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THINGS TO DO WITH YOUR TRS-80® MODEL 4 COMPUTER

JERRY WILLIS, MERL MILLER, &
CLEBORNE D. MADDUX

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THINGS TO DO WITH YOUR TRS-80® MODEL 4 COMPUTER

by

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CHAPTER ONE

Introducing the TRS-80 Model 4

Although ads, articles, and books about personal computers seem to be everywhere today, the plain fact is that most of us were not prepared for this new *computer revolution*. We attended schools that had no courses on computers, and we took jobs that did not require us to deal with one. Things have changed very quickly, however. Computers are on many Christmas lists today because many of the models play great video games. They are more and more common in the nation's classrooms, and an increasing number of professional and technical workers use computers in their jobs. The computer is a versatile machine that can do many different jobs and provide hours of fun.

Computers don't do all that automatically, however. Before a computer balances your checkbook or helps you beat back invading hordes of space no-good-niks, you will have to learn a bit about how it works and what it can do. The new computer owner generally finds there are many different ways of getting the computer to do a particular job. For example, you can buy at least ten good programs for the TRS-80 Model 4 that help you balance your checkbook. There are at least a hundred video games

for the TRS-80 Model 4, some good, a few that are great, and some that can only be described as terrible. Several word processing programs are available for the Model 4. Nobody will want to buy all of them, but it is often difficult for someone new to computers to select the most suitable programs for a particular application.

This book should help you make good decisions. It is written for people who already own or are considering the purchase of a Radio Shack TRS-80 Model 4 computer.

The TRS-80 Model 4 is essentially an upgraded TRS-80 Model III. Software that runs on the Model III also runs on the Model 4. The major difference is in the amount of material that you see on the screen at one time. The Model 4 lets you see more than the Model III.

We assume the reader is relatively new to computers and would like to know a lot more about what the TRS-80 Model 4 can do at the office, home, and school. Each chapter in *Things To Do with Your TRS-80 Model 4 Computer* introduces you to one area of computer application, provides some general information most consumers need, and then gives some detailed information on the products available in that area. The book is written in a format that allows you to skip around as much as you like. If you are interested in video games, for example, it is not necessary to read the chapter on business applications. Here is a list of the chapters and a short description of their content:

CHAPTER ONE. *Introducing the TRS-80 Model 4.* Explains what a personal computer is, explains what *software* is, and introduces you to the TRS-80 Model 4.

CHAPTER TWO. *Games and Entertainment.* Tells about the various recreational uses of the computer, with

an emphasis on video games. It includes reviews of many of the most popular games.

CHAPTER THREE. *Arts and Crafts*. The Model 4 is not a great music machine and doesn't have color graphics. But there are some useful music and visual arts programs. You may not become a modern day Van Gogh or Bach, but there is more artistic potential in the computer than you might expect. It is more than a number cruncher!

CHAPTER FOUR. *The Model 4 as Teacher*. Deals with two aspects of educational computing: the use of the computer to teach other academic subjects and the computer as a topic of study itself. Over a thousand programs for the TRS-80 Model 4 teach everything from grammar to algebra. In addition, many books and programs that can help you become *computer literate* on the TRS-80 Model 4 are described.

CHAPTER FIVE. *Home Finance, Record-Keeping, and Health Care*. The time it takes to keep track of family finances can be cut drastically by computerizing some of these tasks. Several programs for the TRS-80 Model 4 can help you with home finance and record keeping.

CHAPTER SIX. *Telecommunications*. Did you know the TRS-80 Model 4 sitting on your kitchen table can be used to connect you to computers all over the world? You can get all sorts of information, from Italian train schedules to reviews of the latest movies. This chapter shows you how.

CHAPTER SEVEN. *Word Processing*. Explains how the Model 4 can be turned into a very smart electronic

typewriter and word processor. The TRS-80 Model 4 is a very good computer for both home and professional or business word processing. With the right programs, a good printer, and some practice, your Model 4 can rival word processing systems that cost four or five times as much.

CHAPTER EIGHT. *Business Applications*. A brief overview of the ways a computer can be used on the job, concluding with a description of some of the business software available.

CHAPTER NINE. *The Model 4's Programming Languages*. Writing instructions that tell a computer what to do is called programming, which is covered here, as well as the various languages available on the TRS-80 Model 4 (for example BASIC, PILOT, FOURTH).

