-step program instructing the computer to do what the student wants it to do.

Linking to a network

Another practical use for home computers, one in which the whole

family can participate, is networking. *Networking* is linking your computer to huge data banks or to other home computers. Several large data banks, or networks, are now making a variety of information and communications services available to the public. Your home computer can tap into vast electronic libraries of information and educational activities.

A special accessory called a *modem* allows you to connect your computer to these networks through the telephone lines. (We'll talk more about modems in Chapter 3, "Looking at Computer Systems.") Once you are connected, on-screen directions help you select whatever information or activity you want from the vast quantity offered. In hundreds of cities, all you need to do is make a local phone call to put your computer "on-line" with the three most popular networks: The Source (a *Reader's Digest* company), CompuServe, and Dow Jones News/Retrieval Service. Each offers a different package of information services.

For students, the networks offer a variety of educational information and activities. The Source offers more than a dozen elementary education drills and practice lessons on arithmetic, spelling, and grammar. Even encyclopedia research can be done at home. *The Academic American Encyclopedia* is available on Dow Jones News/Retrieval Service. *The World Book Encyclopedia* is available on CompuServe.

Need to write a current events report? Subscribers to The Source can obtain the latest breaking news from United Press International (UPI), even before it hits the local newspaper. CompuServe offers similar news services, but it selects its items from the Associated Press (AP) and from several major metropolitan newspapers. To find news on a particular topic, you can type in a key phrase, like *energy conservation*. The network's computer searches its files for all news stories

related to that subject. You can view as many or as few of them as you need, with the most recent story appearing first.

The whole family will enjoy the world of information and electronic communication available on the networks. Up-to-the-minute news on stocks and bonds, medicine, sports, travel, gardening, cooking, movie reviews, and computer games are only the beginning of the list. You can even shop or do your banking electronically. The Source and CompuServe also feature information "bulletin boards" and electronic newsletters on popular brands of computers. By answering each other's questions, computer users frequently make new friends all over the country. They can communicate by electronic mail and by live, two-way keyboard "conversations."

Networking may be the beginning of a new era in which we will be banking, shopping, even "going to work" via computer and telephone.

Costs of networking vary according to the service. One-time membership fees range from $10 to $100. For this fee, you receive a reference manual, local phone number, and an individual password that you will need to type into your computer each time you link up with the service. You are billed only for the time you are connected to the data bank, plus the local phone call. Connect rates for evenings and weekends are usually in the range of $5 to $10 per hour. Your password, by the way, offers a level of security, because no one can charge connect time to you unless they know your password.

Local networks. A few local school systems and colleges are experimenting with networking on a community level. Students with computers at home can link up by telephone or cable to a specially designed computer at school to view lessons or to take practice drills prepared by teachers. This community networking activity will

probably increase as computers become more common both at home and at school.

Something for everyone

You shouldn't get the impression that a home computer is only for the young. In most cases, once a computer appears in the home, the whole family wants to get involved.

People of all ages are attracted to the computer because it's just plain fun. In addition to the hundreds of arcade-style action games, entertainment software programs offer strategy games and real-world simulations that exercise powers of logic, imagination, and memory. Adults are as easily engrossed by these activities as children are.

You may also decide to explore some of the computer's many practical uses—for keeping track of personal finances, managing the home, simplifying work for clubs and community organizations, adult education, and assisting business and professional people. Many business executives do heavy

number processing (budgets and forecasts) as "homework." Traveling salespeople and self-employed professionals, who frequently work out of their homes, will find that a home computer proves practical long after the children are in bed.

Nor is it ever too late for you to learn what computer programming is about. Although programming knowledge is not essential, conquering a computer language can be useful in unexpected ways, both at home and on the job. All lower-cost machines come with programming lessons written especially for the first-time computer owner.

Why buy now?

Many consumers have understandable doubts about taking action too soon. They are aware that technology is advancing steadily. They have also seen rapid drops in prices for electronic gadgetry like calculators and computers. Should you wait for a whole new generation of computers to come on the market? Should you wait for prices to come down? Probably not. The lower-

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priced computer market is becoming stable enough for you to make a sensible purchase now. Here's why.

Rising technology

As to the question of rising technology, our examination of the market and possible products of the near future indicates that today's home computer—the hardware—has already advanced beyond the available software. The computer has capabilities we aren't even using yet. Software designers have a long way to go before they exhaust the possibilities of today's home computers. In other words, the computer itself is not likely to become outdated in six months or a year like pocket calculators did in the 1970s.

Most computer manufacturers have made too heavy an investment in their models to change course too quickly. Certainly manufacturers will continue to bring out new models with new or different features. But if you wait for new models, you will have to wait even longer before a large variety of software is written to use those new models for many dif-

ferent applications. If you keep waiting to see what the next models will bring, you might never take the plunge. With the wide range of features and capabilities available right now, you should be able to select a computer with the basic power and important features you need.

Falling prices

Even the recent dramatic price drops were not caused by any striking technological advance. In fact, all but one of the most popular computer models available at the end of 1982 had been on the market for at least two years. No, what fanned the home computer fire was a price war waged by manufacturers.

As 1982 opened, lower-priced computers were spread out in the $300 to $500 range. Then Timex brought out their version of a very successful basic computer, designed by Britain's Sinclair Research, at the unheard of price of under $100. Even though the Timex Sinclair 1000 is a limited-feature machine, the competition started slashing prices drastically. By the end of 1982, the $300 to $500 com-

puters designed for home use were in the $100 to $300 range.

At this new price range, more kinds of stores started offering computers. Mass merchants, drug stores, toy stores, and discounters of every variety started selling Atari, Commodore, Texas Instruments, and Timex computers at very attractive prices. Specialized computer stores soon discovered that they could not compete effectively. Many computer stores have all but abandoned the under-$500 computers to concentrate on more sophisticated and expensive computer systems like Apple and IBM.

There may still be some minor price drops in the lower-priced home computer models, but the big price breaks of the last few years are probably slowing down. We forecast most of the coming price cuts to occur in the lower-priced professional computers, those currently in the $500 to $1000 range. In the lower-priced home computer field, prices have already fallen to the point that nearly every model is an excellent value for the money.

In other words, we recommend getting your feet wet in computers now—today! Parents can make a sensible start in the world of home computers, as long as they have some basic knowledge about computers.

What do you need to get started?
What do all those technical terms mean?
How can you choose the best system for your family?
To help you in your quest, we'll tackle these questions and many more. We will show you how to shop for a home computer. We will provide you with some computer basics to help you compare computer models and their specifications. We'll also survey a selection of home computer models, including several new systems that have only recently hit the market. And we'll help you choose software that can make your computer a valuable part of your child's education.

Chapter 2

SHOPPING FOR YOUR FIRST COMPUTER

Many people put off buying a computer because they don't know where or how to begin. This chapter offers some guidelines to help you shop for and choose a computer system that is right for your family.

As with any other product, the way you plan to use a computer is an important factor in your buying decision. While you may have some specific uses in mind now, you and your children will find more and more uses for the computer as your computer knowledge grows. Therefore, you'll probably want to look for a computer that has strengths in education as well as in a variety of other uses for the whole family.

Because you are looking for a versatile machine, you need to take a broad look at entire computer systems. In the word *system,* we include:

1. The *capabilities* of the basic computer console;

2. The *accessories* that will let your system grow with your family's needs and experience; and

3. The amount and types of *quality software* available for the computer.

The system that can expand with your experience and provide a variety of software may be more valuable to your family than a system that offers impressive specifications but only a meager software selection.

Your choice of a system will of course depend on your own family's circumstances. You want a system that is appropriate for your child's age, interests, and previous experi-

ence with computers. Also keep in mind any specific uses that are important to your family. Is word processing essential now, or can you wait for a while before investing in the equipment necessary for word processing? Is your main interest in education? entertainment? learning programming? (Chapter 5, "Buyer's Guide to Personal Computer Systems and Software," offers suggestions on which systems are appropriate for different uses and for different age groups.) And, of course, you want a system that offers the features you want for the price you want to pay.

How much computer do you need?

For first-time computer buyers, there are few reasons to invest in a more expensive professional computer, such as the Apple IIe or the IBM Personal Computer. One such reason would be that you plan to use the computer for business or professional purposes, as well as for education and entertainment. You might also want a more professional computer if an older child has had extensive programming experience and intends to pursue programming seriously. A third reason might be that you have easy access to a large software library for one of these computers and lots of friendly help nearby. For most beginners, however, we recommend that you start out with one of the many low-cost systems while you and your family

learn what home computing is all about.

Although the under-$300 computers are often called basic machines, that doesn't mean that they are too basic to be useful. Most low-cost machines are expandable into pretty powerful home computers, boasting color graphics and sometimes built-in music synthesizers. Even if you start small, your first system can take you a long way down the road to computer literacy. The experience you and your children gain on your first machine may play a key role later if you decide to switch to a computer that offers more built-in power to handle heavy-duty personal computer work. You will be much better prepared to make an informed choice about a more expensive system after you've used a computer and are more aware of what you want to do with one.

Establishing a budget

Before setting a budget figure for your initial buy, you should be aware that the prices touted boldly in the newspaper ads are often for the basic console only. You may need one or more accessories, like a cassette tape player/recorder, to get the computer going. And you will need software, which may cost anywhere from $10 to $80 per program. You should probably be prepared to spend $200 to $500 your first time out. This figure includes the computer, essential accessories, and a few software packages.

Also keep in mind that a computer

a keyboard adapter. Several adapters, including one made by Atari, will be available for the most popular home video game of them all, the Atari 2600. Keyboard consoles simply plug into the 2600 via the cartridge slot. No modification of the game unit is required. Mattel's Intellivision computer module system even features an optional music keyboard that turns the game/computer combination into an eight-octave, six-voice music synthesizer.

With prices in the $90 to $125 range, these computer adapters provide a low-cost transition from video game to basic computer—without discarding your investment in the game console. Because these machines are new to the market, there won't be much software available at first—only a handful of programs from the manufacturer. Until sizable software libraries exist, the computer add-ons will be useful primarily as tools for learning computer programming. Yet in time these video game/computers should be as expandable as most other low-priced computers.

Buying the computer

Unless you are uncertain about the type of computer you want and have not yet defined your price range, limit your shopping trips to stores that sell computers within your budget.

Where to shop

As a general rule, you will find the more expensive computers, such as the Apple IIe or the IBM Personal Computer, in full-service computer stores. You will find most lower-priced computers in department stores, discount outlets, toy stores, and specialized computer stores offering just a few computer brands.

Computer stores. Many computer stores offering the more expensive

Keyboard adapters that expand the Atari 2600 video game into a home computer are available from Atari (above), as well as from third-party companies (below).

is not a one-time purchase. Once you own the starter system and software, you will be drawn to buy additional software and accessories. The more you learn about the computer, the more you'll want to do with it. Don't be surprised to turn around one day and realize that you have a software library of greater value than the computer itself. This is quite normal in the personal computer world.

Upgrading home video games

If your household is one of the 15 million equipped with a home video game, you could be in luck, depending on the model you have. The Atari 2600, Mattel Intellivision, and Colecovision home video games—the three most popular, as it happens—are upgradable to home computer status by adding

home computers are full-service specialists. Often you can sit down in front of a computer for an hour while a salesperson demonstrates various machine features and software packages. After you buy a system, the salesperson or store service technician usually checks out all the pieces and performs diagnostic tests to make sure everything is installed and running correctly. If you encounter problems or questions, you should be able to call for help as often as needed.

Stores for under-$500 systems. For lower-cost computer systems, you'll be shopping in department stores, catalog showrooms, discount stores, large toy store chains, and electronics stores. In many of these stores, you won't have a place to sit and operate the computer. The reason behind this is simply money. To be competitive in the marketplace, these stores sell the basic computer consoles at prices very close to their cost. This leaves the stores with less money to provide specialized services, but gives the customer the benefit of lower prices.

Mail-order offers. You can also buy a computer system by mail order. In many cases, mail-order firms offer low prices for a true savings. Do not assume, however, that mail-order prices are automatically cheaper. Some mail-order prices are higher than those you can get by carefully shopping around in the stores.

For the first-time computer user, we do not recommend buying from a mail-order firm. Once you have become more familiar with computers and can better evaluate your needs, then consider taking advantage of mail-order buys. Until then, the support of the supplier will be important to you.

Package deals

From time to time, computer manufacturers or specific stores put together package deals. They'll offer a selection of equipment (and sometimes software) for a package price lower than you would pay if you bought the items individually. The savings are often substantial. You should take advantage of a package deal if you have the opportunity.

Warranties and service

Warranties vary widely from company to company. Many manufacturers offer over-the-counter exchange of defective equipment for 30 to 90 days after purchase (when most problems will surface). This is a much faster solution than sending the unit away to be repaired. Out-of-warranty service terms also vary, but repair work should be done at an authorized service location. For some companies that means the factory; for others, like Atari, that means one of the hundreds of local agents in their nationwide network. Full-service computer stores are often authorized service centers for the models they sell. Be sure to check on warranties and service policies before making a purchase so that you know what to expect.

Careful shopping

Here are a few final tips to help you make the best choice for the best price. Take your time looking at a few of the models in your price range. Chapter 5, "Buyer's Guide to Personal Computer Systems and Software," will give you a good over-

view of specific computer systems. Since prices, equipment, and available software are changing all the time, try to get as much information and product literature as you can from the stores. If at all possible, get a hands-on demonstration of the models you're interested in. And by all means, shop around for the best price before making your purchase.

Try to talk to other home computer owners. Friends and neighbors who already own different computer models can share their experiences with you. (And if you end up with the same computer model, they may be willing to swap software with you.)

There are also clubs, called *user's groups,* made up of owners of particular computer models. Some of the stores that carry computers may know of local user's groups for the machines you're interested in buying. These clubs can be helpful both before and after you've bought a computer. You'll meet computer users with a wide range of experience, including some who can help you out of practically any computing problem you run into.

Finally, prepare yourself with some basic knowledge about.computer equipment. In the next chapter, we will look at the system ingredients you'll be shopping for, as well as some of the specifications used to compare models. We'll also provide some guidelines as to the features your first computer should have.

Chapter 3

LOOKING AT COMPUTER SYSTEMS

Because you won't always find knowledgeable sales help at stores selling starter computers, you will be way ahead of the game if you understand a few simple terms and concepts about home computers. First, you'll need to know about the components that make up a computer system. This will be very much like learning about turntables and receivers for a stereo setup. You'll also benefit by knowing a few of the specifications so that you can compare capabilities of competing machines.

In the computer world, the physical components of a computer system are called the *hardware*. The instructions that direct the hardware to perform specific tasks are termed *software*. All components beyond the basic computer console are called *peripherals,* because they exist on the outer edges of the system and are brought into action only when needed. For example, a cassette recorder is under the computer's control only when loading or saving information. A few peripherals are essential to running the basic system. Other peripherals are strictly optional, depending on what you want to do with your computer.

The basic computer system

There are three basics you need to get your system going:

1. The keyboard console containing the basic computer circuitry;

2. A video display; and

3. Software, along with equip-

ment for loading the software into the computer.

Keyboard console

The central component of any computer system is the *keyboard console.* Along with the keyboard, this basic console houses all the sophisticated circuitry that runs the computer. This circuitry processes information and follows the instructions in programs. It also controls every other piece of equipment connected to the console. The built-in keyboard is used to *input* (enter) information into the computer. Two keyboard features important to the user are the type of keys and the layout of the keys.

Keyboard construction. One keyboard model is called a *membrane keyboard.* Instead of individual keys, a membrane keyboard has a flat plastic surface on which the locations of touch-sensitive keys are printed. This type of keyboard is durable and well-sealed against spilled food—advantages if the computer is to be used by young children. However, the keys are difficult to use for touch-typing because there is no "feel" or movement when a key is pressed. This is one reason why membrane keyboards are becoming less popular.

The trend is toward *raised keyboards,* which have individual keys made of plastic or rubber. One type of raised keyboard is called *full-travel* because the keys move when pressed, just like on an elec-

tric typewriter. Another type of raised keyboard with pushbutton-style keys is often called a *chiclet keyboard* because the keys look like the tabletlike chewing gum. The action of chiclet keys is very stiff. They may feel uncomfortable to the experienced touch-typist who is more used to a full-travel keyboard.

Keyboard layout. Another important keyboard feature to watch for is the layout of the keys. You will rarely see the exact same keyboard layout on two different computer models. Even computers costing many thousands of dollars place special function keys in different locations. But you might want to avoid computers with keyboards lacking the standard typewriter layout—those without space bars, for example. Youngsters learning on such keyboards would need to do some adjusting if they later switched to more standard computer keyboards or typewriter keyboards.

Keyboard overlays. A number of raised keyboards are designed to accept what are known as *overlays.* Usually cut from thick plastic or cardboard, an overlay fits on the keyboard (with cut-outs for the keys). The overlay has words or characters printed above most key cut-outs. That's because some programs, to reduce the amount of typing, give special functions to keys—for example, pressing one key may produce the word *PRINT* on the screen. Overlays come with such programs to help you use these special function keys. Overlays also

are used with some typing instruction programs to simulate a typewriter keyboard (if the computer's keyboard does not have a standard typewriter layout).

Video display

All home computers need a video display for the same reason a stereo system needs speakers or headphones: to let its human users know what is going on inside. Very few computers have built-in monitors. Most of those that do are professional machines designed for heavy-duty business applications. Therefore, you will need a separate video monitor to use your home computer.

Of the home computers discussed in this book, only the Timex Sinclair 1000 produces black-and-white video; the rest produce color video. Most educational and entertainment software programs take full advantage of a computer's color capabilities. In a program with graphics and animation, color makes the program more interesting than watching several shades of gray on a black-and-white TV. In some cases color is used to highlight information—a key point within a lesson, for example—that might not stand out as clearly in black-and-white.

There are several types of monitors you can use, depending on the types of video output your computer is capable of sending to a video display.

Home TVs. Fortunately, every home computer is capable of sending its video information to a home TV via a single cable attached to the television's antenna terminals, the same way you connect a home video game. This helps keep the initial cost of a home computer system down.

Most home computer consoles have an extra built-in feature called an *RF modulator*. This converts the computer's video display to Chan-

nel 3 or 4 so that a home TV can tune it in properly. A few computers, however, come packaged with a separate RF modulator box or offer a separate RF modulator as an option. Computers with separate RF modulators are capable of displaying their video output either on a standard television (using the modulator) or on a color monitor (without the modulator).

Color monitors. *A color monitor* is actually a special kind of television that produces sharper images than a standard television. A color monitor can be used with any computer that has *composite video output*. Instead of converting from straight video to a TV channel and back again inside the TV, composite video takes a more direct route. The result is sharper images (higher resolution) and better colors. Color monitors with this composite video capability are available in the same price range as quality color TV sets. The degree of sharpness (resolution) you get is usually related to how much you spend. Programs with a lot of text (such as word

processing, advanced drill and practice, or tutorials) may call for more sharpness than required by most games.

A number of the latest home TV models are now equipped with separate video input jacks in order to bypass the TV tuners and produce a better image when hooked up to a computer. They produce computer displays very much like those on color monitors.

Monochrome monitors. Another kind of video display is called a *monochrome monitor*. The text appears in only one color, either green, white, or amber on a black background. Text is much easier to read on green or amber monitors. Most monochrome monitors reproduce graphic shapes, but only in the one color. This type of monitor also requires a computer with composite video output. Monochrome monitors are preferred for long sessions with text, especially for word processing or electronic filing.

RGB monitors. One more kind of video output may crop up in your
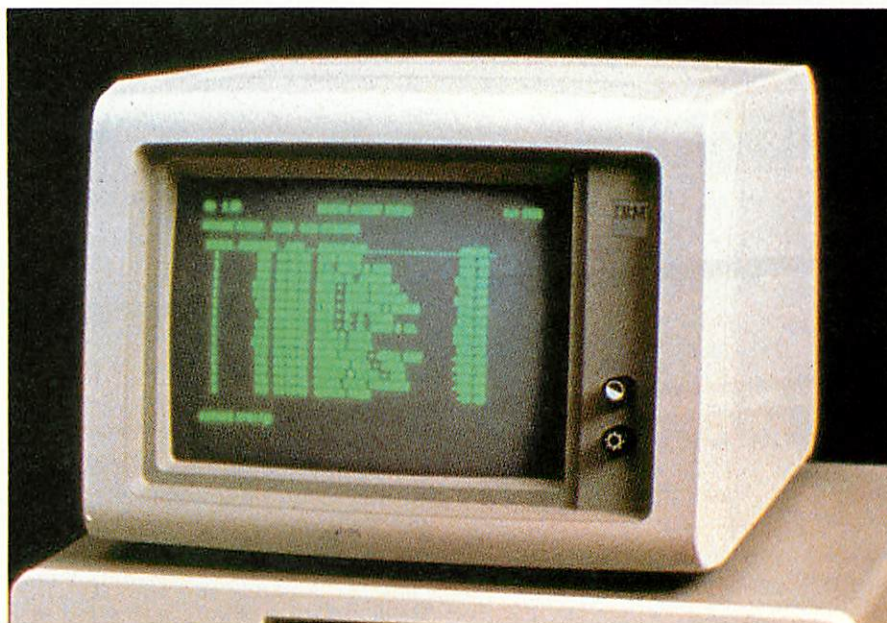
A monochrome monitor displays text and graphics in only one color — either green, amber, or white.

search. It is called *red-green-blue*, or *RGB* for short. Computers with an RGB video output send these three colors to the RGB inputs of specially equipped and expensive high-resolution monitors. The Sony Profeel series of monitors, for example, has RGB input (plus composite video input). RGB monitors are expensive and are usually required only for precision color graphics work.

Why buy a monitor? Though you may want to start out using your home TV, you'll probably soon want to hook up your computer to either a second TV or a video monitor. Setting up the computer with the color TV in the family room may not be practical—especially if you find your family having to choose between watching *Sixty Minutes* or practicing multiplication. Also, the computer should be set up in a quieter location if possible. If you need to buy a second color TV or a monitor to accomplish this, you will be able to use it for years to come, even with more sophisticated generations of computers.

Software formats

Since software programs are what makes the computer run, you need to load (enter) programs into the computer. Depending on the computer model, there are as many as three ways to load programs.

Plug-in cartridge. By far the simplest method is the *plug-in cartridge*. Most under-$300 computers offer a cartridge slot on the keyboard console, just like on a home video game. A cartridge contains a factory preprogrammed chip that essentially acts as an extension to the console's circuits. However, when you unplug a cartridge, you lose the information you typed into the computer while the program was running. A cartridge cannot record the information you entered for later use.

A floppy disk can store the equivalent of 25 to 40 typewritten pages of information on its magnetically coated surface.

Cassette tape. Another software format is the *cassette tape*—the same kind of audio tape used in stereo systems. When you load a program tape into the computer, the console's circuitry stores an exact copy of the program—where it will stay as long as the power stays on. Unlike a cartridge, a cassette tape can record and save information you entered into the computer for later use.

To load a cassette program into a computer, you need a cassette player/recorder. Some computer consoles have special connectors that accept only matching cassette recorders (also called *cassette drives* or *data recorders*) made by the computer manufacturer. Other computer models provide a connecting cable that plugs into any standard portable cassette player/recorder. (Play-only Walkman-type units won't work.) If you have to buy a cassette player for your computer, the standard recorders are usually less expensive and can be used for purposes other than computer work. In general, a cassette recorder or data recorder will cost under $100.

Disk. A third software format is the *disk* (also called *floppy disk* or *disk-ette*). Programs and other informa-

tion are stored on a magnetically coated disk that is permanently housed in a protective cardboard sleeve. Like a cassette, a disk sends a copy of the program to the console's circuitry where it stays as long as the power is on. A disk can also record and save information you enter into the computer.

Loading a disk program requires a relatively expensive ($250 to $500) accessory called a *disk drive*. Think of a disk drive as a precision turntable that can record and play back your information. Inside the disk drive, the disk spins at 300 revolutions per minute (almost 10 times faster than a 33 rpm record). That's one reason why a disk drive is much faster than a cassette player.

Another reason for the disk drive's speed is a feature called *random access*. The head in a disk drive can jump to any track on the disk without playing through the disk from the beginning. This means you can get to any information you want on any part of the disk in milliseconds. On the other hand, a cassette player may have to play through a long portion of tape before finding the information you need.

Which format is best for you? While disks are more expensive than cassettes, disks are also faster and

SOFTWARE FORMATS

	Advantages	Disadvantages
Cartridge	Fast Easy to use	Cannot save data
Cassette	Inexpensive Can save data	Slow Sometimes problems in saving and loading
Disk	Fast Can save data	Expensive

more convenient. A typical game program may take three to five minutes to load from a cassette tape. The same program on disk would be ready to go in less than ten seconds. Saving information you've entered may require lengthy cassette recording time. But with a disk, you can save information in seconds. Cassettes are also more prone to errors in loading or in saving information, so it may take more than one attempt to be successful. You can often improve program loading and saving accuracy by adjusting the volume and tone controls on the cassette recorder.

Our recommendation, however, is to start out with cartridge and cassette software unless you have access to a large disk library for a given machine. You can always add a disk drive later if your system is designed to use one and if you decide that the speed and convenience of a disk drive is worth the extra cost.

Software compatibility. On every prerecorded cartridge, cassette, and disk, a label clearly states the model of the computer for which the software is written. That label is there for an important reason. *Software programs written for a specific computer brand will not work on another brand.* Although all disks and all cassettes look alike to us, there are significant differences in programs for different machines.

Practically every computer brand has its own way of storing computer information on tape and disk. Some disk drive systems store more information on the same size disk than other systems do. Some cassette systems transfer data faster or in different codes than others. Each computer has slight variations in their programming languages.

When buying software, be sure that it is compatible with your computer brand and model. You cannot stretch your software budget by mixing and matching. Nor can you take advantage of certain excellent software programs if they are unavailable for your particular computer model.

Optional peripherals

Depending on the system you choose, you will have the choice of adding other accessories that let you use a computer in a variety of ways. Game controllers are probably the most common and are often the first accessory that people want to buy. You may decide later that you have a use for a printer or a telephone modem. Speech synthesizers and electronic drawing boards are specialized accessories that add new ways for you and your computer to communicate with each other.

Some peripherals plug directly
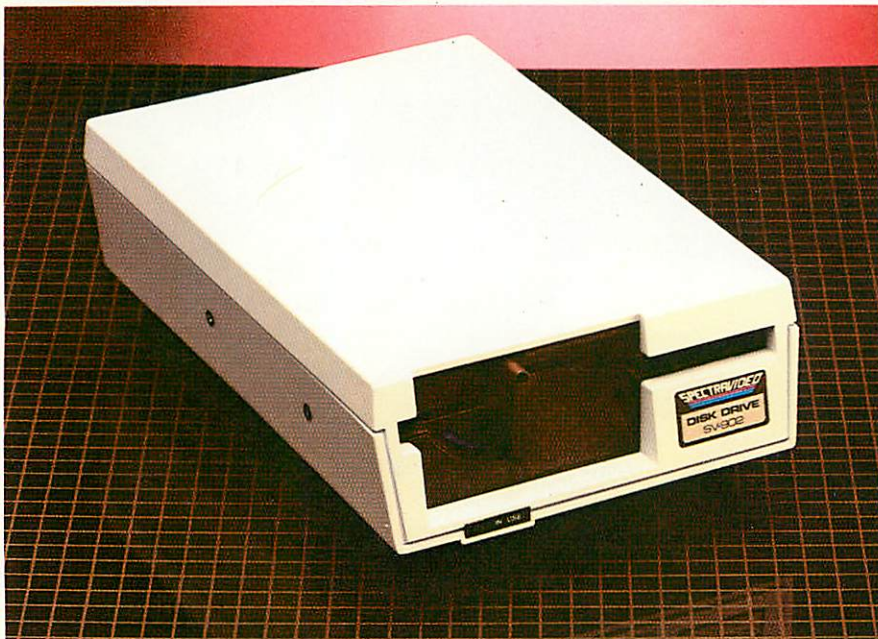
A disk drive can record information or load a program into a computer in a matter of seconds.
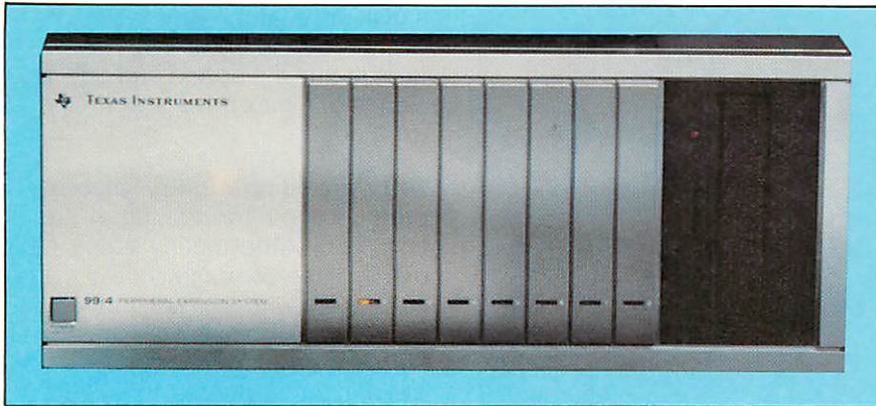
Some computer systems offer convenient expansion cabinets for connecting a variety of accessories to your computer.

into the keyboard console. Others require special connecting cables. A few systems help keep the tangle of interconnecting cables and add-on boxes under control with a single expansion cabinet that houses several peripherals and leaves room for further expansion of your system. In some cases, adding a peripheral will require the use of a special accessory called an interface.

Interfaces

In computer terms, an *interface* is simply an intermediary or adapter between two pieces of equipment. It makes sure that each will talk to the other in the same language. Interfaces let you add a broad range of accessories to your computer console.

Although there are many types of interfaces, the most common is called an *RS-232 interface.* RS-232 is simply the number assiged to a technical standard that all manufacturers can follow. An RS-232 interface lets your computer send information to or receive it from printers, telephone modems, and other control devices to come in the very near future (such as a timer for lights and appliances or a burglar alarm). Though an RS-232 interface is often an optional accessory, some computers come with this interface built into the console.

Game controllers

No matter what application a home computer is originally intended for, practically everyone buys games software. While many programs let you control arcade-style games by pressing keys on the keyboard, a hand-operated game controller sometimes offers more realistic play. There are a few types to choose from.

The most popular is the *joystick.* For many computers this is the only kind of game controller you will need, because the game programs for those computers are written only for use with a joystick. A few computers also offer *paddle* controllers —so named because a rotating dial on the controller moves a cursor "paddle" from side to side on the screen, like those of the early *Pong* video games. More recently, a device known as a *trackball* or roller controller has become available as a way of imitating some of the coin-operated arcade games. So far, however, there are not many games on the market that take advantage of the trackball's swift, 360-degree control action.

When choosing a game controller, remember that almost every computer has a different game-controller connector on the keyboard console. Be sure it states clearly on the box that the controller is directly compatible with your computer. When you buy your first entertainment software for your
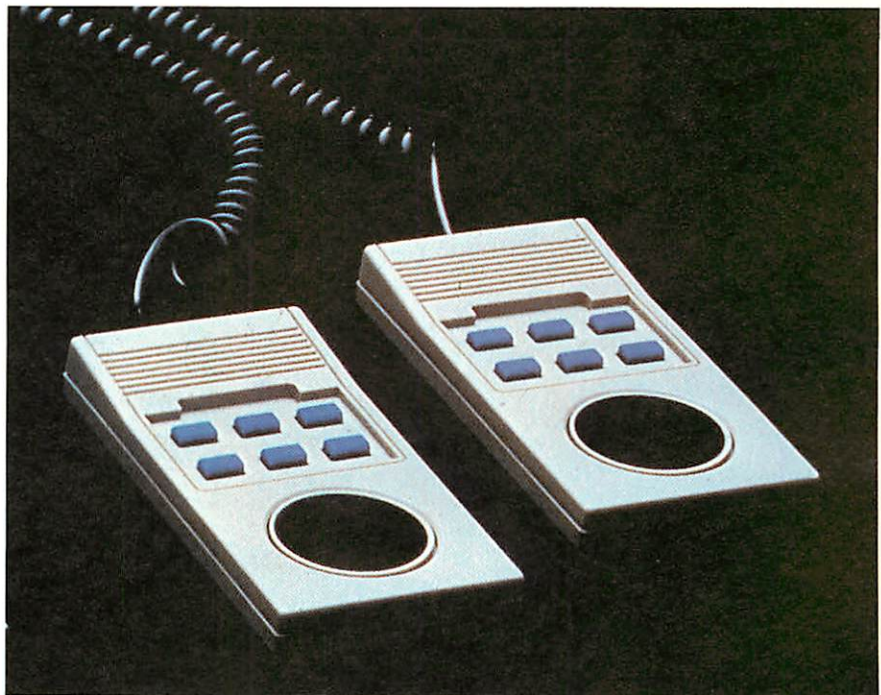
Hand-operated game controllers get you into action in the world of computer games.

computer, you should be prepared to buy an appropriate game controller.

Telephone modems

An accessory that lets you enter the world of electronic communications is called a *telephone modem* (pronounced "mō'-dem"). This device converts computer information into audible signals that can travel over the telephone lines to other computers. A modem can hook your computer into huge computer data banks called *networks,* which offer a variety of information and communications services. It also lets you link up with local community, school, or business networks.

There are two types of modems. An *acoustic* modem has rubber cups that accept a standard phone handset. A *direct-connect* modem features a built-in modular phone jack into which you plug the coiled cord that normally goes to your telephone handset. Either type of modem requires an RS-232 interface.

Printers

A printer is usually considered a deferrable purchase. Unless they want a printer for business or professional use, few families need to include a printer in their starter systems. If the computer will be used by young children, a printer is of questionable value. Older children, however, may like having printed material to refer to when working on homework or learning programming. Since a printer often costs more than the lower-priced computers, you might want to wait a while before deciding if you need one.

A printer either plugs into a special jack on the computer or requires an interface module. Printers can be tricky beasts, especially if you try mixing different brands of computer and printer. Before buying a printer, be sure the dealer guarantees that the computer-
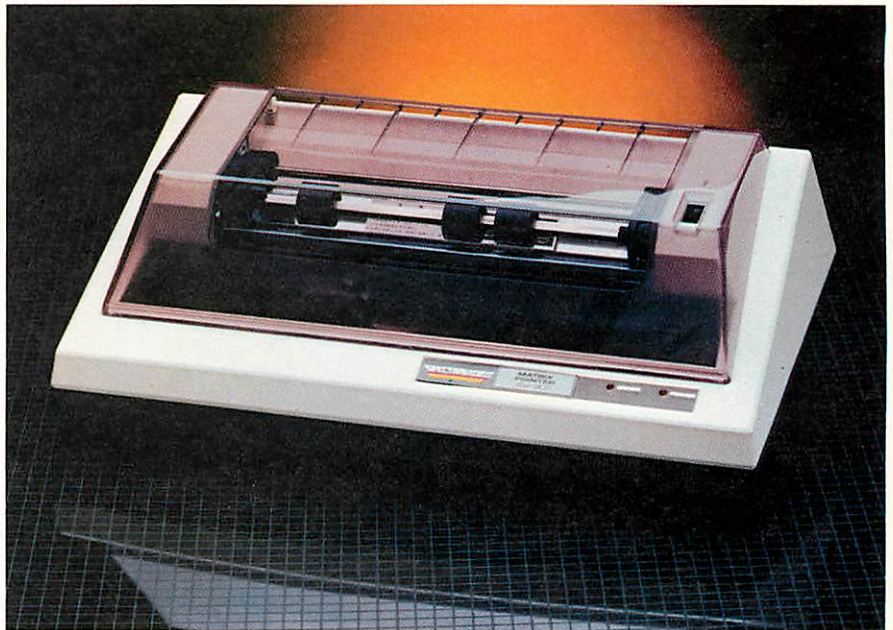
A wide variety of printers can serve different printing needs — from address labels to schoolwork to letters to colorful graphics.

printer combination will work. There are two types of printers: dot matrix and letter quality.

Dot-matrix printers are the most common and least expensive ($200 to $800). They are available in different sizes that can print from 40 to 132 characters per line. This type of printer forms characters (and sometimes graphics shapes) by printing a mosaic of dots on the paper. It can operate at speeds of 50 to 160 characters per second and faster. Some dot-matrix printers are *impact* printers that print the characters by striking a traditional inked ribbon on plain paper (like a typewriter). Others are *thermal* printers, which print by a low-level heat process on specially treated thermal paper. Thermal printers are quieter and have fewer moving parts (potential sources of service problems) than impact printers. However, impact printers can operate at much faster speeds.

Letter-quality printers use any of several impact printing methods to produce typewriter-quality printing. The compromises for high-quality printouts are slow speed (10 to 40

characters per second) and high prices ($700 to $2500). Letter-quality printing is used primarily for business and professional work (since dot-matrix printing can be more difficult to read for long stretches). For home use, a good dot-matrix printer provides excellent value for the money.

Plotters. A specialized type of printer, which you're likely to see in computer stores, is called a plotter ($700 and up). Typically, a plotter contains a pen that literally draws graphics shapes on paper. Pens of different colors can be inserted to draw precision color charts, graphics, and art with the help of a computer. More expensive multi-color plotters automatically change pens in the middle of a program.

As with most specialized peripherals like this, a plotter must have companion software available to work its color wonders. Some graphics software packages are designed specifically for plotters. Few home computer uses call for a plotter, except in the case of a serious computer artist.

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A digitizer can turn you into a computer artist. Lines and shapes drawn on its surface appear like magic on the computer screen.

Digitizers

Another specialized peripheral lets you produce custom graphics on a home computer. A few computers now let the creative artist enter freehand or traced drawings into a computer using an electronic drawing board, most often called a *digitizer* ($150 to $500). The surface of a digitizer senses the pressure of a pen or pencil. It converts the lines drawn on its surface into lines on the computer's monitor—just as though you were drawing on the screen.

To be used effectively, digitizers need companion software that gives artists much more power over their creations. For example, by pressing at two points on the digitizer, you can have the computer draw a perfectly straight line between the two points. Since the software is doing most of the work, shopping for the right graphics software is important. Unless your home holds a talented computer artist-to-be, a digitizer should be looked upon as an option of very low priority.

Speech and music synthesizers

At this stage, only a few computer models offer speech synthesizers or music synthesizers as options.

A *speech synthesizer* ($150 to $250) electronically creates voices, without using any tapes, records, or moving parts. Voice quality on various machines ranges from a monotone, robotlike voice to very realistic human-sounding voices. Only software especially written for a speech synthesizer will create the voice.

Some educational software needs a speech synthesizer to give directions to children who are too young to read instructions on the screen. Most synthesizers allow a home programmer to add voices to simple BASIC programs.

A budding musician will undoubtedly become fascinated with the *music synthesizers* of many computer models. Some have built-in multiple-tone synthesizers that can be programmed directly with the machine's BASIC language. A few models offer optional music synthesizers, some complete with a piano keyboard. Musicians can create new electronic sounds or play traditional music, reproducing several instruments. The computer records the music as electronic pulses on disk or cassette. During playback, the computer can vary the meter, tempo, and pitch at your direction. Music synthesizer peripherals are relatively expensive, costing as much as $1000. Many dealers do not carry them because they are so specialized.

Computer specifications

Because home computers grew out of an industry that started with computer engineers selling to dedicated computer hobbyists, much of their computer jargon has stuck. A successful first computer purchase will require a basic familiarity with a few of the terms and comparative measurements of a system.

Memory and storage capacity

The two types of computer memory, termed ROM and RAM, serve as storage space for the data you put into the computer as well as for the computer's operating system. This operating system performs what could be termed "housekeeping" tasks, which take up some of the storage space in memory.

RAM: The computer's gas tank. A computer's ability to hold and store information usually is rated by the amount of *Random Access Memory*

(RAM) it has. Each computer's specifications tell how much RAM is built into the console, as well as how much total RAM the computer can have by adding RAM expansion modules.

You can visualize RAM as being like a chalkboard with a grid of tiny squares. When you turn on the computer, the RAM "chalkboard" has nothing written in those squares. As you load a program or type characters on the keys, the squares fill up one by one with symbols that represent characters (letters, numbers, and spaces). When you turn off the computer, everything in the RAM is erased, just like wiping a chalkboard clean.

RAM is measured in a unit called a *byte* (pronounced "bite"). Each character or space loaded or typed into the computer takes up one byte of space. RAM is more commonly measured in a larger unit called a *Kilobyte,* abbreviated *K.* While the *Kilo* prefix should mean 1000, by a quirk of computer math a kilobyte is equivalent to 1024 characters. Disk drive storage capacity also is measured in Kilobytes. The higher the *K* rating on a disk drive, the more information you'll be able to store on a single disk.

The amount of RAM you need depends somewhat on the software format you'll be using at first. Cartridge software usually works with whatever amount of RAM is built into the computer. You'll rarely need to expand memory to run cartridge programs. Most cassette programs are written for systems with 16K RAM. Only the limited-memory computers (those in the under-$100 category) will need expanded memory to run cassettes. Disk drives and disk programs frequently need 32K, 48K, or 64K of RAM. Disk drives require larger memories for a couple of technical reasons, not the least of which is that disk programs are generally longer than cassette or cartridge programs. Also, some disk drives use part of the computer's memory to operate.

The RAM you'll need also depends on the complexity of the software programs you want to use. For instance, many games, home management, and educational programs require less RAM than more specialized programs like word processing or electronic filing. Check the RAM requirements of some of the software programs available for computers you're considering. This is especially important if a computer comes with a low RAM rating and is not easy to expand. See Chapter 5, "Buyer's Guide to Personal Computer Systems and Software," for examples of the RAM requirements of different types of software programs for each computer.

Adding more RAM. The amount of built-in RAM that comes with your computer should be enough to get you started. The time may come, however, when you'll want to increase the amount of memory available to you. This would happen for any of three reasons:

1. You want to use prewritten software that requires more than the built-in RAM;

2. You are writing programs longer than your computer's memory can hold at one time;

For many home computers, adding memory is as simple as plugging in a RAM expansion cartridge.

3. You are adding a disk drive that uses part of the computer's memory to function properly.

Most home computers are designed to make the upgrade to more RAM a snap. The most common method is to add a plug-in RAM expansion cartridge. On some computers, RAM expansion requires adding a plug-in card that goes inside the keyboard console.

If RAM expansion cartridges or cards for your machine come in varying amounts of added memory, you're better off buying the largest capacity you can. There is a peculiar "snowball" effect common to home computer owners. As they become familiar with computer uses at a given memory level, they usually want to go on to more sophisticated uses that require still more memory, and so on.

The deceiving ROM. Another kind of memory in the computer is called *Read Only Memory,* or *ROM.* Also measured in Kilobytes, a computer's ROM contains factory preprogrammed instructions that tell all those chips inside the console to behave like a computer. ROM also contains the computer's built-in programming language. The instructions in ROM are permanent; they cannot be altered by the user.

Generally speaking, the bigger the ROM, the more built-in language commands the programmer has available. That means that a 16K ROM computer usually lets the programmer create more complex programs (more clever graphics and sound, primarily) than can be created on an 8K ROM computer. ROM size, however, is a less important buying factor than RAM size. One ingenious engineer may be able to design 8K of ROM that can do what would ordinarily take 10 or 12K of ROM. Therefore, the numbers may be misleading. Incidentally, software cartridges contain ROM chips and thus add to the computer's built-in ROM when you plug in the cartridge.

Microprocessors

A *microprocessor* is the technical name for the single chip circuit (one of several in your console) that runs the whole show inside your computer. Since the microprocessor is responsible for directing information to all the right places in the system, it is also called the *central processing unit,* or *CPU.* The microprocessor is like a microminiaturized traffic cop that controls perhaps millions of pieces of information every second.

Some manufacturers make a big deal about the kind of microprocessor inside their computers. It is true that some microprocessors process information faster than others, which may be important in expensive professional computers. However, with few exceptions, most home computers operate at comparable speeds. Leave CPU concerns to the hobbyists and the programming professionals. The type of microprocessor used is rarely a critical factor when buying a home computer.

Graphics resolution

A more important specification is *graphics resolution.* This refers to the number of keyboard characters the computer can present on the screen, as well as the quality of the graphics (pictures, graphs, maps, or other visual displays). Graphics resolution capabilities depend on the computer's circuitry, not on the size of the TV or monitor screen you're using. There are two kinds of displays you will be working with: text and graphics.

Text displays. Text displays consist of letters, numbers, and punctuation. Text display specifications tell you the number of columns (characters) that can fit across the screen and the number of rows (lines) running down the screen. Simply, this tells you the amount of information that can be shown on the screen at
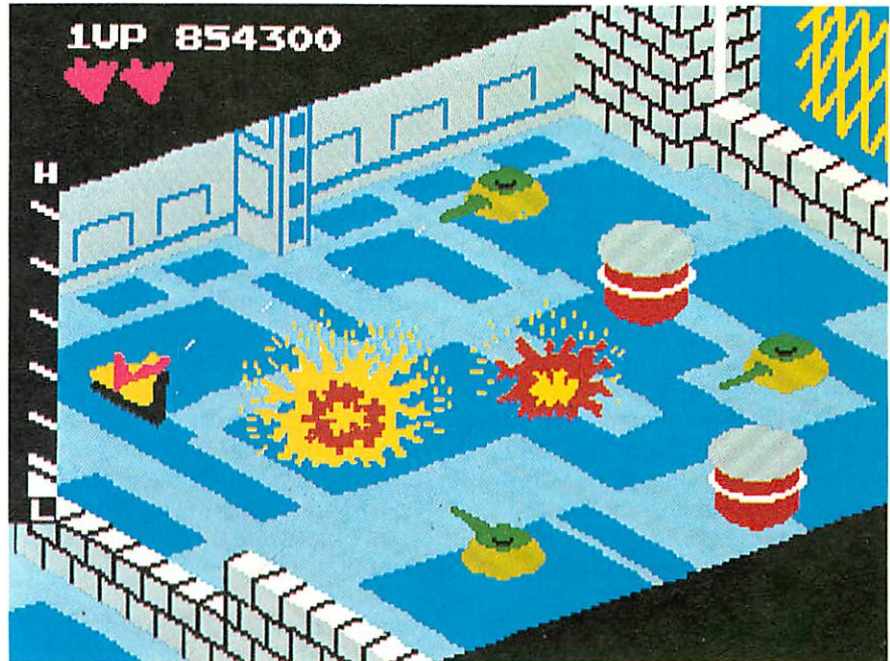
Many home computers have the capabilities to display colorful, exciting graphics in educational programs and games, like Colecovision's ZAXXON.

one time. Most under-$300 computers have in the vicinity of 32 columns x 21 rows. More expensive models have 40 columns. Many professional computers have an 80-column width (preferred for special uses like word processing because it lets you see the full width of a typed page). However, an 80-column text display is seldom needed for home use. Even if you think you might eventually want to print out letters or papers, the number of characters you can print per line depends on the printer and the software, not on the number of characters displayed on the screen.

Graphics displays. Graphics displays are measured by the number of individual picture elements, called *pixels,* that can appear on the screen. You might think of pixels as rows of little boxes, like on a sheet of graph paper. Shapes are formed on the screen when some of the little boxes are filled with different colors. In a graphics display, the video screen becomes an intricate

mosaic. The more pixels on the screen—and thus the smaller each pixel needs to be—the higher the resolution will be. The higher the resolution, the sharper the image. If you are interested in prewritten programs with interesting graphics, you should choose a computer with at least 32,000 pixels (multiply the horizontal and vertical pixel counts), with amounts greater than 48,000 preferred.

If you or your children want to create your own computer graphics, you will want a computer not only with 48,000 or more pixels of graphics resolution, but also with the ability to program the computer to draw shapes and designs in color. Check the BASIC language manual supplied with the computer, and look for graphics commands such as CIRCLE, LINE, PAINT, and DRAW. These commands indicate that, with practice, the beginning programmer can use the computer's video monitor as an electronic canvas. Without these kinds of commands, graphics program-

ming in BASIC will be limited to block and stick characters that are entered directly from the keyboard. Occasionally, graphics commands are only available in an expanded version of the BASIC language called Extended BASIC, sometimes available in a plug-in cartridge.

We offer two cautions about graphics resolution specifications. The first is that some computers boast optional, high-resolution capabilities (pixel counts above 60,000). Often this is possible using only one or two of the computer's 8 or 16 colors. Check the computer's BASIC manual under the subject "graphics modes" to find out if you will be limited in color selection in high-resolution graphics.

You should also be aware that creating graphics on the screen is one thing. Reproducing them on paper is another. If you want to transfer your computer art to paper, you'll need a printer capable of printing high-resolution graphics, which can be expensive.

Computer languages

As we've stated, knowledge of a computer language is not needed to run prewritten software. But youngsters always seem to want to make the computer do what *they* want. Programming a computer requires knowing a computer language. A computer language is a set of commands and instructions that the computer can understand and follow. Many people consider mastery of a computer language to be a key element of computer literacy.

A programming language is usually built into a computer's ROM. You may also buy software that lets you use additional programming languages.

BASIC

Most home computers come out of the shipping carton with a popular language called BASIC built into ROM. The few that do not must load a BASIC program each time from a disk, cartridge, or cassette. BASIC (which stands for Beginner's All-purpose Symbolic Instruction Code) uses many plain English words and provides good exercise in logically arriving at answers. Most machines come with a tutorial book that explains how to use the machine's BASIC language. BASIC, therefore, is one of the most accessible languages for beginning programmers.

Just like a spoken language, BASIC has many *dialects*—slightly different versions of the language. In fact, there are nearly as many dialects as there are home computer models. A computer cannot understand any dialect but its own. Many of the commands in the language are identical for all machines. But there are some variations in graphics, in wording, and in the precise way commands are typed on the keyboard. Computers featuring Microsoft BASIC (a language developed by Microsoft Corporation) are somewhat more compatible, but there will still be significant differences in graphics and sound commands.

No one BASIC dialect is necessarily better than any other. Once you're comfortable with one, you'll be able to pick up another dialect quickly if you change machines sometime later. Unless your child has already become fluent in a particular BASIC dialect at school and wants to work on the same programs at home, the BASIC dialect available on a computer should not influence your purchase decision.

For programmers who want to write more complex programs than the built-in BASIC allows, some machines offer a software program called *Extended BASIC*. Extended BASIC supplements the BASIC language already built into ROM. For some machines, Extended BASIC provides additional commands or specialized instructions, such as those used to create graphics.

Logo

Many schools that teach computer programming to elementary and high school students prefer a language called *Logo*. Logo was developed as an educational tool at the Massachusetts Institute of Technology. It is an easy-to-use language for children and beginning programmers. Logo takes varying forms on different computers. Essentially the user moves a symbol on the video screen to create graphics scenes and shapes. While doing this, the user is learning about geometry *and* about programming. Not all computers have Logo yet, but those that do offer the language on a software cartridge or disk.

Pascal

Another language gaining in popularity among serious programmers is *Pascal*. Programs written in Pascal generally operate at much faster speeds than those written in BASIC. Unfortunately, only a few lower-cost computers have the Pascal language software available.

Now that we've discussed the basics you need to know about computer systems, let's take a look at the types of educational software available for your family.

Chapter 4

LOOKING AT EDUCATIONAL SOFTWARE

To get the most from your computer system you need good software. When you take a computer out of its box and hook up the cables, the machine needs precise instructions to follow, in the form of programs or software. Even if you learn to write some programs yourself, all computer owners make use of prewritten software programs. Experts in computers write the programs that turn a keyboard console into any number of special-purpose tools for its human user. Software can turn your computer into an arithmetic teacher, a game player, a typing tutor, or a word processor for your children.

When choosing a computer for your family, the educational software available for a machine is as important as the machine itself. Here is an overview of the types of educational software you will come across, along with some guidelines for choosing and buying good software programs.

Types of educational software

Because the computer is a versatile teacher, educational software programs can use a variety of instruction or learning methods. Educators often divide educational software programs into basic types—drill and practice, tutorials, arcade-style learning games, problem-solving games, simulations, discovery, and tutee programs. We also include word processing programs, since they can be useful tools for older

students. Many educational software programs combine several types of learning. For example, some games combine arcade-style action with problem solving or drill and practice.

Drill and practice

This is the type of educational software most often found in the classroom. As the name suggests, drill-and-practice programs give students a chance to practice with skills or concepts they've already been taught. Many of these programs resemble the old flash-card learning system. After showing an example or two, the computer presents a series of problems or drills (for example, in arithmetic or algebra). The child is given two or three chances to come up with the right answer and to tap it out on the computer keyboard. If the child makes too many errors, the program may automatically repeat the problems or present another set of problems at the same difficulty level. A good score usually brings to the screen a rewarding phrase, a fanfare, or a cartoonlike scene. Then the program challenges the student with problems that are a little more difficult. Some drill-and-practice programs have a running clock to encourage students to think quickly.

Some software publishers have devised creative variations on the flash-card system. Because these are more fun, children want to use them more often. One example is *Concentration,* a game in which the student not only must figure out

the correct answer, but also must remember where that answer is hidden behind a grid of blocks. (For example, if the problem is to add 2 + 2, the student must know that the answer is 4 and then find the location of the 4.)

Tutorials

A tutorial teaches a new skill or concept. It can present nearly any topic; touch-typing, mathematics, and science are popular subjects for tutorials. This type of program teaches the basics of the material from the beginning, assuming that the child knows nothing about the topic. A good tutorial stands on its own, without additional help from parents or teachers. A tutorial goes through the subject matter one step at a time, with a quiz at the end of each mini-lesson. As the tutorial course progresses, the quizzes test for all the material the child has learned up to that point. An example is a map of the United States, in which the names of the states and their capitals are presented a few at a time. There are even tutorials to teach children simple computer programming.

Tutorials can be very creative and enjoyable. Many have excellent graphics and present ideas in interesting or unusual ways. Some even have animation and music.

Arcade-style learning games

This type of software mixes learning with the fun and challenge of arcade
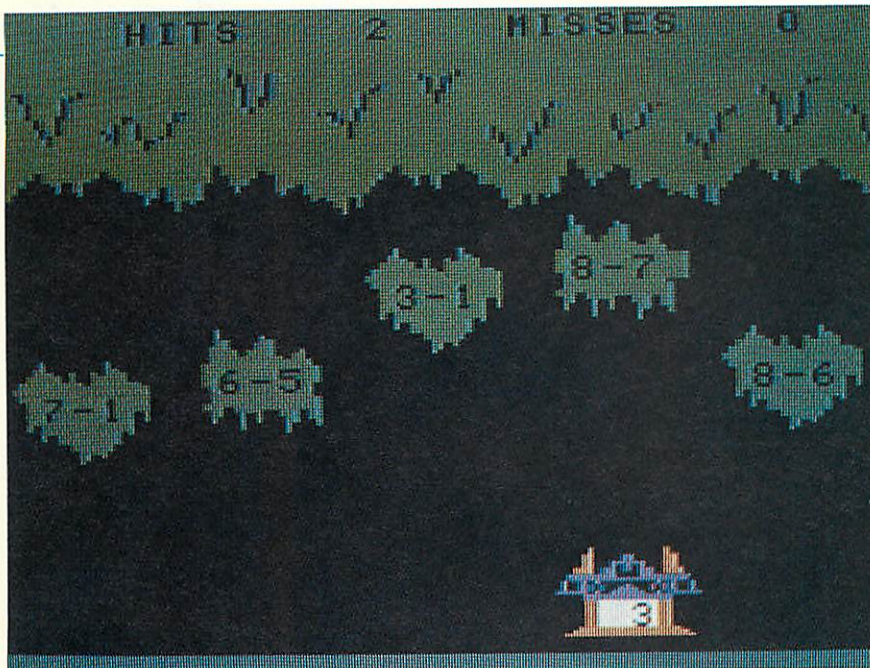
An arcade-style learning game, like TI's Minus Mission, can add fun and excitement to practicing basic math skills.

video games. The player wins points for performing tasks or learning concepts. The more the student learns, the better the score on the game.

A young child, for example, might be asked to find all round objects or all red objects. An older child might play a game much like bingo. In this game, the video screen shows two bingo cards, each with the same grid of numbers. The computer then presents three more numbers. With those three numbers, two competing children must create math formulas to arrive at the numbers on the bingo grid. For each correct formula, the computer puts a bean on a square of the bingo card.

Problem-solving games

Some of the most popular games ever devised are problem-solving games. The player must use logic to solve an unusual problem or a mystery. The player has to pick up facts and discover the rules of the game along the way. The player may have to work out three or four different parts to a puzzle and then put them together in order to solve another problem. These problem-solving

games delight preteens, teenagers, and adults.

Simulations

In a simulation, the computer puts you into an imaginary setting where you experience what happens in some real-life situation. You can drive a car, land an airplane, or take a trip to the stars. Or you may get the chance to prove a law of physics or mathematics (like the law of averages). In a simulation, you make choices and decisions as you try to perform the task. The computer shows you what would happen if you made those choices in real life. Did your plane make a perfect landing, or did you crash into the trees at the end of the runway? One simulation on ideal gas laws shows with exciting and dynamic graphics the results of mixing certain chemical elements—complete with explosions.

Discovery programs

In discovery programs (also called exploratory programs) children learn by experimenting and trying things out. Along the way, they

"discover" and learn. Logo is one example. Logo is a computer language, but it is also a learning experience. Logo features a "turtle" (a symbol that moves around the screen at the child's direction). The child can move the "turtle" around to create designs and shapes. At the same time, the child is discovering the basics of geometry and simple computer programming. Another discovery program lets the child compose music on the computer.

Tutee programs

In this type of program, the child becomes the tutor, and the computer becomes the student or "tutee." The child must "teach" the computer by answering its questions. One well-known game of this type is *Animal*. The computer asks questions to try to identify what animal the child is thinking of. A question might be "Does the animal have claws?" or "Does it have a beak?" The child must know or learn facts about animals in order to give the information to the computer. The computer stores the information for later use. The game becomes especially challenging when more than one player participates. The new player is then playing a guessing game with the computer based on information provided by someone else.

Word processing

For high school students, word processing can be a valuable contributor to schoolwork. A word processing program for young people should be *user friendly*: that is, it should be easy to work with. Most of the instructions for using the program should be available on the screen, requiring little or no reference to an instruction manual. The program should also contain safeguards that make it difficult to accidentally erase material. The codes for moving or editing text should be easy to remember and

logical. If the computer usually provides only uppercase letters (capital letters), you can buy word processing software designed to offer both uppercase and lowercase letters. Remember that printing the text requires the extra expense of a printer. However, word processing programs can be used simply to let students practice their writing. There are even a few programs written for younger children that let them practice and enjoy working with words.

Choosing educational software

The educational software best for home use often is not the type of software most frequently used in schools. Schools usually need fast drill-and-practice programs because a number of students must use the computer within a short period of time. At home, a child has time to get involved in solving a mystery, to learn touch-typing or Spanish, or to play a learning game over and over again. Since there are no required courses at home and no teacher to prod children, the software itself must be challenging, entertaining, and exciting enough so that young people want to use it on their own.

The best way to know what you're getting is to see a demonstration of a software package in the store. However, you will not always be able to see a program in action before you buy. A store may not be willing to open the box to show you how the program works, so you may have to rely on whatever information is printed on the package. Some software programs are available only by mail order, which makes a demonstration impossible.

A good way to get information is to read the software reviews in computer magazines. These reviews may be anything from brief descriptions to detailed discussions of the
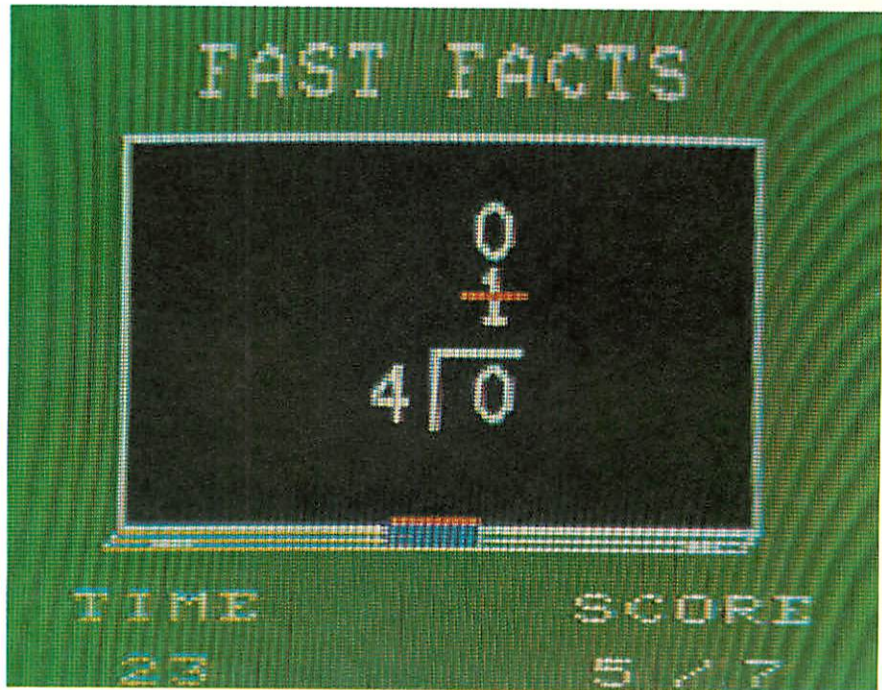
A running clock, a running score, a correct answer for each student error — these are some of the features built into effective educational programs, like this one from Milton Bradley.

program's advantages and disadvantages. Reading these reviews will keep you abreast of new packages as they come onto the market. Be sure to check the software recommendations in Chapter 5 of this book. If a program is included there, it meets certain basic requirements in terms of value, attractiveness, and effectiveness.

What to look for

Your family's individual tastes and interests play an important role in choosing software. However, there are certain features you should look for in educational software. Your computer investment will be more valuable if you try to find software that contains as many of the suggested features as possible.

Essential features:
1. Instructions on how to start using the program.
2. Examples that are carefully explained and easy to understand.

3. Short sentences with correct spelling, punctuation, and grammar (sadly, this is not always the case).

Additional valuable features:
1. Cues and prompts are given to aid the student and serve as hints or guides.
2. The student can control the pace and order of the material.
3. The student can enter and exit the program at any point. (Many students are frustrated when they are forced to cycle through material they've already learned from the beginning.)
4. HELP commands provide listings of codes and procedures used in the program.
5. Text on the screen is easy to read (and large enough for younger children).
6. The student can use abbreviations for No (N) and Yes (Y) in order to speed up the game or quiz.
7. Responses are timed with a running clock. (This can encourage quick responses but it also permits

the player to speed up or slow down the amount of time allowed for each answer.)

8. A running score gives continuous feedback on how the child is doing.

9. For each incorrect answer, the student is given a chance to try again.

10. If the student cannot answer, the program offers the correct answer.

What to avoid

There are some programs whose structure and setup create obstacles to learning and can frustrate children. Here are some guidelines on what *not* to buy.

Features to avoid:

1. Programs in which an incorrect answer causes the whole game to shut down or freeze.

2. Programs that are preset to move ahead after a certain number of seconds, whether or not the student has had enough time to answer the question.

3. Software that does not allow for a typing mistake or inappropriate answer, interpreting it as an incorrect answer. (For example, if the answer requires a number but the child types a letter, the program should offer the question again.)

4. Programs that only allow forward movement, so that the student cannot go back to review previous frames.

5. Programs that simply imitate a book format. (The best programs take advantage of the capabilities of the computer; they interact with the student and use visual displays, rather than simply placing book pages onto the screen.)

Software sources

Some educational software programs are produced by the computer manufacturers for use on their own machines. However, all computer manufacturers have limited resources for producing an extensive software library. Manufacturers that understand the importance of a large and diverse software library often encourage outside software programmers. A company may sponsor a software exchange club or service. It may even accept software written by individuals and market that software under its own brand name. Both plans let the company boost its software offerings without investing in a huge programming staff.

Many excellent software programs are available from sources other than the manufacturer (most often called *third-party* companies in the computer world). Some are no larger than an entrepreneurial teenage programmer operating out of the basement. Others are huge, multimillion-dollar software publishers.

Some manufacturer's software and third-party software is available in the stores. Of course, with so much software on the market for a number of computer systems, no one store can possibly have all the software available for your machine. In fact, a surprisingly large percentage of software packages designed for popular computers are sold only through mail order by third-party developers.

Check the advertisements in computer magazines for software offered by mail-order companies. Especially check the ads in those magazines written specifically for users of particular computer brands. Many small innovative software companies put their precious advertising dollars only into those specialized publications.

Some of the larger mail-order software companies offer discounts on packages. You can make your software budget go further by purchasing software through these discount mail-order firms. Of course, the disadvantage with mail-order software is that you can't see a demonstration of the package before you buy. And with most software—especially cassettes and disks—once you open it, you own it, even if you aren't satisfied. Try to buy from mail-order firms that offer money-back guarantees. Even if you can't return software simply because you don't like it, you should try to buy from a supplier who will stand behind the product if there are mechanical problems. Some stores and mail-order firms guarantee replacement if a mechanical difficulty develops within the first 30 days.

The next chapter takes a closer look at educational software available for specific computer systems. It lists some of the best educational programs available for each system. It will also help you decide if the types and quantities of software available for a system will meet your family's individual software needs.

Chapter 5

BUYER'S GUIDE TO PERSONAL COMPUTER SYSTEMS AND SOFTWARE

In this chapter we examine specific home computer systems in detail. For each computer, we discuss the capabilities of the basic computer hardware, as well as its peripherals or optional equipment. We recommend a starter system for each computer—the equipment you should probably consider including in your initial purchase. We also include a roundup of the types of software available for each computer, along with a list of recommended software packages for children of various ages. Finally, we evaluate each computer system's suitability as an educational tool for different age groups and different types of users. The information provided here should help you choose a home computer system that will meet the computer needs of your family.

The listings of recommended software programs do not attempt to include all educational programs available for each computer. The lists are intended to suggest some of the best educational programs and to give you some idea of the types of programs that are available. The recommended programs were chosen not only because they teach, but also because they make learning fun. Many are enjoyable for parents as well as children.

The description for each software package includes the name of the program or group of programs; the software publisher; the approximate retail price; the software formats in which it is available (cartridge, cassette, or disk); appropriate age ranges; the type of instruction used (drill, tutorial, discovery, simulation, problem-solving, or arcade game); and, in some cases, additional equipment needed to use the program (such as a joystick). When a software program is available for more than one computer, the full description is usually given only once. The program is listed with each computer for which it is available, and that listing refers you to the full description.

Some of the computers included here are quite new to the market. These new machines offer high-quality hardware at reasonable prices, but they may not yet have large amounts of educational software available. The value of such a machine to parents may increase dramatically if a variety of high-quality software is produced for that machine. This is likely to happen if the machine is low-priced, if it has good graphics and accessories, or if it includes some special feature (such as good sound or a graphics tablet). A computer with these qualities is likely to attract educational software in the future and may be a good purchase.

In the meantime, if the price is low enough, ask yourself if you can use the hardware while waiting for more educational software to appear. If your children are computer-oriented and are junior high or high school age, they may want to start using the computer to learn typing or simple programming. In those cases, even without a variety of software available, the purchase may be worthwhile now. If your children are younger, they are less likely to be learning programming and will need to have software programs available. For younger children, you should probably consider a system that is better supported by educational software.

Even machines that have been on the market for some time have varying amounts and types of software programs. Before making a purchase, you should consider whether the software available for a particular computer will meet your family's needs.

All prices listed for computer hardware and software are approximate retail prices. Manufacturer's prices are subject to change, and actual prices you see in the stores may vary considerably. Due to strong competition, manufacturers and individual dealers may offer discounts, rebates, or package deals. Be sure to shop around for the best price before making a purchase.

Apple IIe

One of the first personal computers to appeal to a broad spectrum of people outside the computer community was the Apple II Plus. The Apple IIe (e for *enhanced*) is an updated version of the Apple II Plus, introduced in early 1983 to replace the Apple II Plus. The company hopes that the IIe will follow in the footsteps of its very popular predecessor.

Apple computers have been used extensively in school systems, which is one reason why there is so much software for them. Many students who learn programming in school do so on an Apple, which has also contributed to its popularity.

The Apple IIe is primarily directed toward the adult and professional market. We mention it here because of the tremendous amount of educational software originally written for the Apple II Plus, most of which can be used with the Apple IIe.

Apple IIe computer, with the Apple Monitor III and disk drive

Hardware

The Apple IIe comes with 64K of RAM built in. It can be expanded to 128K. The Apple IIe has a heavy-duty keyboard that resembles a high-quality standard typewriter in both layout and touch. It offers high-resolution color graphics and a simple built-in tone generator. (However, the tone generator is not as complex as those on the Atari computers or the Commodore 64.) The screen shows uppercase and lowercase letters, and the starter package includes a high-quality monitor.

Peripherals

One of the main reasons that the Apple has won the hearts of so many is that it is a flexible machine. Inside the keyboard console are several expansion connectors that accept a variety of plug-in interfaces (also called *cards*). Largely available from third-party companies, these interface cards let you add a variety of features and use the machine in more ways. For example, one card gives you an 80-column-wide text display—highly desirable for word processing and other programs that use a large amount of text. Another lets you turn the Apple into a sophisticated music synthesizer, controlled by an electronic piano keyboard.

Every accessory—except a video monitor, a cassette player/recorder, and game controllers—requires an interface card. That's why the first disk drive is more expensive than the second disk drive; the first comes with an interface that accommodates the second drive as well. Peripherals (such as printers, digitizers, and speech synthesizers) also need interface cards before they'll work with the Apple.

Connection to a home color TV requires an optional RF modulator, available from an Apple dealer for about $20 to $25. If text is more important to you than color graphics, the Apple Monitor III is recommended. Text, especially in the 80-column format, is easier to read on the Monitor III. This video display is a green-screen monochrome video monitor. It reproduces high-resolution graphics shapes, but in only the same green color as the text. It is not unusual for families to own both a monochrome monitor and a color monitor, to accommodate varied kinds of uses by different members of the family.

The Apple IIe is an expensive system for a beginning computer. The recommended starter system of computer, 80-column text card, disk drive, monitor, and stand is a special package offered by Apple. Its $1995 cost represents a savings of over $300 compared with buying these components individually. Some stores even throw in additional "sweeteners," like free software. Even if you plan to use the

Apple IIe

Memory
Built-in RAM: 64K
RAM expandable to: 128K
Built-in ROM: 16K

Graphics resolution
Text: 40 characters x 24 lines
(80 characters x 24 lines
with optional 80-column
text card)

Color graphics:
1,920 pixels (40x48)
in 16 colors
26,880 pixels (140x192)
in 4 colors
53,760 pixels (280x192)
in 1 color

Video output
Composite video for video
monitor
Optional RF modulator for home
color TV

Software formats
Cassette
Disk

Approximate retail prices
Base price $1395

Accessories:
1st 140K disk drive $545
2nd 140K disk drive 395
80-column text card 125
80-column text/64K RAM
expansion card 295
Apple Monitor III 249

Recommended starter system
64K keyboard console,
80-column text card, disk
drive, Monitor III, and monitor
stand. (All are included in a
special package from Apple
for $1995.)

Apple IIe with your home TV set, this company-sponsored package is worth the money. So much software is available on disk that you will probably not want an Apple without a disk drive. To buy only the computer and the disk drive would cost $1940. For only $55 more, the package gives you the more professional hardware, which allows you to expand into more serious computing.

The Apple *Owner's Manual* (included) is one of the industry's best introductions to home computing. It guides the complete beginner in getting the system going. On the other hand, Apple is one of the few companies that does not provide BASIC programming instructions with the computer. If you want to explore the built-in Applesoft BASIC (which resembles Microsoft BASIC), you may spend as much as $50 for additional manuals.

Many authorized Apple dealers can repair Apple computers and accessories, often without sending

them away for repair. A service plan is available in which one fixed price covers all repair expenses for a period of a year.

Software

The Apple IIe can use almost all of the software originally written for the Apple II Plus, which gives it an instant software library in all areas, with an extremely strong showing in educational software. The Apple II Plus had more software written for it than has been written for all other computers combined. Many programs originally written for the Apple II Plus (for example, in the word processing field) are being revised to take advantage of the Apple IIe's additional capabilities.

Along with the BASIC language built into the computer, you can purchase software for other programming languages. Logo, Pascal, and several other languages are available on disk for the Apple IIe,

either from Apple or from third-party companies.

The educational software programs recommended here are only the tip of a very huge iceberg. People seem to create ten new programs for the Apple every minute of every day, so the iceberg keeps growing. All programs reviewed here operate on the standard 64K of RAM built into the Apple IIe.

Suggested software programs

PLATO courses (Control Data Publishing. About $45 to $50 each. Disk. All ages. Drill, Tutorial.) These courses were originally created by elementary and high school educators, with the help of Control Data's PLATO (a computer language designed to help non-computerists create educational materials on computers). PLATO courses for the Apple include basic arithmetic, reading, grammar, social studies, science, and foreign languages. Some, but not all, of these courses are available for the Atari 800 and TI 99/4A computers. Also see *PLATO courses* under software for TI-99/4A.

Delta Drawing (Spinnaker. About $60. Disk. Ages 4 to adult. Discovery.) This is one of the best educational packages you can buy for the Apple. Children use it to create beautiful, colorful pictures and geometric shapes. As they draw, they are programming. They can manipulate the programs to build even more elaborate and interesting pictures. *Delta Drawing* is a must if you have small children or if you want your children to learn to program. More *Delta* programs are on their way, including *Delta Math, Delta Writing,* and perhaps *Delta Music.* Also see *Delta Drawing* under software for IBM PC.

Apple Presents (Apple and Children's Television Workshop. $50 per package. Disk. Ages 4

to adult. All modes of learning. Some require game paddles.) There are four packages available for a total of 18 programs. The packages are called *Instant Zoo* (ages 7 to 10); *Mix & Match* (for the whole family); *Ernie's Quiz* (ages 4 to 7); and *Spotlight* (ages 9 to 13). The recommended age levels for these packages are conservative in both directions. Three-year-olds as well as thirty-year-olds have found *all* of the packages stimulating and exciting. The 16 programs contained in these 4 packages are hard to describe. They involve pattern recognition, strategy and tactics, physics, counting, word play, parts of the body, and more. These packages are well worth the price.

Apple Logo (Apple/Logo Computer Systems. About $175. Disk. Ages 5 to adult. Discovery.) Logo is the famous computer learning language for children, pioneered by Seymour Papert at MIT during the 1970s. Logo features a variety of symbols that the child can move around the screen to create interesting shapes and pictures. Logo is not as easy to use as *Delta Drawing,* but it is an excellent intermediate step in teaching a child how to program. It also illustrates basic geometry concepts.

Story Machine (Spinnaker. About $35. Disk. Ages 5 to 9. Simulation, Discovery.) See *Story Machine* under software programs for Commodore 64.

Hey Diddle Diddle (Spinnaker. About $30. Disk. Ages 3 to 10. Discovery.) See *Hey Diddle Diddle* under software programs for Commodore 64.

Snooper Troops, Cases #1 and #2 (Spinnaker. About $45 each. Disk. Ages 10 to adult. Discovery, Problem-solving, Simulation.) See *Snooper Troops* under software programs for IBM PC.

FaceMaker (Spinnaker. About $35. Disk. Ages 4 to 12. Discov-

ery.) See *FaceMaker* under software programs for IBM PC.

Deadline (Infocom. About $50. Disk. Ages 12 to adult. Simulation, Problem-solving, Discovery.) See *Deadline* under software programs for IBM PC.

EduFun! (Milliken. About $30 on cassette; about $33 on disk. Ages 5 to adult. Arcade games.) There are 8 packages with 2 games per package. These games teach word and number skills by challenging the child to contests against creatures like aliens, big hungry fish, or battling bugs.

Stickybear (Xerox Education Publications/Weekly Reader. About $40. Disk. Ages 3 to adult. Arcade game, Discovery, Drill.) There are four programs: *Stickybear Bop* (shooting gallery), *Stickybear ABC, Stickybear Numbers,* and *Old Ironsides* (a naval battle game). The computer cartoons with full-color moving pictures make these programs unusual, attractive to children, and worth the price.

Language and math programs (Milton Bradley. About $50 each. Disk. Ages 11 to 14. Simulation, Drill, Discovery. Some require game paddles.) Subjects include vocabulary, punctuation, decimals, division, and mixed numbers. The programs were designed by teachers skilled in both computers and teaching. These programs use

Math program/Milton Bradley

high-quality graphics and present the educational material in the company of wizards, aliens, and electronic books.

Bank Street Writer (Brøderbund. About $70. Disk. Ages 6 to adult. Discovery. Printer recommended but not required.) The *Bank Street Writer* is a very useful word processor, but it is also a great learning program for the whole family. You can easily make, erase, change, and print words. The program creates its own letters, and they're really quite handsome. You do your writing in a little box on the screen, which you can easily fill with words. This is much less intimidating for children than trying to fill in a big blank sheet of paper.

In Search of the Most Amazing Thing (Spinnaker. About $40. Disk. Ages 10 to adult. Simulation, Discovery.) See *In Search of the Most Amazing Thing* under software programs for Commodore 64.

Chem Lab Simulations (High Technology Software. About $100 per package. Disk. Teenagers through adults. Simulation, Problem-solving, Discovery. Paddles required for package Number 2.) See *Chem Lab Simulations* under software programs for Atari.

MasterType (Lightning Software. About $40. Disk. Ages

Language program/Milton Bradley

5 to adult. Drill, Arcade game.) See *MasterType* under software programs for Atari.

Is the Apple IIe for you?

Because of the high investment required, the Apple IIe may ask too much of a commitment for a first-time computer buyer. But it is often the ideal system for families who have outgrown the under-$100 "learning" computers, or who have several children with a variety of needs and interests. Some parents may feel that the Apple IIe is worth the price just to be able to use its high-quality, diversified educational software.

Students who have been learning programming on an Apple in school (especially those who show a high aptitude and interest in programming) may be dissatisfied with a less powerful computer. For a child who is serious about computing, there are more books, magazines, advanced software, and fellow computer hobbyists accessible to Apple users than to users of any other home computer. This will probably continue to be true for at least a couple of years.

Atari 400, 800, 1200XL

Although the Atari name is best known for home video games, the company has become a major factor in the home computer market. Three Atari models—the 400, the 800, and the new 1200XL—are all essentially the same computer inside. They differ primarily in their keyboards, amounts of memory, and expandability. Much of the Atari software will run on all three machines. However, some programs for the 800 and 1200XL require more RAM than the 400 can handle. The Atari computers feature rich graphics and sound, and they are very easy to use, especially for little children.

Atari 400 computer

Atari 400 hardware

The Atari 400 is the widest selling Atari because of its low price. Although the suggested list price is near $300, actual store prices in this competitive market are under $200. Memory is limited to 16K, which is adequate for the large library of plug-in cartridge software available from Atari and independent software companies. Some third-party companies offer RAM expansion kits that should be installed by a dealer. (Adding such a RAM expansion device to the 400, however, voids the Atari warranty.)

You can hook up a disk drive to a 400, but most disk programs require more than 16K RAM. Therefore, you'll probably want to stick with Atari's optional cassette program recorder. Because a special connector is required and some of the cassette programs have unique formats, only an Atari program recorder will work. The optional RS-232 interface module allows you to connect a telephone modem to the 400.

The 400 is one of the few home computers that does not have the BASIC language built into the computer console. Atari BASIC comes in a separate cartridge, which is an option for the 400. The 400 is also one of the few remaining home computers with a flat membrane keyboard.

Atari 800 hardware

The Atari 800 is a much more versatile machine than the 400. The 800 offers 48K of built-in RAM, giving it considerably more memory than the 400's 16K of RAM. The 800 features a full-travel typewriterlike keyboard. The Atari BASIC language cartridge is included with the

Atari 800 computer

The HELP key will provide on-screen aid and information; the function keys will save time by reducing the number of keystrokes required to enter commands. In the meantime, all 400/800 software in cartridge, cassette, and disk formats can be used with the 1200XL.

Atari's service network is one of the largest of all home computer manufacturers, thanks in part to the broad popularity of the company's home video games. Nearly every major community has either an Atari-owned or an Atari-authorized service center.

Software

To help first-time computer buyers put together a hardware/software system, Atari packages special kits that offer savings on selected software programs and peripherals. The Educator Kit, for example, features a cassette program recorder, a BASIC language cartridge, and the *States and Capitals* software program, for a savings of about $10. Other kits focus on telecommunications, BASIC programming, and entertainment. If your interests lie in any of these areas, we recommend these packages.

800. Actual dealer prices for the 800 have been in the $500 range (much less than the list price of $679).

Although you can run disk programs on the 800, you should start with the cassette program recorder because many Atari educational and self-help programs are available only on cassette. This means that you will want to keep the cassette machine handy even if you have a disk drive on the system.

Atari 1200XL hardware

The Atari 1200XL, a low-profile keyboard console with built-in 64K RAM, is the newest of these three Atari models. Upgraded features from the 800 include a series of function and HELP keys. These keys are to be controlled by software especially developed for the unit.

For educational purposes, a series of Atari cassette tape programs provides recorded voice instruction while the computer presents information on the screen. The series includes three courses that teach programming. Other courses teach geography, touch-typing, speed-reading, and foreign languages (French, German, Italian, and Spanish).

In addition to Atari BASIC, programming enthusiasts can choose Microsoft BASIC—a faster, more complete dialect of BASIC. The Microsoft BASIC comes on disk and requires a minimum of 32K RAM. Therefore, you'll need to have an Atari 800 or 1200XL to use Microsoft BASIC. Atari has also developed a Logo cartridge.

Atari 1200XL computer

Atari 400
Atari 800
Atari 1200XL

Memory

	400	800	1200XL
Built-in RAM:	16K	48K	64K
RAM expandable to:	NOT	NOT	NOT
Built-in ROM:	10K	10K	10K

Graphics resolution

Text: 40 characters x 24 lines

Color graphics:
15,360 pixels (160x96)
in 4 colors
61,440 pixels (320x192)
in 1 color

Video output

400 and 800—Built-in RF
modulator for home color TV
1200XL—Composite video for
video monitor
Built-in RF modulator for home
color TV

Software formats

Cartridge
Cassette
Disk

Approximate retail prices

Base prices:
Atari 400 . . . . $299
Atari 800   679
Atari 1200XL   899

Accessories:
92K disk drive $600
Cassette program recorder . . .   100
40-column printer   299
80-column printer   549
Acoustic modem   200
Interface module   220

Recommended starter system

Atari 400 or 800 computer,
Cassette program recorder

For a variety of home applications, Atari is developing powerful programs that are very easy to use, like the *Home Filing Manager* (disk, 16K RAM), one of the simplest electronic card file programs available. Word processing programs are very popular now that Atari has an 80-column dot-matrix printer (which requires the RS-232 interface module). However, the text display is limited to 40 characters across the screen at any one time.

In addition to Atari's own programs, the company sponsors APX (Atari Program Exchange), which markets independent programmer's software. Cash prizes are awarded regularly to authors of the best programs. Most of the awards thus far have gone to people who have only recently been introduced to computers.

The Atari color graphics capabilities are one reason that these computers are popular with children. Nine graphics modes give the BASIC programmer great flexibility in text, graphics, and mixed displays. This potential can be used to produce extremely attractive software. Although not all the colors can appear on the screen at the same time, there is a vast palette of colors from which to choose. The BASIC graphics commands can create interesting screens for educational or other software.

Most software programs for Atari are in the entertainment field. Atari itself makes plug-in cartridges for most of the popular arcade games (like *Asteroids, Pac-Man,* and *Centipede*). But entertainment includes more than shoot-'em-up games, as can be seen from the following reviews of suggested software. Unless otherwise noted, all Atari programs listed here require 48K of memory.

Suggested software programs

Paint (Reston/Capital Children's Museum. About $40. Disk. Ages 3 to adult. Discovery. 48K RAM and Joystick required.)
Paint turns you into an artist. It gives you amazing tools to work with, including brushes of different sizes, and pots and pots of different colored electronic paint (all on the picture screen). You paint by moving the joystick and holding the "fire" button down to lower the paintbrush on the screen. You can "zoom" in and see your pictures from an ant's-eye view. You can also save them on disk and hold an "art show."

MasterType (Lightning Software. About $40. Disk. Ages 5 to adult. Drill, Arcade game.)
This is a "typing tutor" program, but before you start to yawn, watch out! Here comes a missile to attack your command ship. To destroy the missile before it destroys you, you must type in a word displayed in a corner of the screen. Just as the missile
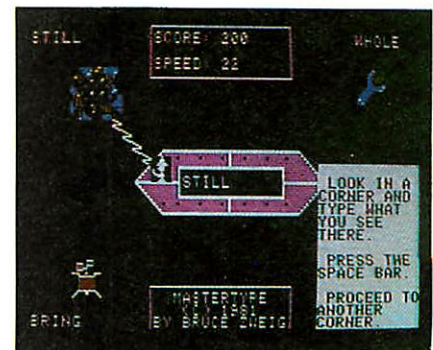
MasterType/Lightning Software

nears your command ship, you complete the word and a laser beam fires from your ship. The attacking missile is destroyed. The program is exceptionally well designed, easy to use, and an exciting way to learn touch-typing.

The Learning Center (The Programmer's Institute. About $75 on cassette; about $80 on disk.

Ages 3 to 7. Drill.) The programs are colorful, simple, and well-designed. They appeal to three-year-olds, seven-year-olds, and all ages between. Programs cover language skills, math and number skills, and special skills (like recognizing colors and identifying different shapes). The light pen (about $30 to $35), which is optional, adds a new dimension to the programs and frees the child from the keyboard.

Player Piano (APX/Jerry White. About $23. Cassette or disk. Ages 4 to adult. Discovery. Atari BASIC cartridge required. Cassette requires 24K RAM; disk requires 40K RAM.) This software turns the computer into a twenty-note mini-piano with the ability to play and store original music (sequences of notes) composed by the child.

Counter (APX/Al Casper. About $30. Cassette or disk. Ages 3 to 8. Tutorial, Drill. Atari BASIC cartridge required. Paddles or joystick optional. Cassette requires 16K RAM; disk requires 24K RAM.) This program introduces counting in four languages (English, French, German, and Spanish). Music and colorful displays entice children to play with the program.

Logo (Atari. Under $100. Cartridge. Ages 5 to adult. Discovery. Requires 16K RAM.) See *Logo* under software programs for Apple IIe.

PILOT (Atari. About $80. Cartridge. Ages 8 to adult. Discovery.) PILOT (Programmed Inquiry, Learning, or Teaching) is an easy way for children to start learning about programming. The commands are so short and simple (only one or two letters long) that even younger children can learn them. Atari PILOT employs "turtle" graphics. The "turtle" is actually a triangle on the picture screen that can be taught to draw and color in pictures.

Hey Diddle Diddle (Spinnaker. About $30. Disk. Ages 3 to 10. Discovery.) See *Hey Diddle Diddle* under software programs for Commodore 64.

FaceMaker (Spinnaker. About $35. Disk. Ages 4 to 12. Discovery.) See *FaceMaker* under software programs for IBM PC.

PLATO courses (Control Data Publishing. About $45 to $50 each. Disk. All ages. Drill, Tutorial.) See PLATO *courses* under software programs for Apple IIe and for TI-99/4A.

In Search of the Most Amazing Thing. (Spinnaker. About $40. Disk. Ages 10 to adult. Simulation, Discovery. Atari BASIC cartridge and joystick required.) See *In Search of the Most Amazing Thing* under software programs for Commodore 64.

The Preschool Library (Program Design, Inc. About $60 on cassette; about $70 on disk. Ages 3 to 6. All modes of learning. Cassette requires only 16K. Disk requires 24K. Joystick required. Disk requires cassette also for audio part of programs.) These programs build skills such as recognition of shapes, numbers, and letters; concepts of same and different; listening abilities; hand-eye coordination; and perception of different directions. All of these programs (including two interactive games) offer excellent narration and music, with simple animation that holds the child's interest. These programs are highly recommended.

Chem Lab Simulations (High Technology Software. About $100 per package. Disk. Teenagers through adults. Simulation, Problem-solving, Discovery. Requires 32K.) There are four packages in this set of laboratory simulations intended for high school and college students. (Number 2 is not available for Atari computers but is available for Apple computers.) The programs come with manuals
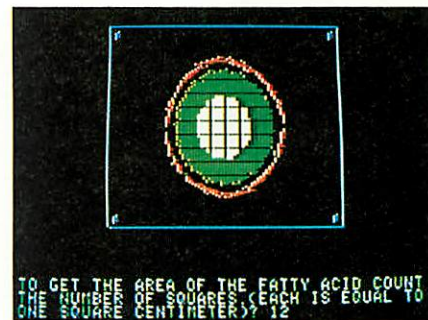
Chem Lab Simulations/High Technology Software

that contain exercises. The graphics and movement that accompany experiment results resemble those that would occur in a laboratory. This is a challenging and valuable set of programs for older students interested in science.

Delta Drawing (Spinnaker. About $60. Disk. Ages 4 to adult. Discovery.) See *Delta Drawing* under software programs for Apple IIe.

Is an Atari for you?

With its membrane keyboard, the Atari 400 is designed to take a beating from even the youngest user. However, more experienced users who want to do programming on the 400 are likely to be frustrated by the lack of real keys and the machine's limited memory. The 400's low price, plus good graphics and sound, make it a good choice for very young children.

For junior high and high school students who are becoming familiar with computers in school, the Atari 800 is the most useful choice of the three.

Right now, we see no practical incentive to buying the more expensive Atari 1200XL. Until a variety of software is available that takes advantage of the new features on the 1200XL, the 800 is a much better buy as the core of an expandable system.

Commodore VIC 20

The inexpensive Commodore VIC 20 is one of the most popular computers to date. Although the list price is $199.95, many stores are offering the VIC 20 for much less—sometimes for under $140. The popularity of the VIC 20 is attracting many third-party software and hardware companies to support the VIC 20. A vast majority of the software, however, focuses on games and other entertainment. There is not much educational software, and home management programs are hard to find.

Hardware

One of the reasons for the VIC 20's low price is the absence of panel-mounted connectors for some of the peripherals. The Datasette program recorder, for example, has a special connector on its cable that slips over an exposed edge of the computer's main circuit board through a slot in the rear of the console. The base unit comes equipped with only 5K of RAM, which will handle cartridge software. More than 5K of RAM is usually needed for cassettes and disks. The machine is rated to expand up to 32K of RAM, but no more than one Commodore 16K RAM expansion cartridge can actually be added to the VIC 20 for a maximum total of 21K. Some third-party suppliers are producing expansion boards with multiple connectors for extra RAM cartridges.

BASIC programmable color graphics resolution for the VIC 20 is below that of comparably priced computers. However, the VIC 20 also has a built-in set of 64 graphics shapes (straight lines, curves, blocks, diagonals) that can be programmed directly from the keyboard in BASIC. The manual that comes with the computer describes how the video screen is divided into a grid of small blocks. By carefully selecting and placing small

Commodore VIC 20 computer, with game cartridges

graphics shapes in these grid locations, larger shapes are formed on the screen. The process is something like piecing a jigsaw puzzle together. It takes time and practice, but it is possible.

Another appeal for game programmers lies in the VIC 20's sound capabilities. Using BASIC, you can summon the computer's voices in three tonal ranges (which can all "sing" at once), plus another "voice" that generates noise. Combining tones and noise, you can create interesting sound effects for fun or for added effects in BASIC programs. Also, the VIC 20 manual provides a chart of tone values corresponding to notes of the music scale. By typing in a short program listed in the manual, you can turn the top row of the keyboard into a simple eight-key piano.

This kind of instant action with the computer—even if more for learning and fun than for practical application—is typical of what the reader will find in the VIC 20 manual. The first two chapters (ten pages) guide the user through enough essential features of the machine so that he or she can jump ahead to any favorite area: screen/keyboard; color and graphics; animation; sound and music; and programming.

Peripherals

One of the VIC 20's greatest strengths is its line of low-cost peripherals that allow upgrading without a hefty investment. Of special note are the 170K disk drive (about $400) and the VICMODEM (about $110). The modem is a cartridgelike box that plugs into a con-

nector at the rear of the console. With the feature of composite video output for the VIC 20, Commodore has recently added a 10-inch color monitor for only about $300. Included with the VIC 20, however, is a separate RF modulator for connection to a color TV.

Software

Commodore has not earned a good track record in supporting its earlier computers with a wide diversity of software or in communicating well with consumers in the United States. This trend is changing slowly with the VIC 20 and the Commodore 64. Commodore's own VIC 20 software library includes about 30 games and children's activities, plus several programming tutorials and aids for the more

serious programmer. But the biggest catalogs of VIC 20 software are from outside software companies that advertise in computer magazines. Commodore is promising to make a greater effort to produce more software and to encourage independent software developers.

The VIC 20 is one of the biggest-selling personal computers ever marketed. Given its popularity, its price, and its simple and powerful keyboard, the VIC 20 should attract additional educational software in the near future. (Note that software for the Commodore 64 will not work on the VIC 20, and vice versa.)

When you buy a VIC 20, you need not immediately buy expensive software. Instead, spend a week or two with your children exploring the VIC 20 keyboard. You can invent games like "fly the cursor," "march-

ing alphabets," or "rainbow numbers" just by experimenting and pressing interesting-looking keys, like the "Shift," "Ctrl," and Commodore-logo keys.

Suggested software programs

Math programs (Micro-Ed. About $8 to $15 each. Cassette. Ages 5 to 12. Drill.) This series of simple programs includes *Math Bid* and *Count 'Em*. The programs help children with their counting and basic arithmetic skills (adding, subtracting, multiplying, and dividing).

Language skills programs (Micro-Ed. About $8 each. Cassette. Ages 5 to 11. Drill.) This is a group of programs on language skills, including *Matching Capital Letters, Matching Small with Capital Letters, Which Letter is Missing?* and *Identifying Complete Sentences.*

Reading Comprehension programs (Micro-Ed. About $35 to $85 per set. Cassette. Ages 5 and up. Drill.) This is a series of cassettes that work with primary grade readers to help increase their reading confidence, speed, word recognition, and vocabulary.

Is the VIC 20 for you?

To date the VIC 20 has primarily been a game-oriented computer. Although the sound, color, and price make it a potentially good vehicle for educational software, such programs have been slow to develop. For preschoolers and younger elementary school students, the VIC 20 can provide a short-term, inexpensive alternative. However, it will not expand well as the children advance. It is not the best choice for high schoolers who want to learn typing or word processing. If your child is intent on learning about computers, there are better long-term choices.

Commodore VIC 20

Memory
  Built-in RAM: 5K
  RAM expandable to: 32K
  Built-in ROM: 16K

Graphics resolution
  Text: 22 characters x 23 lines

  Color graphics:
    506 pixels (22x23)
    in 8 colors
    32,348 pixels (176x184)
    requires extended
    BASIC and memory
    expansion

Video output
  Composite video for video
    monitor
  Separate RF modulator box for
    home color TV included in
    base price

Software formats
  Cartridge
  Cassette
  Disk

Approximate retail prices
  Base price $200

  Accessories:
  170K disk drive $399
  Datasette program recorder . . . 75
  8K RAM expansion cartridge . . 50
  16K RAM expansion cartridge . 80
  Color video monitor 299
  Graphics printer 395
  Plotter printer 199
  Modem cartridge 110
  RS-232 interface 50

Recommended starter system
  VIC 20, Datasette program
    recorder

Commodore 64

A considerable step-up in features over Commodore's VIC 20 is the newer Commodore 64. The cost of this machine is dropping somewhat as more general and mass merchandisers carry the 64 at discount prices.

Hardware

The Commodore 64 looks very much like the VIC 20 on the outside, except for the color. They even have an identical layout of connectors and slots for cartridges and peripherals. Despite this similar appearance on the outside, they are quite different machines on the inside.

The most noticeable improvement in the Commodore 64 over the VIC 20 is a remarkable amount of memory for the money—64K of RAM. This 64K is enough to handle even many small business chores with ease. Text display is improved to 40 characters across, and some third-party companies offer an 80-column text display upgrade. The large amount of ROM (20K) provides additional color graphics and sound capabilities.

Color graphics are much enhanced over those on the VIC 20. The same graphics shapes are programmable from the keyboard, but the 64 also features a sophisticated graphics technique called *sprite graphics*. Essentially, this allows a user who is knowledgeable in programming to create as many as eight special shapes that can then be directed to move around the screen independently. This capability holds promise for very clever displays in entertainment and educational software.

A much more sophisticated sound synthesizer is built into the 64. The programmer has three voices, each with a tonal range of nine octaves. Improved tonal quality control is available, as well. As with expensive music synthesizers, sound on the 64 is programmed for the type of waveform the sound should be (sawtooth, triangle, variable pulse, and noise), as well as for the following sound-generation parameters: attack, decay, sustain, and release. Adding to this versatile sound package is an optional speech synthesis cartridge (about $100) that lets the BASIC programmer add an electronic voice to any custom-written program.

Peripherals

The 64 accepts the same low-cost peripherals as the VIC 20 (170K disk drive, Datasette program recorder, modem cartridge, monitor, graphics printer). These low-cost peripherals can turn the 64 into a modestly professional computer system that is much more affordable than other 64K computers.

Software

Because the Commodore 64 was introduced more recently than the Atari or Apple computers, it has less software available. However, with its graphics and sound capabilities and its anticipated high sales, it should attract a rich array of educational programs.

Commodore's own library of cartridges is weighted toward entertainment and business software, with prices ranging from about $30 to about $100. A Logo cartridge will soon be available. If this version of Logo makes use of the machine's sprite graphics capabilities, Commodore's Logo could be among the most powerful available for home computers.

Third-party software suppliers are converting many of their VIC 20 titles to the Commodore 64 format. It may take some time for the capabilities of the 64 to be exploited to their fullest. To keep track of

Commodore 64 computer, with the Commodore Datasette program recorder, graphic printer, and disk drive

software development, it is advisable to read advertisements in the latest issues of various computer magazines.

Suggested software programs

Logo (Commodore. Price to be released. Cartridge. Ages 5 to adult. Discovery, Problem-solving.) See *Logo* under software programs for Apple IIe.

ED-U-PAK (ComputerMat. About $25. Cassette. Ages 5 to 12. Drill, Arcade game.) Educational games include *Geography, Dungeon of Mathacos* (math adventure), *Ruler,* and *Micro.* The programs make extensive use of the 64's color, graphics, and sound.

Sprite-Magic (SJB Distributors. About $20. Cassette and disk. Ages 5 to adult. Discovery.) Using *Sprite-Magic,* the child can invent Sprites (imaginary creatures) on the display screen just by moving the joystick and pressing the fire button. You can save your Sprites on disk or cassette and view them later.

FaceMaker (Spinnaker. About $35. Disk. Ages 4 to 12. Discovery.) See *FaceMaker* under software programs for IBM PC.

Story Machine (Spinnaker. About $35. Disk. Ages 5 to 9. Simulation, Discovery.) Your child gets to pretend being the director of a live play. There are various actors (a boy, girl, cat, dog, etc.) and various props (tree, boulder, house, flower, etc.) to use in the play. The child creates the play by writing a story. As the story unfolds, the actors and props appear and move around the picture screen. The child can save the stories on disk and recall them later.

In Search of The Most Amazing Thing (Spinnaker. About $40. Disk. Ages 10 to adult. Simulation, Discovery.) This is a marvelous "junior adventure." Your chil-

dren travel across the world on an epic voyage "in search of the most amazing thing." It teaches teamwork, observation, problem-solving, self-reliance, and creativity. And most of all, it's fun!

Hey Diddle Diddle (Spinnaker. About $30. Disk. Ages 3 to 10. Discovery.) There are three learning sequences. The first two show and sing 30 rhymes, encouraging parent and child to join in and follow along. The third sequence scrambles the order of the lines so that the child must find the rhymes and put the lines back so that they rhyme

Hey Diddle Diddle/Spinnaker

and make sense. This software set is highly recommended.

Delta Drawing (Spinnaker. About $60. Disk. Ages 4 to adult. Discovery.) See *Delta Drawing* under software programs for Apple IIe.

Is the Commodore 64 for you?

The Commodore 64 and its low-cost peripherals rate very high in computing capability for the dollar. Although it has not yet attracted nearly as many programs as the Apple IIe or the Texas Instruments TI-99/4A, the educational software that is available for this computer is of very high quality. It seems likely that the Commodore 64 will attract good programs in all age categories. The machine is more desirable for word processing with the addition of an 80-column text display. For other purposes it offers a good combination of memory, sound, and color capabilities.

Commodore 64

Memory
Built-in RAM: 64K
RAM expandable to: NOT
Built-in ROM: 20K

Graphics resolution
Text: 40 characters x 25 lines

Color graphics:
1,000 pixels (40x25)
in 16 colors
64,000 pixels (320x200)
in 16 colors

Video output
Composite video for video monitor
Separate RF modulator box for home color TV included in base price

Software formats
Cartridge
Cassette
Disk

Approximate retail prices
Base price $595
Accessories:
170K disk drive $399
Datasette program recorder . . .   75
Color video monitor 299
Graphics printer 395
Plotter printer 199
Modem cartridge 110
RS-232 interface   50

Recommended starter system
Commodore 64, Datasette program recorder

IBM Personal Computer

A serious professional computer such as the IBM Personal Computer (the IBM PC) would probably not be included in a discussion of home computers, except that IBM is strongly encouraging school systems to adopt the PC. Moreover, Science Research Associates (an educational publisher owned by IBM) has developed a few educational software packages for the PC that are readily available to consumers.

Hardware

The large initial investment required for the IBM PC is due to the machine's construction quality and range of expandability. Just one of the high-capacity disk drives stores 360K of programs or data on a single disk—at least twice that of other home computer disk drive systems.

Construction quality is apparent in the detached keyboard. Although the location of some keys has been criticized, the keys have the "feel" of a high-quality electric typewriter, rather than the typically "spongy" feel of most computer keyboards. The detached keyboard lets you make yourself more comfortable—even put the keyboard in your lap—without having to move the whole computer.

Although the IBM PC can store data and programs on a standard cassette recorder, few machines are sold without one or two disk drives. All software available for the PC is on disk.

Peripherals

The IBM PC is not a machine that you can simply buy, take out of the carton, plug in, and work on. The computer is so modularized that you probably need a dealer to help you plan a system for your needs, including various accessory boards

IBM Personal Computer console with disk drives, detached keyboard, printer, and monochrome monitor

and adapters. With so many choices, the IBM PC may seem to be a complex and expensive system.

For example, you have a choice of two displays, either a color monitor for graphics and text, or a high-quality monochrome (green screen) monitor for text only. Each type of monitor requires a different type of adapter (interface card) that plugs into the main console. The monochrome monitor requires the monochrome display adapter (which also contains the interface for the IBM dot-matrix text/graphics printer). The color/graphics monitor adapter, on the other hand, provides video outputs for high-resolution RGB monitors and for composite video. If you plan to use your home color TV as a monitor, you'll have to buy an RF modulator in addition to the color/graphics monitor adapter.

Most IBM dealers are reasonably knowledgeable about the IBM PC

and IBM-brand software. Dealers are also equipped to handle service. As a holdover from its "big business" computer service, IBM offers expensive maintenance contracts after the 90-day warranty expires. Out-of-warranty repair is expensive because IBM replaces complete modules (the whole monochrome monitor, for example) rather than fixing the troublesome part. Reports from users, however, indicate that problems rarely occur when the computer is treated correctly.

Software

Since the IBM PC was introduced in 1981, an incredible amount of software has been developed for it. Most of the PC's software is designed for professional and business uses. Education and entertainment packages are less numerous.

However, new programs for the

IBM PC are accumulating at a phenomenal rate. IBM is investing heavily in innovative educational programs, including the "Writing to Read" kindergarten program being field-tested in several states. The results of such efforts should mean more high-quality educational software for the IBM PC.

As a professional computer, the IBM has practically every major programming language available, including Pascal. Microsoft BASIC is built into the PC. More advanced BASIC commands are available in a disk version included with the Disk Operating System (DOS), a special program you need before you can use disk software. Logo should soon be available from a third-party supplier.

Suggested software programs

Delta Drawing (Spinnaker. About $60. Disk. Ages 4 to adult. Discovery.) The *Delta Drawing* version for the IBM PC is by far the most elaborate and advanced, yet it is also very simple to use. If you have been reluctant to use a computer or to learn how to program, sit down and play *Delta Drawing*. *Delta Drawing* turns all other programming languages upsidedown. Most programming languages require you to learn the computer's language before you can write your first program. *Delta Drawing* is just the opposite—you get to draw beautiful pictures first, and the pictures automatically create the program.

Children as well as adults love it. Also see *Delta Drawing* under software for Apple IIe.

Word Challenge (Proximity Devices Corp. About $40. Disk. Ages 7 to adult. Discovery, Problem-solving.) One of three graph-paper grids appear on the screen, depending on the level your child selects. In the grid's boxes are letters. Your child tries to build as many words from the letters in the grid as possible before the game ends. Then the computer reviews the words with the child and shows additional words (from its 90,000-word vocabulary) that the child could have found.

Arithmetic Games, Sets 1 and 2 (IBM. About $60 per set. Disk. Ages 5 to 10. Problem-solving, Drill, Arcade game.) Four games build number skills. Set 1 contains *Beano* (number logic, sequence, counting) and *Rockets* (addition, subtraction, multiplication, division). Set 2 contains *Discovery Machine* (transformation of numbers and formula-building) and *Number Chase* (a guess-the-number game). *Discovery Machine* is especially interesting. Here's an example of how it works. A 2 goes into the machine. Out pops a 4. What happened? How did the number change?

Microsoft Adventure (IBM. About $30. Disk. Ages 7 to adult. Discovery, Problem-solving, Simulation.) This is the classic computer role-playing game. You and your children journey into the world of Colossal Cave. You search for treasures, solve puzzles, avoid dangerous hazards, and fight deadly adversaries. The goal is to explore the whole cave, find all the treasures, and escape with your life. Accompanying you on the perilous journey is an intelligent, "aware" companion—the computer. At the outset you learn only a few commands. You must discover everything else on your own.

IBM Personal Computer

Memory
Built-in RAM: 64K
RAM expandable to: 640K
Built-in ROM: 40K

Graphics resolution
Text: 80 characters x 25 lines

Color graphics:
64,000 pixels (320x200) in 4 colors
128,000 pixels (640x200) in 2 colors

Video output
Graphics and text: Requires the optional color/graphics monitor adapter, which produces both composite video output for video monitor and RGB (red-green-blue) signals for high-resolution color monitors; RF modulator for home color TV is also optional.

Text only: Requires the optional monochrome display adapter that produces special signals for the IBM monochrome monitor.

Software format
Disk

Approximate retail prices

Base price	$1355
Accessories:	
180K disk drive and adapter	$509
Additional 180K disk drive	289
360K disk drive and adapter	749
Additional 360K disk drive	529
Monochrome display adapter	335
Color/graphics monitor adapter	244
32K RAM expansion card	325
Monochrome monitor	345
Color monitor	680
Text/graphics printer	595
RS-232 interface	120

Recommended starter system
64K console, one disk drive, one display adapter

Hey Diddle Diddle (Spinnaker. About $30. Disk. Ages 3 to 10. Discovery.) See *Hey Diddle Diddle* under software programs for Commodore 64.

FaceMaker (Spinnaker. About $35. Disk. Ages 4 to 12. Discovery.) This is a fun way to use the computer to perform simple tasks. There are three games. All involve building a face on the picture screen, choosing from a variety of
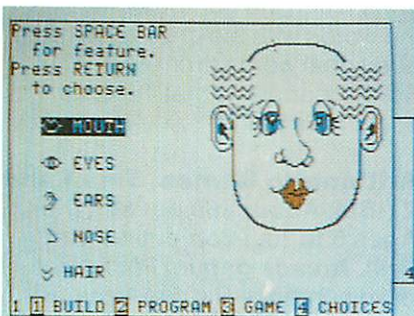
FaceMaker/Spinnaker

ears, eyes, noses, mouths, and hair. Your child can animate the faces and get them to wink, frown, smile, and wiggle their ears. A concentration game (showing a sequence of faces) helps children strengthen their observation and memory skills.

Snooper Troops, Cases #1 and #2 (Spinnaker. About $45 each. Disk. Ages 10 to adult. Simulation, Discovery, Problem-solving.) Challenging, realistic mystery-adventure games use full-screen color graphics. This is fun for children and adults. For example, in Case #1 (the Granite Point Ghost Mystery) someone is trying to scare the Kim family out of their new home. To find out who it is, you question witnesses, search dark houses, and solve riddles.

Deadline (Infocom. About $50. Disk. Ages 12 to adult. Simulation, Problem-solving, Discovery.) A locked door. A dead man. And only 12 hours to solve the

Deadline/Infocom

murder. This is an advanced interactive adventure for teenagers and parents.

MasterType (Lightning Software. About $50. Disk. Ages 5 to adult. Drill, Arcade game.) See *MasterType* under software programs for Atari.

Is the IBM Personal Computer for you?

The IBM PC educational software available for preschool and early elementary children is very limited at this time, and will probably remain so for a while. The IBM PC was not intended to be a "family" computer, but that doesn't mean children can't use it. If a professional or business use brings an IBM PC to your home, high school students will be able to advance their knowledge of programming, possibly expanding into a wide variety of computer languages. The IBM PC word processing and graphics software, although expensive, will give any high school or college student extremely useful skills and knowledge.

Mattel Electronics Aquarius

Mattel Electronics, a company known for its Intellivision video game, is introducing its new computer system, the Aquarius. While the video game is getting a computer expansion system of its own, the Aquarius is a completely separate computer system. Intellivision game cartridges cannot be used on the Aquarius.

Hardware

Built into the Aquarius keyboard console is 4K RAM, which will be adequate for most of the plug-in software cartridges. Additional

RAM expansion cartridges plug into the same cartridge slot as the software. To accommodate both memory expansion and software cartridges at the same time, you need a plug-in module with two cartridge slots called a Mini Expander. Even with this unusual expansion set-up, the user is allowed no more than one 16K RAM expansion cartridge, bringing the total RAM to 20K. Mattel plans a 48K RAM expansion cartridge for the future, which will allow the full expansion to 52K. In addition to adding memory potential, the Mini Expander enhances the Aquarius' sound capabilities (to three voices); it also

comes with two detachable hand controllers to be used primarily for the game software.

The keyboard may concern some prospective Aquarius owners. There is no space bar, and a number of keys are in different locations than they are on a standard typewriter keyboard and on many computer keyboards. You will probably not want to learn touch-typing on the Aquarius. Its raised rubber keys, however, were designed so that keyboard overlays will help users take advantage of special key functions written into some of the software packages. One overlay comes with the Aquarius; it shows

Aquarius computer, with its data recorder, printer, Mini Expander, game controllers, and RAM expansion cartridges

high schoolers, *College Boards Primer* provides math and verbal exercises designed to help students prepare for the standard college entrance tests.

In the home management series, cartridges are planned for a record-keeping program, a financial program that acts like an electronic spreadsheet, tax return pointers, stock charting, and a menu planner. Entertainment cartridges will be Aquarius versions of ten popular Intellivision video game titles, plus reversi and chess.

Programming in BASIC can be enhanced with the Extended Microsoft BASIC cartridge. This cartridge can be used in conjunction with a 16K RAM expansion module (with both plugged into the Mini Expander). A home programmer will be able to create more sophisticated programs and to take full advantage of the high-resolution graphics available on the Aquarius.

Manuals included with the Aquarius feature in-depth BASIC instructions, as well as a reference flip chart. By quickly reading through the chart, the first-time computerist will soon be writing simple programs.

where the shortcut BASIC commands are located. If you press the CONTROL key (similar to a SHIFT key) and one of these BASIC command keys at the same time, you get the same result as typing out the whole command word.

Peripherals

Aquarius users must use the matching cassette data recorder to store information or programs written with the console's somewhat limited built-in Microsoft BASIC. A 40-column thermal printer will print graphics characters as seen in the 40-column video display. Both peripherals plug directly into the Aquarius console.

A modem that plugs into a cartridge slot, plus what Mattel is calling a Master Expansion Module, will soon be available as well. The Master Expansion Module will neatly house up to two disk drives and several peripherals.

Software

As with any new system, software offerings are limited by the manufacturer's ability to create only so

many packages in a short time. Most of Mattel's initial software offerings are in three areas: education, home management, and entertainment.

Aquarius educational software leads off with one of strong interest. The Logo cartridge is one of a few to plug directly into the computer without additional memory. A series of math cartridges is planned for elementary school children. For

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Mattel Electronics Aquarius

Memory
Built-in RAM: 4K
RAM expandable to: 52K
Built-in ROM: 8K

Graphics resolution
Text: 40 characters x 24 lines

Color graphics:
61,440 pixels (320x192)
in 16 colors

Video output
Built-in RF modulator for home color TV

Software formats
Cartridge
Cassette
Disk (available soon)

Approximate retail prices
Base price $150

Accessories:
Mini Expander . . . .$ 60
Data recorder 55
Thermal printer 165

Recommended starter system
Aquarius computer, Mini Expander, Data recorder

Suggested software programs

Logo (Mattel. Under $100. Cartridge. Ages 5 to adult. Discovery, Problem-solving.) See *Logo* under software programs for Apple IIe.

Melody Chase (Mattel. About $30 to $100. Cartridge. Ages 5 to adult. Discovery, Arcade game. Mini Expander with hand controllers required.) First you must dodge notes flying around a bass clef staff, then hit the notes floating above a treble clef staff. Each time you hit a note, you'll hear a tone. Hit them all and the computer will play your song. If you get hit, the song is over.

Spelling and Space (Mattel. About $30 to $100. Cartridge. Ages 5 to 8. Drill.) After completing a spelling exercise, your child is rewarded with a space game. The student can come home from school, type in the latest spelling words, and the computer will run a quiz. Then the child can blast some aliens! (The more exercises completed, the more games there are to play.)
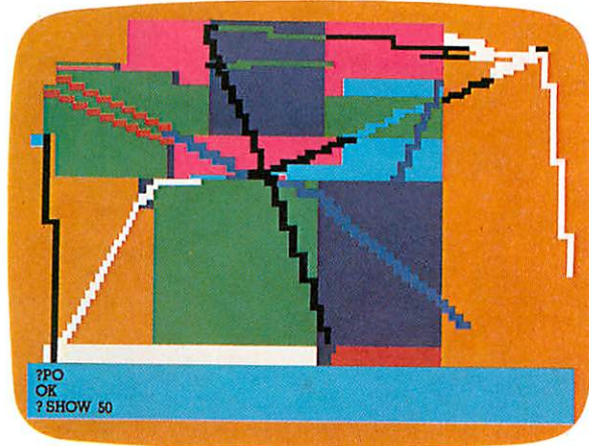
Aquarius Logo/Mattel Electronics

Is the Aquarius for you?

With the Aquarius, as with all new machines, there is one uncertainty—software. For any new system, it's hard to predict if enough software will be developed to make the machine usable in a wide variety of ways. If Mattel and independent software developers can build a software library quickly, the Aquarius will become an attractive, expandable home computer system. It starts off well with several interesting software packages, especially for elementary school children. The drawback for high school students is the keyboard; the rubber keys and nonstandard keyboard layout inhibit typing and word processing. The BASIC programming capabilities, however, offer opportunities to beginners, as well as to serious programming students.

NEC PC-6000

Available in Japan since 1982, the NEC PC-6000 comes to the United States with a modest library of entertainment software adapted from its Japanese offerings. NEC has also lined up several U.S. software firms to adapt some of their programs for the PC-6000. Unlike most of its competition in the under-$500 arena, the PC-6000 will be sold primarily through a network of computer dealers. That may give potential buyers an opportunity to talk with a dealer and to preview some software before taking it home.

Hardware

The PC-6000 features one of the most professional computer keyboards in its price range. Keys are full-travel, typewriter-style. A separate group of keys is used for cursor control and editing, which will come in handy for word processing programs. The keys are in two

PC-6000 series computer, with NEC printer, color monitor, expansion module, disk drive, data recorder, and touch panel

colors: gray for standard letters and numbers; orange for all others. This color-coding makes learning the keyboard easier for beginners. A row of five function keys makes properly coded software easier to use when the single-key functions are described on the screen.

The text display of only 16 lines is more limited than the display on most home computers. Color graphics resolution is average. However, NEC also produces a full line of monochrome and color monitors that is well respected among serious computer hobbyists.

Peripherals

An unusual peripheral is available for the PC-6000, one that is rarely available for home computers at such a low price. NEC calls it a "touch panel," while some computerists would call it a "digitizer." By any name, this accessory allows the user to literally draw or trace shapes so they will appear on the video screen. The touch panel detects pressure from a pencil, or even a finger, and transfers whatever is drawn on the panel directly to the video monitor. The touch panel connects to the keyboard console through the joystick controller jacks. This is an artist's and experimenter's delight.

Software

In the educational software arena, the PC-6000 will probably come to be known as the "Walt Disney machine." At least ten Walt Disney programs for the PC-6000 will enable children to play with Donald Duck, Mickey Mouse, Goofy, Winnie the Pooh, Cinderella, and other Disney movie characters—and learn at the same time. This material mixes animation and still screens, and seems to be similar in quality to the excellent Sesame Street packages for the Apple computer.

The Logo programming language will be available on disk for the PC-6000. The built-in language is Microsoft BASIC, which will allow some degree of compatibility with other Microsoft BASIC programs. You will still need to know enough of the BASIC language to customize other Microsoft programs for the PC-6000's graphics and sound capabilities.

In addition to the software programs listed here, NEC plans fifteen to twenty programs to be available soon. These include games (*Context Clues, Spelling Game,* and *Early Reading*) as well as a typing tutor, a family-oriented word processing cartridge, and a tutorial spreadsheet.

Suggested software programs

Logo (NEC. Disk. Price not available. Ages 5 to adult. Problem-solving, Discovery.) See *Logo* under software programs for Apple IIe.

Mickey and the Beanstalk and Cinderella's Beads (NEC/Disney. About $35. Cassette or disk. Ages 7 to 10. Arcade game, Problem-solving.) Each NEC/Disney cassette contains two games. In *Mickey and the Beanstalk,* your child must get Mickey to the top of a continuously moving and wiggling beanstalk to bring home the hen, the harp, and the golden egg. In *Cinderella's Beads,* the child helps Gus the mouse gather beads, count them, and carry them to his mouse hole. If the child is successful, Cinderella gets to go to the ball and kick up her heels.

Goofy in Space and Minnie and the Haunted Mansion (NEC/Disney. About $35. Cassette or disk. Ages 9 to 14. Arcade game, Discovery, Simulation, Problem-solving.) *Goofy in Space* is a junior adventure game in which your child and Goofy journey to an imaginary planet. They explore the planet and map it like pioneers. *Minnie and the Haunted Mansion* is a mystery adventure game. Minnie Mouse must get out of a haunted house and solve a mystery. To help her escape, the child must solve puzzles, discover rules, and catch ghosts.

NEC PC-6000

Memory
Built-in RAM: 16K
RAM expandable to: 32K
Built-in ROM: 16K

Graphics resolution
Text: 32 characters x 16 lines

Color graphics:
3,072 pixels (64x48)
in 9 colors
24,576 pixels (128x192)
in limited colors
49,152 pixels (256x192)
in 1 color

Video output
Composite video for video monitor
Built-in RF modulator for home color TV

Software formats
Cartridge
Cassette
Disk

Approximate retail prices
Base price $350

Accessories:
Disk drive $550
Data recorder 100
Expansion module 100
Printer 250
Touch panel 150

Recommended starter system
PC-6000, Data recorder

Donald's Word Arcade and Dalmatian Multiplication (NEC/Disney. About $35. Cassette or disk. Ages 7 to 14. Drill, Problem-solving, Arcade game.) In *Donald's Word Arcade,* Donald Duck and your child visit a word carnival. In *Dalmatian Multiplication,* each dalmatian is at the center of a large, graph-paper grid. Your mission is to get dalmatians to their food dish. To move the dalmatians, you must compute multiples of different numbers.

Cinderella's 3-D Maze and Mickey's Mathmagical Mops (NEC/Disney. About $35. Cassette or disk. Ages 7 to 12. Arcade game, Problem-solving, Drill.) *Cinderella's 3-D Maze* combines an adventure game and spelling drills. Your child's mission is to find the way through a 3-D maze and collect the materials Cinderella will need for her trip to the ball, including a coach, four horses, a dress, and a pair of glass slippers. To leave the maze, your child must solve riddles and spell answers correctly. If the child succeeds, Cinderella goes dancing. *Mickey's Mathmagical Mops* animates a popular scene from the Walt Disney movie *Fantasia.* Mickey is the apprentice to a powerful sorcerer. Mickey puts on the sorcerer's hat and casts a spell on his broom to get it to carry buckets of water. That's where this game begins. Mickey is in the center of a grid of 35 boxes. He has a golden wand. A blue broom appears. Your child must help Mickey zap the blue broom with the magic wand before the broom turns red. If the broom turns red before it is zapped, then two new brooms appear. The brooms multiply and pour buckets of water everywhere. If your child zaps three brooms in a row, a math problem appears. If the problem is answered incorrectly, two new brooms appear. This game features five levels of difficulty.

Winnie-the-Pooh's Alphabet Adventures and Mickey's Lucky Stars (NEC/Disney. About $35. Cassette or disk. Ages 3 to 7. Arcade game, Drill. Touch panel required.) *Winnie-the-Pooh's Alphabet Adventures* gives a new twist to a standard game involving word and number exercises. Your child can draw a letter or number to answer a question using the PC-6000's touch panel. The child's answer appears in color on the computer picture screen. If the answer is right, then Winnie-the-Pooh, Eeyore, Piglet, and other characters appear and play with the child. Exercises include uppercase and lowercase letters, and numbers from 0 to 10. In *Mickey's Lucky Stars,* your child helps Mickey capture falling stars by solving math problems.

Music Editor (NEC. About $40. Cartridge. Ages 5 to adult. Discovery.) Your child composes a song by placing notes on a musical score on the computer's display screen. The child can print the musical scores on the PC-6000's thermal printer or save them on a cassette.

Is the NEC PC-6000 for you?

At this point it is difficult to recommend the PC-6000 system, particularly if you are looking for a computer with educational software galore. The initial software, however, looks promising. The touch panel (digitizer) offers opportunities for the child with an artistic bent. The keyboard setup (with addition of a monitor) should encourage word processing and typing.

Panasonic JR-200

From Panasonic, the company that manufactures so many other home electronics products, comes the JR-200 computer. Its attractive, low-profile keyboard console houses a lot of capability.

Hardware

Keys are raised rubber pushbuttons. Unusual for a console in this price range, there are separate keys for cursor control, INSERT, and DELETE. Most of the keys also have special functions that act as shortcuts when writing programs with the machine's built-in BASIC language. Most BASIC commands can be typed by pressing single keys. Any experienced programmer will tell you that such a feature is a real time-saver.

Sixty-four graphics characters (sticks, blocks, and diagonals) are also found right on the keyboard. The graphics resolution specification is a bit misleading—actual resolution is much greater. The programmer has the option of creating individual graphics shapes, by filling in or leaving blank small squares in an 8 x 8 grid. By carefully placing these custom shapes on the screen, the programmer can create colorful, entertaining video displays. The net result is 256 x 192 resolution (49,152 total pixels) in one color.

The JR-200 is also one of the few budget computers to offer three different video output formats, including RGB (red-green-blue) signals for high-resolution monitors. Panasonic recommends its own monitors (CT-1300D RGB monitor or CT-1112V television with composite video input jack). However, you can use any monitor or color TV for video display.

A built-in speaker plays back whatever music is programmed

either by commercial software or in BASIC. The music generator includes three separate voices over a range of five octaves.

Standard with the JR-200 is a built-in interface that allows direct connection to an optional matching dot-matrix printer, rated to print up to 50 characters per second.

Peripherals

You have two options for cassette program storage with the JR-200. You may want to use a standard portable cassette player at first. Later you can graduate to the RQ-8300 data recorder (which records and plays back computer data at a speed four times faster than a standard cassette player). A disk drive is scheduled to be available soon; it will offer faster program transfer speeds.

An optional RS-232 interface module can be installed inside the computer console, thus reducing the number of extra boxes hanging onto the console. With the RS-232 interface, you can plug in an acoustic modem for telecommunications.

Software

As with most new computers, software announced so far for the

Panasonic JR-200	
Memory Built-in RAM: 32K RAM expandable to: NOT Built-in ROM: 16K	**Software formats** Cassette Disk (available soon)
Graphics resolution Text: 32 characters x 24 lines Color graphics: 3,072 pixels (64x48) in 8 colors 49,152 pixels (256x192) in 1 color	**Approximate retail prices** Base price ....$350 Accessories: RQ-8300 data recorder ....$ 90 Printer .... 370 RS-232 interface 60
Video output Composite video for video monitor Built-in RF modulator for home color TV RGB (red-green-blue) signals for high-resolution RGB video monitor	**Recommended starter system** JR-200, standard portable cassette player

JR-200 is somewhat limited. The emphasis is on entertainment and education. The first program cassettes for education include some titles licensed with Walt Disney characters. The other educational titles focus on basic math and reading, the scientific method, touch-typing, U.S. geography, speed-reading, and basic electricity. The

range of subjects is wider than that of many software libraries for new computers. Also available will be an optional manual written especially for children so that they can experiment with BASIC programming and with the computer's sophisticated graphics and sound features.

Panasonic software will eventually be available on both cassette and disk. Currently it is available only on cassettes. On each cassette, Side A is for 600 baud (standard speed) cassette players. Side B is for 2400 baud (high speed) players like Panasonic's RQ-8300 data recorder.

Suggested software programs

Word Watch (Panasonic. About $15. Cassette. Ages 6 to 10. Drill, Arcade game.) This package includes four games: *Word Race, Hide 'n Spell, Spelling Bee,* and *Spelling Tutorial.* In *Word Race,* your child can play against the computer

Panasonic JR-200 computer

or against another child. Each time a word is spelled correctly, the player moves forward; each time a word is missed, the player moves backward. In *Hide 'n Spell,* four words are shown. One of the words is spelled incorrectly. To score points, the child must find the misspelled word and then spell it correctly.

English Olympics (Panasonic. About $15. Cassette. Ages 7 to 12. Drill.) Your child is quizzed on rules of grammar. For each correct answer, the child is awarded Olympian sound effects and pictures.

Math Master (Panasonic. About $15. Cassette. Ages 5 to 12. Drill.) Large-number "flash cards" appear on the picture screen to help your child practice basic arithmetic skills (addition, subtraction, multiplication, division).

Typing Teacher (Panasonic. About $20. Cassette. Ages 5 to adult. Tutorial.) This is a touch-typing tutorial.

U.S. Geography (Panasonic. About $20. Cassette. Ages 7 to 14. Drill.) A picture of each state appears on the computer's display screen. Then the computer asks your child questions about the state. For correct answers, the computer plays "Yankee Doodle."

Electronic Speed Reading (Panasonic. About $25. Cassette. Ages 7 to adult. Drill.) The computer flashes words and sentences on the screen according to the reading speed set by your child.

Electronic Breadboard (Panasonic. About $40. Cassette. Ages 12 to adult. Drill, Simulation.) The computer teaches the fundamentals of electric circuitry by letting your child conduct experiments on simulated circuits drawn on the display screen.

Science Skills (Panasonic. About $15. Cassette. Ages 7 to adult. Tutorial, Problem-solving.) This package helps your child learn the scientific method by forming hypotheses and performing tests and solving problems. This is a tutorial, not a drill.

Is the JR-200 for you?

The basic computer offers a lot, although it is more expensive than comparable machines. Until a full line of accessories appears, however, its use is somewhat limited. The software planned by the manufacturer aims the computer primarily at educational applications. There are color and programming capabilities for high schoolers, but the rubber keys make typing and word processing rather awkward (compared to machines that have a standard typewriter keyboard).

Radio Shack TRS-80 Color Computer

Scattered across the United States are more than 6500 Radio Shack stores. More than 360 of these are special Radio Shack Computer Centers, where you will find every model in the line already set up with well-trained salespeople eager to help you. At all Radio Shack stores and computer centers, you will find the TRS-80 Color Computer.

Hardware

The TRS-80 Color Computer is available in three formats or configurations.
1. The 16K RAM model with standard BASIC language in 8K of ROM;
2. The 16K RAM model with Extended BASIC in 16K of ROM; or
3. The 32K RAM model that comes with the Extended BASIC in 16K of ROM.

The Extended BASIC in 16K of ROM offers much more programming power for color graphics. No matter which model you start with, it can be upgraded gradually to the full 32K RAM with Extended BASIC at an authorized Radio Shack service center. We recommend starting with the Extended BASIC 16K machine, and later upgrading to the 32K RAM if you plan to stay with your Color Computer.

Peripherals

You will need a portable cassette player/recorder for some programs (most of the rest are in cartridge form). If you don't already own a cassette player, the model CCR-881 (offered by Radio Shack for under $60) or any comparable player is adequate.

Radio Shack Centers also offer several types of printers. These range from simple dot-matrix printers to daisywheel letter-quality printers ($400 to $2000).

Software

Radio Shack's educational software library includes a *Reading Is Fun* series, which presents classic stories in a talking-picture-book fashion with the help of an audio cassette recorder. Titles include *Dracula, The Hound of the Baskervilles, Moby Dick,* and *20,000 Leagues Under the Sea.* A new series of activities created by the Children's Computer Workshop —a branch of the Sesame Street originators, Children's Television Workshop—will be released soon. A Logo program called *Color Logo* is available now.

A version of Radio Shack's popular *Scripsit* word processing pro-
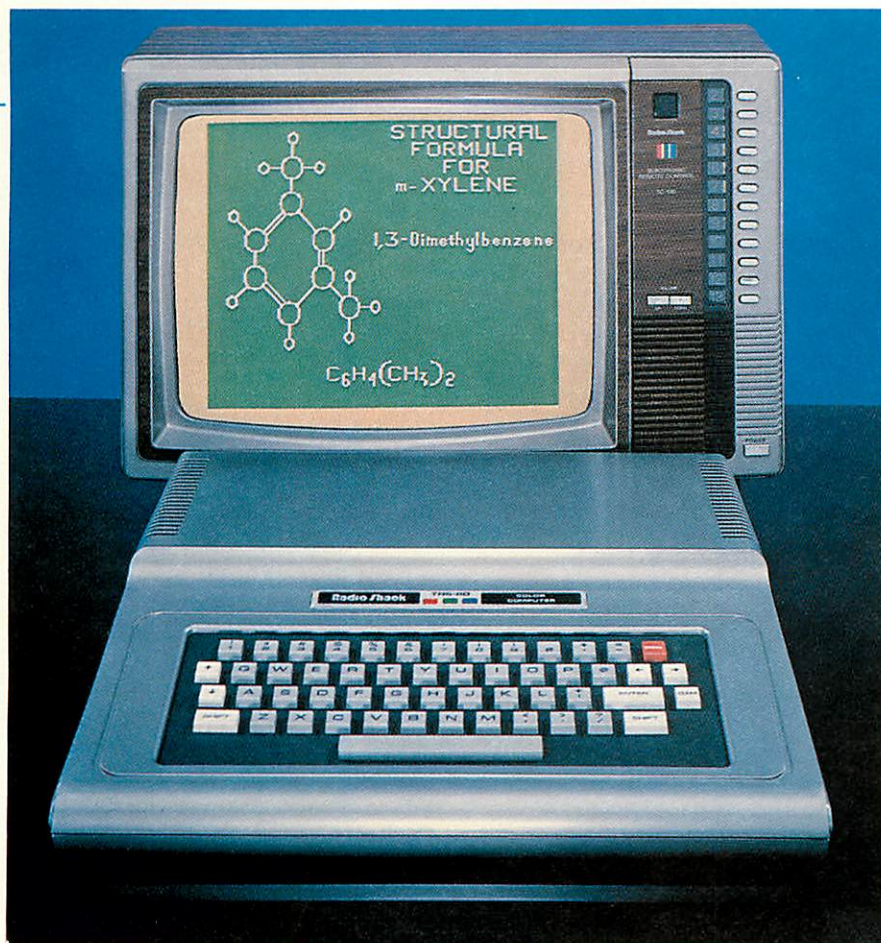
Radio Shack TRS-80 Color Computer, with a Radio Shack video display

gram (about $40, cartridge) is offered for the Color Computer. More powerful versions of *Scripsit* and *Spectaculator,* an electronic spreadsheet program, are available in disk form for more expanded Color Computer systems.

Games make up the majority of the software for the TRS-80 Color Computer. But there are also some home management programs that are very helpful. For example, *Handyman* (about $30, cartridge) is a computerized helper for the do-it-yourselfer around the house. By answering questions on the screen, you can immediately determine how much paint you'll need to cover the room or how many yards of dirt you'll need to fill a specific area of the lawn.

The number of third-party software offerings is growing. One of the best sources for software information and advertisements is *80 Microcomputing,* a magazine dedi-cated to all Radio Shack TRS-80 brand computers.

Suggested software programs

Computer Carnival (Wayne Green Books. About $17 for book only. About $25 for book with cassette. Ages 6 to adult. All modes of learning.) This is a book of 60 children's programs by a specialist on children and computers, Richard Ramella. Ramella writes programs for children, about children, and to children. Among these are a palindrome program (where the words appear the same both forward and backward), a fortune-cookie program, and a program that just laughs. Adults may think that Ramella's programs are strange, but children love them, and we highly recommend them. The instructions for each program are printed in the book and can be typed easily into the computer.

ABC's in Color (T.C.E. About $20 on cassette; about $25 on disk. Ages 2 to 8. Drill. Requires 16K Extended BASIC.) Pictures of objects (airplanes, balls, cats, etc.) appear on the screen, and the child types in the beginning letter of the object's name. Each correct answer earns a note in the ABC song. When the child has answered all the quiz-zes correctly, the computer plays the whole song.

Basic Math (T.C.E. About $15 on cassette; about $20 on disk. Ages 4 to 9. Drill. Requires 16K Extended BASIC.) This program provides exercises in addition and subtraction at three levels, with mus-ical reinforcement.

Counting (T.C.E. About $15 on cassette; about $20 on disk. Ages 2 to 7. Drill. Requires 16K Extended BASIC.) Your child counts happy faces. If the count is right, the face disappears and the number behind it pops out. The program can operate in two ways: presenting the numbers in sequence or in a random order.

Math programs (T.C.E. About $15 to $30. All on cassette; some on disk. Ages 7 to adult. Drill. Some require 16K Extended BASIC.) Programs for different age groups include *Flash Card* (multi-plication and division for ages 7 to 13), *Fractions* (ages 10 to 15), *Place Values* (ages 8 to 15), and *Friend or Foe Math* (ages 9 to adult).

Language programs (T.C.E. About $20 to $25. All on cassette; some on disk. Ages 5 to adult. Drill. Some require 16K Extended BASIC.) Programs for different ages include *Plurals* (ages 9 to 15), *See and Spell* (ages 5 to 9), *Spelling Rules* (ages 9 to 15), and *Vocabu-lary Builder* (ages 10 to adult).

**Teaching Clock (T.C.E. About $20 on cassette; about $25 on disk. Ages 4 to 10. Drill, Simula-

tion. **Requires 16K Extended BASIC.)** The face of a clock appears; the computer asks the child to type in the correct time. If the child is wrong, the correct time (in digital format) appears in flashing boxes.

Color PILOT (Radio Shack. About $60 on cassette; about $80 on disk. Ages 7 to adult. Problem-solving, Discovery. Printer optional.) The PILOT program lets you mix text and color graphics. It includes commands like COLOR, LINE, BOX, and CIRCLE. See *PILOT* under software programs for Atari.

Color Logo (Radio Shack. About $50 for Program Pak; about $100 on disk. Ages 3 to adult. Discovery, Problem-solving.) Even if your child is not reading yet, he or she can use a "doodle" mode to create colorful pictures. A HATCH command creates several picture-screen turtles, each capable of run-

ning its own program. All the turtles can work at the same time.

The Sands of Egypt (Radio Shack. About $30. Disk. Ages 7 to adult. Discovery, Problem-solving, Simulation.) This program features animated color pictures and text. You make a perilous journey through the desert searching for the ancient tomb of RA. Can you crack the mystery and escape with the treasure?

Color Robot Battle (Radio Shack. About $40. Cassette. Ages 7 to adult. Problem-solving, Arcade game.) Program your robots for battle. This is a great introduction to programming concepts.

Reading Is Fun (Radio Shack. About $20 each. Cassette. Ages 9 to 11. Discovery, Drill.) Each "electronic book" in this series is a computer introduction to a high-interest classic like *20,000 Leagues*

Under the Sea, Dracula, and *Moby Dick.*

Simulation games (Radio Shack. About $15 to $30 each.) Cassette. Ages 7 to adult. Discovery, Problem-solving, Simulation.) Radio Shack offers a variety of simulation games, including *Wildcatting* (drilling for oil), *Madness and the Minotaur* (a maze treasure hunt), *Pyramid,* and *Raaka-Tu.*

Paint programs (Radio Shack. About $40 each. Cassette. Ages 3 to adult. Discovery. Joysticks optional.) There are two programs: *Micro Painter* and *Art Gallery.* Your child is given three palettes; each has four colors. The painter creates pictures using a joystick or the keyboard, and can then save the pictures on a cassette tape. *Images 1 and 2* (each $8.95) provide additional pictures and images to be used with *Micro Painter* and *Art Gallery.*

Bingo Math (Radio Shack. About $30. Cassette. Ages 5 to 10. Drill, Arcade game. Joysticks required.) The three games are *Bingo Math* (solve problems to score a bingo), *Speed Math,* and *Number Hunt.*

Color Computer Learning Lab (Radio Shack. About $50. Cassette. Ages 10 to adult. Discovery, Tutorial.) Helps you and your child learn the fundamentals of programming the Color Computer in BASIC.

Is the TRS-80 Color Computer for you?

With its slowly broadening educational software library, the TRS-80 Color Computer should soon have activities for all student age groups, from preschool through high school. High schoolers will also find the 32K Color Computer an adequate word processor for reports, although a monitor and disk drive should be added for this use.

Radio Shack
TRS-80 Color Computer

Memory
Built-in RAM: 16K or 32K
RAM expandable to: 32K
Built-in ROM: 8K or 16K

Graphics resolution
Text: 32 characters x 16 lines

Color graphics:
2,048 pixels (32x64)
in 8 colors
49,152 pixels (256x192)
in 1 color,
programmable with
optional Extended
BASIC cartridge

Video output
Built-in RF modulator for home
color TV

Software formats
Cartridge
Cassette
Disk

Approximate retail prices
Base prices:

16K RAM with 8K ROM	$300
16K RAM with 16K ROM	400
32K RAM with 16K ROM	550

Accessories:

1st 153K disk drive/disk controller	$599
Built-in Extended BASIC ROM	99
32K RAM expansion kit	149
Printers	from 399
Direct-connect modem	149
Joysticks (pair)	25

Recommended starter system
TRS-80 Color Computer with
16K RAM and 16K ROM,
standard cassette player

Spectravideo SV-318

Most personal computer systems come onto the market with only a few pieces of what eventually becomes a complete system of many peripherals and a large software library. Spectra Video, Inc. plans to avoid this lag with its new SV-318 computer. Soon after the initial release of the SV-318, Spectra Video intends to have ready a full range of expansion modules, peripherals, and over 100 software programs.

Hardware

The SV-318 is, to put it mildly, a well-endowed computer for its price range. Of the console's built-in 32K RAM, 16K is devoted to color graphics, leaving the remaining 16K available to the user for programming with the built-in Extended Microsoft BASIC (which includes color graphics and sound commands). RAM can be expanded up to a total of 144K (minus 16K for graphics), which will accommodate even the most sophisticated business applications that become available for the machine.

Probably the most striking element of the console is a built-in joystick, which is used not only for games, but also for cursor control. Other keyboard features are five separate function keys that can be programmed to make software more user-friendly (by allowing the press of a single key to perform multiple commands).

Fifty-two graphics shapes can be programmed directly from the keyboard in a low-resolution 32 x 24 graphics mode. In high-resolution graphics, the programmer has the versatility of sprite graphics, which handles up to 32 different moving objects on the screen. The screen shows 40 characters across and 24 lines at a time.

Peripherals

Cassette storage of data and programs is possible with the matching cassette drive. Like the Atari program recorder, the Spectravideo cassette drive is a dual-channel unit: one channel can carry computer data while the other channel can carry a voice recording for educational materials. A built-in microphone on the recorder allows home programmers to create their own programs with voice recordings.

The SV-318's disk drive stores 256K of data, more than all other disk drives for computers in this price range.

One interesting peripheral for the artistically creative is a graphics tablet (sometimes called a *digitizer*), which reproduces on the computer's video screen any shape drawn on the touch-sensitive panel. One application of this would be tracing maps or other shapes for input to or printout from the computer.

Instead of delaying the introduction of an expansion chassis, as some manufacturers are doing, Spectra Video offers a seven-slot expansion cabinet. Called the Super Expander, it accepts a wide range of plug-in accessories, such as a disk drive controller, printer and RS-232 interface, 16K and 32K RAM expansion modules, and an 80-column text display card. Each expansion cartridge has a small red Light Emitting Diode (LED) that is visible whenever the particular cartridge is being used.

Spectra Video has also announced that the SV-318 will have an adapter that allows you to plug in and play Colecovision video game cartridges.

Software

The majority of initial software programs are in education, entertainment, and business. The SV-318 will also have the capability to run the business-oriented CP/M operating system, opening the way to thousands of professional programs.

Spectravideo SV-318 computer

Suggested software programs

Logo (Spectra Video. Price not available. Cartridge. Ages 5 to adult. Discovery, Problem-solving.) See *Logo* under software programs for Apple IIe.

The Romper Room Series (Spectra Video. About $35 to $40 each. Cartridge. Ages 3 to 7. Discovery, Drill.) There currently are three programs in this set of early-learning software, and the series is scheduled to expand. The first is *DoBee's First Alphabet. Romper Room's Countdown to Fun* teaches basic number skills—counting, number recognition, simple arithmetic. In *The Street Where You Live,* the computer asks questions about pets, about the people your child knows, and about the home, family, and neighborhood.

Is the Spectravideo SV-318 for you?

As with any new computer, it is too early to determine whether the SV-318 will be popular enough to encourage third-party software suppliers to develop software for it.

Spectravideo SV-318

Memory
Built-in RAM: 32K (16K for user; 16K for color graphics control)
RAM expandable to: 144K (128K for user)
Built-in ROM: 32K

Graphics resolution
Text: 40 characters x 24 lines

Color graphics:
49,152 pixels (256x192)

Video output
Composite video for video monitor
Optional RF modulator for home color TV

Software formats
Cartridge
Cassette
Disk

Approximate retail prices
Base price $299

Accessories:
256K disk drive $525
Cassette drive 90
Super Expander 175
Graphics tablet 130
Printer 499
Modem 175

Recommended starter system
SV-318, Cassette drive

But the computer is off to a good start. It can also be expanded to a rather sophisticated system (including 64K RAM, printer, disk drive, and expansion chassis) for less than $2000, which is a good sign.

If the graphics software for the optional digitizer is well written, this could be one of the few home computers that will attract the student who wants to specialize in computer art or graphics. At this point, however, the only software for the machine is designed for preschool and elementary aged children. Once more abundant software is available, the machine will be an excellent choice for these age groups; in the meantime, programming would be a suitable activity for older students who want good color capabilities at a reasonable price.

Texas Instruments TI-99/4A

Probably the biggest educational software library for a home computer in this price range is for the Texas Instruments TI-99/4A. A large portion of the software is in plug-in cartridges, making the keyboard console (and your home TV) all you need to gets lots of return from your computer investment. And if you want to expand your system and your computer literacy horizons, this TI system can accommodate you.

One element about the TI-99/4A makes it appealing for the computer newcomer. The company's emphasis on plug-it-in-and-run software means that you can get a lot of use from the machine before learning any programming. In fact, much of the software tells you what to do on the screen, so you barely have to look at the software manual.

Hardware

The base console features a full-travel, typewriter-style keyboard. The optional 10-inch color monitor provides a sharp color picture, but an RF modulator is included for use with a color TV. Except for a speech synthesizer—which generates a natural-sounding electronic voice in several educational cartridges—most peripherals stow neatly in a single Peripheral Expansion System. In it is room for a disk drive and seven plug-in peripherals (like memory expanders, RS-232 interface, and others).

Texas Instruments is making the TI-99/4A even more of a bargain by offering a long-term $50 rebate. That brings the effective retail price of the console to around $100—a fantastic buy for this powerful a

Texas Instruments TI-99/4A computer, with its peripheral expansion system and color monitor

school (in math, writing, science, social studies, and reading).

The TI-99/4A was one of the first home computers to have Logo available for it. Recently, Texas Instruments introduced its second-generation TI Logo II (which requires the 32K RAM expansion card) with added features, including access to the TI-99/4A's versatile sound capabilities. TI-BASIC is built into ROM, and the following languages are available as software options: Extended BASIC; a popular version of Pascal (called UCSD Pascal); and PILOT.

The TI-99/4A is not all work, however. Its library boasts an ample selection of games and other entertainment activities, mostly in cartridge form. Rounding out the TI offerings is an equally impressive lineup of home management titles such as *Home Financial Decisions, Personal Report Generator,* and *Securities Analysis.* Third-party companies are also jumping on the TI bandwagon with disk software in all areas.

Suggested software programs

TI Logo II (TI. About $130. Cartridge. Ages 5 to adult. Discovery, Problem-solving. Requires 32K RAM expansion card. Disk drive or tape player optional for saving programs and shapes.) See *Logo* under software programs for Apple IIe.

TI Logo/Texas Instruments

TI PILOT (TI. About $80. Disk. Ages 7 to adult. Problem-

machine. The company also offers periodic promotions on peripherals like the speech synthesizer.

Expanding the TI, however, is not as inexpensive, particularly in the disk drive department. But with so much cartridge software available, you can go for quite some time, adding a cassette recorder (optional cable needed for standard recorder) for data storage.

Texas Instruments is one of the most progressive companies when it comes to consumer education. In some cities, TI has opened what it calls *TI Learning Centers,* and is planning to open many more. Consumers can talk to people trained on the TI computers and can see much of the software in action. The Learning Centers are not stores; they do not sell the products there. From there, the consumer can shop around for the best prices at local

stores. The Learning Centers function as information centers and classrooms. Several home computer courses are offered, including courses on computer awareness and programming on the TI-99/4A. Separate courses are held for children and adults, and family discounts are available.

Software

Texas Instruments already has dozens of cartridges developed by Scott, Foresman and other educational publishers. It has also agreed to produce cartridge software for 108 courseware packages from Control Data's PLATO collection. Sixty-four packages will be designed for grades 3 through 8 (in math, reading, and grammar). Forty-four packages are for high

Alligator Mix/Texas Instruments

solving, Discovery. Requires 32K RAM expansion card.) See *PILOT* under software programs for Atari.

Beginning Grammar (TI. About $30. Cartridge. Ages 6 to 10. Drill.)

DLM Arcademics Series (TI/DLM, Inc. About $40 each. Cartridge. Ages 5 to 9. Arcade game, Problem-solving, Drill. Joystick optional.) Six *Arcademics* ("Arcade/Academics") cartridges provide programs that teach basic

arithmetic in an arcade-game format. Three games teach addition and subtraction; three teach multiplication and division. In *Alien Addition,* you defend a missile base by solving addition problems. In *Minus Mission* you must stop robots, blobs, and creeping slime with the right answer to a subtraction problem. *Alligator Mix* asks you to solve addition and subtraction problems to get a finicky alligator to eat. In *Meteor Multiplication,* save the star station from bombarding meteors by multiplying correctly. *Demolition Division* encourages you to divide quickly, if you want to stop the advancing tanks. In *Dragon Mix,* you solve multiplication and division problems correctly to persuade a fire-breathing dragon to *defend* your city.

BASIC self-taught (TI. About $20 to $30 each. Cassette or disk. Ages 8 to adult. Tutorial, Discovery.) There are 25 lessons in 3 packages: *Teach Yourself BASIC, Teach Yourself Extended BASIC,* and *Beginner's BASIC Tutor.*

Music Maker (TI. About $40. Cartridge. Ages 6 to adult. Discovery.) Even a young child can compose music by putting notes on a staff.

Computer Music Box (TI. About $10. Cassette. Ages 10 to adult. Discovery.) Your older child can compose and edit three-part music, save it, and recall it to play later. The program has an automatic chord generator.

Texas Instruments TI-99/4A

Memory
Built-in RAM: 16K
RAM expandable to: 48K
Built-in ROM: 26K

Graphics resolution
Text: 32 characters x 24 lines

Color graphics:
49,152 pixels (192x256)

Video output
Composite video for video monitor
Separate RF modulator box for home color TV included in base price

Software formats
Cartridge
Cassette
Disk

Approximate retail prices
Base price	$150

Accessories:
1st 90K disk drive/controller	$650
2nd 90K disk drive	500
32K RAM expansion card	300
Color monitor	400
80-column printer	750
Acoustic modem	200
RS-232 interface	175
Speech synthesizer	150
Peripheral expansion system	250
Joystick controllers (pair)	35
Data recorder	70
Standard cassette cable	15

Recommended starter system
TI-99/4A computer console

PLATO courses (TI/Control Data Publishing. About $50 each. Cartridge and disk *together.* All ages. Drill, Tutorial. Disk drive/controller required.) PLATO programs for elementary school children include a wide variety of topics in math, reading, and grammar. Programs for high school students include many topics in mathematics, reading, literature, writing, science, and social studies. Also see *PLATO courses* under software for Apple IIe.

Educational programs (Micro-Ed. About $10 each. Cassette or disk. Ages 5 to 12. Drill.) This is a series of programs on math, reading, grammar, music, and other basic skills. It includes titles like

Count 'Em, Clock, The Verb, Making an Outline, and *Antonym Machine.*

Is the TI-99/4A for you?

We cannot disguise our enthusiasm for this computer system because it is so easy to use, so well supported for education and family software, and so well priced in the market. It has speech, beautiful color, and sound effects. The console is well built, and no damage will occur if cartridges are accidentally removed by a youngster while the computer is on.

More TI-99/4A software exists for the preschool and elementary

school age groups than on any home computer except the Apple. Children interested in programming can go a long way in developing skills in several computer languages, including Pascal. The TI-99/4A is a computer on which to learn a lot and really have fun doing it.

There is one disadvantage that must be noted, however. The cost of expanding the TI-99/4A with peripherals is high. Some of the more advanced software calls for additional memory and a disk drive, both of which are expensive. Other peripherals are also priced relatively high and often require an interface card, still another expense. This is a good system, but ultimately not a cheap one.

Timex Sinclair 1000

The small computer that had a big impact in 1982 was the Timex Sinclair 1000. The TS1000 was originally designed by Sinclair Research, a British firm. Under the Sinclair brand, the computer was known as the model ZX-81 (a successor to Sinclair's first computer, the ZX-80). The ZX-81 was unique for its small size and outstanding value in Britain.

In 1982, Timex—the famous wristwatch company—bought the rights to market the ZX-81 in the United States. The product was upgraded with a little more memory (2K), given a new name, and planted in more retail stores than any computer ever had been before. The advent of the TS1000 is largely responsible for the price cuts initiated by other manufacturers that began in the second half of 1982. Despite the competition, however, the TS1000 sold very well.

Hardware

The TS1000 is a "bare bones" kind of computer with monochrome video output (shows up as black

and white on a color TV) and very limited memory. Most people buy the 16K RAM expansion cartridge when they buy the computer. This isn't necessary right away if you're going to be using the TS1000 primarily as a computer literacy tool. But if you want to use a variety of

prewritten software, you will need to expand the memory to 16K.

The computer's flat membrane keyboard is small and can be difficult to use. Each key has up to five different functions and mastery of the keyboard takes some practice. Many of those functions are

Timex Sinclair 1000 computer, with television

Prices are accurate at time of printing; subject to manufacturer's change.

55

Timex Sinclair 1000

Memory
Built-in RAM: 2K
RAM expandable to: 16K
Built-in ROM: 8K

Graphics resolution
Text: 32 characters x 24 lines

Color graphics:
None—monochrome only

Video output
Built-in RF modulator for
home TV

Software format
Cassette

Approximate retail prices
Base price . . . . $ 70

Accessories:
16K RAM expansion cartridge . $ 50
Printer 100

Recommended starter system
Timex Sinclair 1000, standard
cassette recorder

designed as time savers. While programming in BASIC, for example, all BASIC commands can be typed by single keystrokes (after a combination of SHIFT and FUNCTION key presses). If nothing else, having all the commands literally at your fingertips helps you become more familiar with the commands—even those you might not use frequently. Also, after you enter one of these commands the TS1000 prompts you for the right kind of number or letter to follow.

Processing time on the TS1000 seems painfully slow if you have ever used a computer—or even a calculator—before. To help speed things up while running parts of a program that don't need video output, you can instruct the computer to blank out the screen and devote full power to the calculations at hand. Even then, it is no speed demon.

Limited monochrome graphics are available to BASIC programmers. From the keyboard, 20 different black and gray squares and rectangles can be linked together to create charts, borders, or whatever you can concoct.

Peripherals

Timex offers nothing more than a printer in the way of peripherals. However, a large third-party industry has surfaced to provide a wide array of add-ons for the TS1000. Memotech (7550 West Yale Ave., Denver, Colorado 80227) offers a line of memory packs to bring the TS1000 up to 64K; a graphics pack that brings graphics resolution to 47,616 pixels (192 x 248); and interfaces for other printers. Another company, Datassette (56 South 3rd St., Oxford, Pennsylvania 19363), offers memory cartridges, as well as a choice of keyboard accessories that provide raised keys for easier typing.

Software

Though the TS1000 has only limited pictures and no sound, its low price has resulted in many sales. This has spurred production of all types of compatible software, including educational software.

Even Sinclair is offering software in the U.S. (by mail order). From

Timex's own library come two popular educational programs: *States and Capitals* and *Super Math.* Home management also has quite a few programs for budgeting, checkbook balancing, and record keeping. Most of the software from Timex, however, is in the games and entertainment area.

The best source of educational software for the TS1000 is third-party producers. To find these suppliers, look in special-interest magazines like *Sync,* which specialize in Timex Sinclair machines.

Software for the TS1000 is available only on cassette. The TS1000 comes packed with cables to connect the computer to a standard portable cassette player. Most of the software for the TS1000 is inexpensive ($10 to $20) and requires small amounts of computer memory (anywhere from 2K to 16K).

Suggested software programs

Super Math (Timex Sinclair. About $15. Cassette. Ages 3 to adult. Drill. Requires 16K.) Program offers five levels of math problems.

States and Capitals (Timex Sinclair. About $13. Cassette. Ages 7 to adult. Drill. Requires 16K.)

The Flight Simulator (Timex Sinclair. About $20. Cassette. Ages 10 to adult. Discovery, Simulation, Problem-solving. Requires 16K.)

Presidents (Timex Sinclair. About $11. Cassette. Ages 8 to adult. Drill. Requires 16K.)

Astronomer's Guide (Timex Sinclair. About $15. Cassette. Ages 10 to adult. Tutorial. Requires 16K.)

Punctuation Master (Timex Sinclair. About $11. Cassette. Ages 7 to adult. Requires 16K.)

Ator the ABC Gator (Timex Sinclair. About $13. Cassette. Ages 3 to 7. Drill. Requires 16K.)

Capitalization Master (Timex Sinclair. About $11. Cassette. Ages 7 to adult. Drill. Requires 16K.)

Guitar for Beginners (Timex Sinclair. About $11. Cassette. Ages 10 to adult. Tutorial. Requires 16K.)

Math programs (Timex Sinclair. About $11 each. Cassette. Ages 13 to adult. Drill. Requires only 2K.) Programs include *Geometry 1, Algebra 1,* and *Algebra 2.*

Super Doodles (Timex Sinclair. About $10. Cassette. Ages 3 to adult. Discovery.)

Music Educator 1 (Timex Sinclair. About $10. Cassette. Ages 8 to adult. Tutorial.)

Conversational Foreign Languages (Timex Sinclair. About $11. Cassette. Ages 7 to adult. Tutorial.) Programs teach a smattering of French, German, and Spanish.

Computer Tutors (Softsync. About $15 each. Cassette. Ages 4 to 10. Drill, Arcade game. Requires 16K.) These programs include *Alpha /Vowel Tutors* and *Math Raiders 1000. Alpha /Vowel Tutors* (ages 4 to 9) offers two games (word and picture matching, as well as drills on recognizing long and short vowels). In *Math Raiders 1000* (ages 6 to 10), your child commands the USS Raider 1000 spaceship, using four weapons (addition, subtraction, multiplication, and division) to defend the earth against alien invaders.

Hangman (Softsync. About $15. Cassette. Ages 6 to 12. Problem-solving.) Five libraries of words

include these categories: animals, science, countries, states, and fruits and vegetables. Your child can play against the computer or against a friend. You also can make up your child's own library of 500 words with which the computer challenges the child.

Is the TS1000 for you?

The TS1000 remains the price leader in home computers, advertised as low as $40. We prefer, however, a new black-and-white economy Timex model, called the TS1500. This machine is fully compatible with all TS1000 software but has raised keys and the ability to expand RAM up to 32K. Selling for about $80, this new 16K model will also have plug-in cartridge software available. The keyboard convenience alone is worth the extra price.

Timex Sinclair 2000

The new Timex Sinclair 2000 has many more features than its little brothers, the monochrome TS1000 and TS1500. Like the TS1000, the new TS2000 is Timex's version of a British computer developed by Sinclair Research. The British version was called the ZX Spectrum; more than 80,000 Spectrums have been sold in the United Kingdom.

Hardware

The TS2000 offers an attractively low price for a 48K RAM color computer. The keyboard has raised keys in a layout very similar to the TS1000 with the addition of a space bar. Each key has as many as six functions, depending on the combination of SHIFT and SYMBOL SHIFT keys pressed with the other keys. Most of those multiple functions are keystroke-saving shortcuts for typing in BASIC programs. Sixteen graphics symbols

(eight symbols each in normal and reverse video) can be programmed directly from the keyboard.

One advantage the Timex version has over its British counterpart is a built-in slot for program cartridges. Timex plans a mixed library of cartridge software (under $25) and cassette software ($10 to $20).

The video display shows up to 64 characters across. This makes word processing and other text-intensive programs easier to use than on computers displaying 40 or fewer characters.

A single channel of sound is programmable over a ten-octave range. The resulting music or sound effects can be played either through the computer's built-in speaker or through an external amplifier via the audio output jack.

The BASIC language included in the computer's ROM is an extended version of the TS1000 BASIC. Added commands include many for

color and graphics. The tape cassette speed of the TS2000—the rate at which data or programs are stored and read—is 2½ times faster than on the TS1000. Therefore, cassettes are not interchangeable between the two machines. An above-average knowledge of the two BASIC language dialects is required if you want to translate programs from the TS1000 to the TS2000.

Peripherals

The TS2000 has a peripheral expansion connector on its rear panel. Immediately available is a 32-column thermal printer, which can also be used with the TS1000. This low-cost add-on (about $100) can print text and graphics at a rate of two lines per second. If you plan to write a lot of BASIC programs, this printer will enable you to print out listings of the programs you save on

cassette. With such a listing, it is often easier to follow the program logic, or find ways to improve it and discover where mistakes may have crept in.

Forthcoming is an RS-232 interface that will allow TS2000 users to add a variety of printers or a telephone modem. Future peripherals for sale in the U.S. have not yet been announced. However, in the United Kingdom, Sinclair has begun offering a very low-cost (under $100) disk drive that uses a much smaller disk than is used by other home computers. Specifications call for the drive to be able to load a 16K program in about one second (compared to the 100 seconds required in the cassette format).

Software

With its low price, color, 48K memory, sound, raised keyboard, and cartridge load, the TS2000 is certain to collect a lot of educational software. According to Timex, all TS1000 educational programs will be enhanced to run on the TS2000. (See software programs for the TS1000.) This will give the TS2000 a large library of software in the near future.

Suggested software programs

Tutor programs (Softsync. Under $20 each. Cassette. Ages 3 to 12. Drill, Arcade game, Tutorial.) Programs include *Math Tutors*, *Alpha Tutors*, *Chemistry Tutors*, and *Statistics Tutors*.

Is the TS2000 for you?

Though a less expensive 16K model is available, we prefer the 48K model because the 16K model apparently will not be expandable to 48K. We also recommend the 48K version over the 16K model because the machine's high-resolution color graphics can take up 7K of the machine's RAM (although the specifications don't reveal this). For the 16K model, that leaves only 9K for the user. With 48K, you will be ready for any software that comes along.

We expect initial educational programs to be of the drill and tutorial types directed toward elementary school children. The BASIC

tutorial should be of high quality similar to that for the TS1000, making the TS2000 an appealing machine for programming students. (A complete list of planned software titles was not available at the time of printing.)

With its history of success in the United Kingdom and reasonably aggressive pricing in the United States, we believe that the TS2000 will become a well-supported computer, particularly for elementary school children. It should also be useful for junior high and high school students who want to learn programming. However, the keyboard makes it unsuitable for word processing or learning typing.

Timex Sinclair 2000

Memory
Built-in RAM: 16K or 48K
RAM expandable to: NOT
Built-in ROM: 24K

Graphics resolution
Text: 64 characters x 24 lines

Color graphics:
49,152 pixels (256x192)

Video output
Composite video for video monitor
Built-in RF modulator for home color TV

Software formats
Cartridge
Cassette

Approximate retail prices
Base prices:
16K $150
48K 200

Accessories:
Printer $100
RS-232 interface
.... price not available

Recommended starter system
Timex Sinclair 2000 with 48K of RAM, standard cassette player

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Video Technology VZ200

The success enjoyed by Sinclair (in the U.K.) and Timex (in the U.S.) with their low-cost computers bearing multi-function, nonstandard keyboards has prompted some manufacturers in the Far East to do the same—but at even lower cost. Enter the VZ200 by Video Technol-

ogy, a veteran Hong Kong maker of electronic games.

Hardware

The VZ200 is the first color computer with a list price below $100.

To make it that inexpensive, some "frills" were left out. Built-in RAM is only 4K, which will limit some of the more interesting possibilities in cassette tape software. The only built-in interface is for a standard cassette player. A printer for the VZ200 requires a printer interface.

For the money, however, the VZ200 has some extraordinary features. The BASIC language dialect is a licensed version of the popular Microsoft BASIC. The keyboard has raised rubber keys. The keys sound a soft electronic beep every time you press one, thus verifying the entry. Keys are set for automatic repeat—if you hold down a key, the character repeats until you let go. And there are separate video outputs for a video monitor and for a color TV (through the built-in RF modulator).

As you can see from the color graphics resolution specifications, you won't have a high-power graphics computer at your fingertips. For the most part, a programmer will be limited to the computer's 16 predefined graphics symbols. The version of Microsoft BASIC in ROM has few graphics commands available beyond that.

Memory can be expanded to 64K, a figure few home machines can match. However, only a 16K RAM expansion module will be available at first. The expansion module plugs directly into a connector on the rear of the console.

Other peripherals planned for the VZ200 include game controllers, a light pen, telephone modem, disk drive, bar code reader, and a color video monitor.

Software

The VZ200 was introduced with a set of educational software and it soon will have more. Initial software plans call for more than 35 cassettes (about $10 to $15 each). Several of them will be in BASIC programming, math, English, science, and history. An impressive list of business and game programs is also planned.

Video Technology VZ200

Memory
Built-in RAM: 4K
RAM expandable to: 64K
Built-in ROM: 12K

Graphics resolution
Text: 32 characters x 16 lines

Color graphics:
2,048 pixels (64x32)
in 8 colors
8,192 pixels (128x64)
in 8 colors

Video output
Composite video for video monitor
Built-in RF modulator for home color TV

Software format
Cassette

Approximate retail prices
Base price . . . . under $100

Accessories:
16K RAM expansion cartridge . $ 35
Four-color graphics printer/plotter 135
Printer interface 16
Light pen 11

Recommended starter system
VZ200, standard cassette player

Suggested software programs

Teach yourself series (Video Technology. About $10 to $15 each. Cassette. Ages 7 to adult. Drill, Tutorial.) This set includes several programs and more are being developed. *Introduction to BASIC* is a tutorial for learning programming. There are several math programs, including *Math Fun I, Math Fun II,* and a program on elementary geometry.

Is the VZ200 for you?

Even though some software and accessories for the VZ200 are not yet available, this machine can at the very least be useful as a short-term starter computer for junior high and high school students who want to try BASIC programming using limited color graphics. The experi-

ence gained from this model will teach your child a lot. It will also prepare you for a later purchase of a more substantial and already well-supported system. The rubber keys make the VZ200 unsuitable for typing or word processing, however, so it cannot be viewed as a complete answer to the needs of high school students. It remains to be seen if the VZ200's low price and its color, sound, and graphics features will attract a wide number of users and a variety of educational software programs.

If Video Technology can bring a lot of software and its full complement of peripherals to the market quickly, the VZ200 will be a system functionally competitive with several others. Dealers, however, tend to carry those computers that have millions of dollars of national advertising behind their products—something that is not likely for the VZ200. Therefore, the VZ200 may be harder to find at retail outlets.

Home computer models

Computer Model	RAM built in	RAM expandable to	ROM built in	Text display
Apple IIe	64K	128K	16K	40x24
Atari 400	16K	NOT	10K	40x24
800	48K	NOT	10K	40x24
1200XL	64K	NOT	10K	40x24
Commodore VIC 20	5K	32K	16K	22x23
Commodore 64	64K	NOT	20K	40x25
IBM PC	64K	640K	40K	80x25
Mattel Aquarius	4K	52K	8K	40x24
NEC PC-6000	16K	32K	16K	32x16
Panasonic JR-200	32K	NOT	16K	32x24
Radio Shack TRS-80 Color Computer	16K or 32K	32K	8K or 16K	32x16
Spectravideo SV-318	32K	144K	32K	40x24
Texas Instruments TI-99/4A	16K	48K	26K	32x24
Timex Sinclair 1000	2K	16K	8K	32x24
Timex Sinclair 2000	16K or 48K	NOT	24K	64x24
Video Technology VZ200	4K	64K	12K	32x16

Color graphics resolution[1] (pixels)	Video output[2]	Software formats[3]	Approximate retail price[4]
53,760	C,TV	CS,D	$1395
61,440	TV	CR,CS,D	299
61,440	TV	CR,CS,D	679
61,440	C,TV	CR,CS,D	899
32,348	C,TV	CR,CS,D	200
64,000	C,TV	CR,CS,D	595
128,000	C,TV,RGB	D	1355
61,440	TV	CR,CS,D	150
49,152	C,TV	CR,CS,D	350
49,152	C,TV,RGB	CS,D	350
49,152	TV	CR,CS,D	300 to 550
49,152	C,TV	CR,CS,D	299
49,152	C,TV	CR,CS,D	150
*	TV	CS	70
49,152	C,TV	CR,CS	150 to 200
8,192	C,TV	CS	<100

[1]Maximum resolution, which may be in limited colors; some require Extended BASIC or memory expansion.

[2]Video output:
C = Composite video for color video monitor
TV = RF modulator for standard television (included or optional)
RGB = High-resolution color monitor

[3]Software formats:
CR = plug-in cartridge
CS = cassette
D = disk

[4]Base price for keyboard console only

*Black and white only

Glossary

BASIC (*Beginner's All-purpose Symbolic Instruction Code*) A computer programming language that uses many plain English words as commands. BASIC comes built into most home computers. Also see *Language.*

Baud A unit of measure of the speed at which data is transmitted, either between a computer and a peripheral or from computer to computer. A rate of 300 baud means 300 bits per second. Dividing a baud rate by 10 gives you the approximate number of English words transmitted per minute.

Bit (A contraction of "binary dig*it*.") The smallest unit of information that a computer handles. An 8-bit microprocessor handles information 8 bits at a time, while a 16-bit microprocessor handles twice that at a time.

Board A thin plasticlike sheet containing etched or printed circuits and electrical components. A plug-in board can be connected to a computer's main circuit board. A plug-in board may serve as an adapter (allowing the computer to communicate with an accessory) or may in some other way expand the capabilities of the computer. Also sometimes called a *card.*

Byte A unit of computer data, consisting of eight bits. Typically, one byte of data is equivalent to one letter, number, character, or space typed on a computer keyboard or displayed on a video monitor.

Card See *Board.*

Cartridge A plastic case that contains a factory preprogrammed chip. When plugged into a computer, a cartridge chip provides instructions (programs) to the computer.

Cassette A plastic case that houses a spool of magnetically coated tape

on which computer programs and data can be recorded and stored.

Central processing unit (CPU) See *Microprocessor.*

Chip A tiny sliver of silicon (less than one-quarter inch on each side) with electrical circuits etched onto its surface. Chips are mounted in plastic cases with many connecting pins for inclusion on a circuit board.

Circuit board See *Board.*

Command A word or other signal that makes the computer perform a specific task or operation. A computer can follow commands typed on the keyboard or a series of commands that make up a program.

Compatible Capable of working together. *Compatible software* is software that can be used with a particular computer without modification. *Compatible hardware* is equipment that can be used together, such as a computer and a printer.

Composite video A type of video output that allows a computer to send its video signals to certain monitors that produce sharper images than standard televisions.

CP/M (*Control Program for Microcomputers*) A disk operating system used by some computers that contain the same microprocessors. CP/M is an attempt to make disk software compatible with different machines that use the same disk operating system. However, there are different versions of CP/M, so not all CP/M systems are compatible. See *Operating system.*

Data Information that is entered, processed, stored, or moved to various parts of a computer system.

Disk, floppy A flat, flexible, magnetically coated disk on which computer programs and data can

be recorded and stored. Also called *diskette* or *disk.*

Disk operating system See *Operating system.*

Documentation Instructions for using software or hardware, either in printed form (as in a manual) or displayed on the video screen.

DOS (*Disk Operating System*) See *Operating system.*

Dot-matrix printer A type of printer that forms letters and numbers by printing a grouping (mosaic) of small dots on the paper. Also see *Letter-quality printer.*

Execute To carry out a command or series of commands, as when a computer follows the instructions in a software program.

Function keys Special keys on a keyboard that can be assigned by a programmer to perform special functions within a program. On the keyboard, these keys are usually labelled F1, F2, and so on.

Graphics The broad range of video displays other than letters and numbers (text). Graphics may appear in several colors (as displayed on a color TV or monitor) or in one color (as displayed on a black-and-white TV or a monochrome monitor). Graphics shapes may be predefined on the computer's keyboard, or they may be programmed in more complex versions of BASIC or other computer languages.

Hard copy A printout on paper of computer information or results (as opposed to information displayed on a video screen).

Hardware The physical components or equipment that make up a computer system (such as the keyboard console, disk drive, monitor, modem, memory expansion boards, and so on).

Input Information that goes into the computer, entered either via the keyboard or via a peripheral such as a cassette recorder or disk drive. Opposite of *Output*.

Interface An intermediary piece of equipment or adapter that links two components of a computer system together and allows them to exchange information. An interface is sometimes needed between the keyboard console and peripherals (such as printers, modems, and disk drives).

Kilobyte(K) The measure of memory capacity within a computer or on a storage medium such as a floppy disk. Each Kilobyte consists of 1024 bytes, or characters, typed into the computer or entered into the computer from a disk or cassette.

Language A system of symbols and words (commands) with which humans can instruct computers to perform specific tasks. Some computer languages use ordinary English language words, making those computer languages easier to learn.

Letter-quality printer A type of printer that uses any of several impact printing methods to produce a printed image similar in quality to that of a typewriter. Also see *Dot-matrix printer*.

Logo A computer language developed at the Massachusetts Institute of Technology. It was specifically designed to assist children in learning geometry, mathematics, and computer programming while creating scenes and pictures on the video monitor. The user controls the motions of an on-screen "turtle" (a type of cursor) to form shapes and designs.

Memory A part of a computer system used to store information either temporarily or permanently (see *RAM* and *ROM*). Memory can be built into the keyboard console or expanded in the form of plug-in cartridges or boards.

Microprocessor The central chip circuit inside a computer console that controls all calculations and movement of information throughout the computer system. Also called a *central processing unit* or *CPU*.

Modem A device that converts computer information into audible signals that can be sent over telephone lines to other computers. A modem also converts audible signals back into electric signals to receive information from other computers.

Operating system Factory preprogrammed instructions that tell the various circuits of a computer how to function. The operating system is typically programmed into the computer's ROM at the factory. A *disk operating system* or *DOS* (pronounced "doss") is a more advanced version, containing further instructions for the computer to follow when transferring information between the computer and a disk drive. Computers with CP/M or MS-DOS standard operating systems can sometimes accept programs that were written for other machines that have the same operating system.

Output Any information that comes out of a computer console, whether that information goes to a video display, a printer, a disk, or a cassette. Opposite of *Input*.

Overlay, keyboard Labels that attach to a keyboard to provide a guide to using keys for specialized functions or for a touch-typing tutorial.

Peripheral Any device that can be connected to a computer console and operate under the control of the computer (such as a disk drive, cassette recorder, printer, or modem).

Pixel (Abbreviation for "picture element.") The smallest dot or box on a video screen that a computer can control to display characters or graphics shapes. Graphics resolution is usually measured by multiplying the number of pixels in each row by the number of rows. The higher the total number of pixels on the screen, the greater the graphics resolution. The greater the resolution, the sharper the image.

Port A connector on a keyboard console for attaching peripherals (such as joysticks, printers, plug-in cartridges, interfaces).

Program A series of step-by-step instructions that a computer can follow to perform a specific job. Programs are written in computer languages (such as BASIC, Logo, or Pascal). Also see *Software*.

RAM (*Random Access Memory*). The part of a computer's memory that temporarily stores information typed into the keyboard or loaded from a cassette or disk. RAM is divided into thousands of individual data storage locations, to which the computer can jump at any time to retrieve information. Information in RAM is usually erased when power to the computer is turned off.

Random access The ability of the computer to go directly to a particular piece of information, without regard for the order in which information was recorded or stored.

Resolution The relative level of detail (sharpness of the image) in a video display, determined by the number of pixels. Also see *Pixel*.

RF modulator (*Radio Frequency modulator*) A device that adapts computer video signals so that they can be displayed on a standard television.

Glossary

RGB (*Red-Green-Blue*) A type of video output that allows a computer to send its video signals to special high-resolution (RGB) monitors. The red, green, and blue signals are sent individually to separate inputs on an RGB monitor.

ROM (*Read Only Memory*) The part of a computer's memory that contains factory preprogrammed instructions. ROM instructions are permanently implanted in the circuit and cannot be changed by the user. Plug-in program cartridges contain ROM-type chips, which essentially add to the computer's built-in ROM when plugged into the cartridge slot.

Software The programs or instructions that tell a computer what to do.

Software may be built into the computer's ROM or may be loaded temporarily into the computer from a cartridge, cassette, or disk.

User-friendly An often overused term to describe hardware or software that allows a user to operate the equipment or software with little or no instruction. Another way of saying "easy to use."

Computer and Software Companies

Here is a list of names and addresses of computer companies and software publishers whose products appear in this book.

Apple Computer Inc.
20525 Mariani Avenue
Cupertino, CA 95014

Atari Incorporated
P.O. Box 427
Sunnyvale, CA 94086

Brøderbund Software
1938 Fourth Street
San Rafael, CA 94901

Commodore Business Machines, Inc.
487 Devon Park Drive
Wayne, PA 19087

Control Data
8100 34th Avenue South
Mailing Address/Box O
Minneapolis, MN 55440

ComputerMat
Box 1664
Lake Havasu City, AZ 86403

Fairway Software Company
Box 106
Freeport, IL 61032

High Technology Software Products, Inc.
P.O. Box 60406
1611 N.W. 23rd St.
Oklahoma City, OK 73146

IBM Corporation
P.O. Box 1328
Boca Raton, FL 33432

Infocom, Inc.
55 Wheeler Street
Cambridge, MA 02138

Lightning Software
P.O. Box 11725
Palo Alto, CA 94306

Mattel Electronics
5150 Rosecrans Avenue
Hawthorne, CA 90250

Micro-Ed
P.O. Box 24156
Minneapolis, MN 55424

Microsoft Corporation
10700 Northup Way
Bellevue, WA 98004

Milliken Publishing Co.
EduFun! Division
1100 Research Blvd.
St. Louis, MO 63132

Milton Bradley Co.
443 Shaker Rd.
East Longmeadow, MA 01028

NEC Home Electronics (U.S.A.), Inc.
1401 Estes Avenue
Elk Grove Village, IL 60007

Panasonic Company
One Panasonic Way
Secaucus, NJ 07094

Program Design, Inc.
11 Idar Court
Greenwich, CT 06830

The Programmer's Institute
P.O. Box 3470
Chapel Hill, NC 27514

Proximity Devices Corporation
3511 N.E. 22nd Avenue
Fort Lauderdale, FL 33308

Radio Shack
A Divison of
Tandy Corporation
One Tandy Center
Fort Worth, TX 76102

Reston Publishing Company, Inc.
11480 Sunset Hills Road
Reston, VA 22090

SJB Distributors, Inc.
10520 Plano Road
Suite 206
Dallas, TX 75238

Softsync, Inc.
14 East 34th Street
New York, NY 10016

Spectra Video, Inc.
39 West 37th Street
New York, NY 10018

Spinnaker
215 First Street
Cambridge, MA 02142

T.C.E. Programs Inc.
P.O. Box 2477
Gaithersburg, MD 20879

Texas Instruments
Consumer Group
P.O. Box 10508 MS 5849
Lubbock, TX 79408

Timex Computer Corporation
P.O. Box 2126
Waterbury, CT 06720

Video Technology (U.S.), Inc.
2633 Greenleaf Avenue
Elk Grove Village, IL 60007

Wayne Green Books
Div. of Wayne Green Inc.
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Peterborough, NH 03458

Xerox Education Publications
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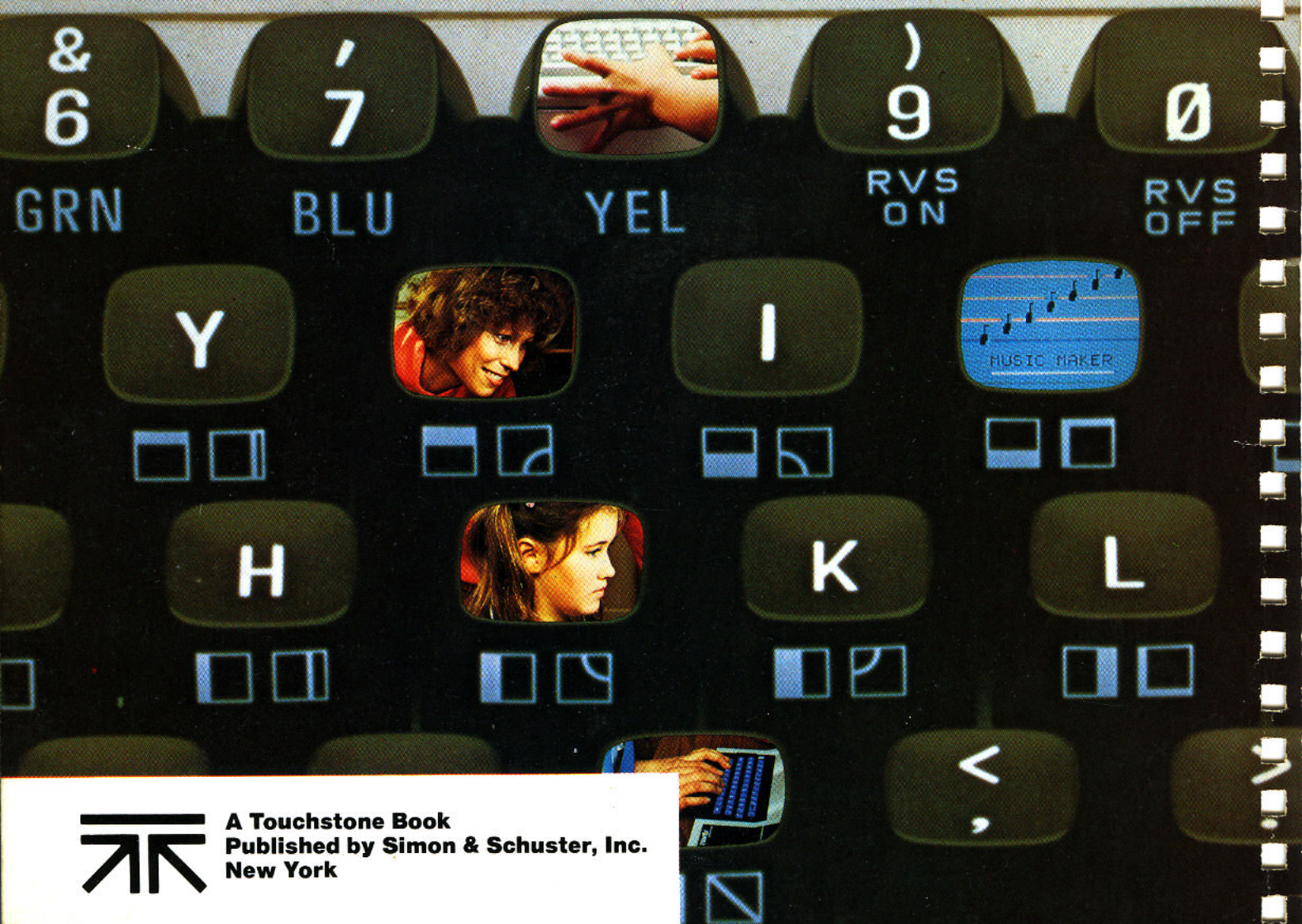
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