CHAPTER TEN. *Peripherals*. The final chapter deals with accessories such as disk drives, printers, plotters, extra memory, and more.

The Computer Revolution

Even if we wanted to, it would be hard to avoid newspaper, television, and magazine coverage of the current computer revolution. Articles in everything from *TV Guide* to *Playboy* explain what is happening. We are told that several billion dollars of computer equipment will be purchased this year for use in offices, homes, and schools. Many articles imply, either directly or indirectly, that if we are not already *computer literate* we are behind. Ads in recent issues of *Business Week* tell the executive that

other executives have computers on their desks. The executive without one is thus at a disadvantage. The punch line of the ad urges you to send $129.95 for a complete kit of information on which computers executives buy, and what they do with them.

An ad with a similar message appeared frequently during the Christmas season a few years ago. Sponsored by Radio Shack, the manufacturer of the Model 4, the message was that all good parents were buying their children home computers that year because the future belongs to kids who understand computers.

Such scare tactics are used in virtually every market today. Those who ignore computers, we are told, will be at a disadvantage in the near future. We feel this approach to creating interest in computers often has the wrong impact. Don't buy a computer because other people are; buy one because you can see uses for it that interest you.

With all the media coverage and the psychological pressure to keep up with neighbors and colleagues, most people approach computers with cautious interest mixed with apprehension and perhaps fear. We are filled with questions. *Will I be able to learn how to use these new devices? How will they change my work? Are they really worth the money for home use? How do I make an intelligent decision about what to buy? Are they simply a fad that will pass, or are they a permanent part of our lives?*

Computers are a permanent part of our lives. They have changed the way we do things, and they will produce even more changes in the near future. Only a few things have produced such revolutionary changes—events such as the industrial revolution, the invention of the automobile, and the development of wireless communication technology. None of these changes were embraced with open arms by everyone. We tend to prefer what we are

familiar with, what we already understand, and what seems comfortable. We like stability and are often uncomfortable with change, particularly rapid change. We need time to adjust, to become familiar with new things.

Computer technology has not permitted us the luxury of time to accept it. Technology can move faster than we can. And it has forced itself upon us as a brash, largely untried newcomer that competes for our attention, our dollars, and our affection. They edge their way onto our office desks, and show up on the workbench in the shop; they sit smugly on the desk in our classrooms, and they insist on a place of honor beside the television and the stereo in our homes. Few inventions have come into our lives from so many directions at once.

The history of computing has not helped most of us to accept computers. Early systems were gigantic, expensive devices operated by highly-trained technicians who wanted to keep the secrets of the computer to themselves. If we used computers before the advent of the *personal* computer, it was probably indirectly. Before personal computers, ordinary people like you and me did not talk directly to the computer. Instead we told one of the experts what we needed the computer to do. Then the expert talked to the computer and let us know what it said. This approach could be called the *high priest* approach to computers. As in ancient Greece, ordinary mortals did not converse directly with the gods. Instead, they talked to a priest who then talked to a god and passed on any reply to the ordinary mortal. Until recently the high priest approach was the only way most of us could interact with a computer.

Two developments that began in the sixties revolutionized the field of computers. First, a technology called Large Scale Integration (LSI) enabled designers to put the equivalent of large rooms of forties-era vacuum tube

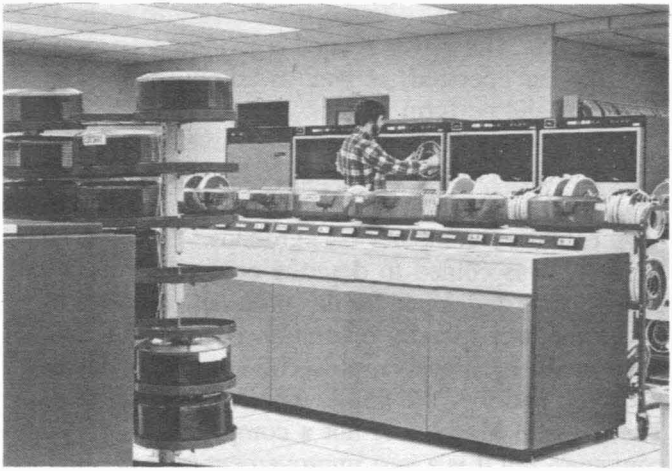

Fig 1.1 A modern mainframe computer center

circuits on a tiny sliver of silicon that could get lost under your fingernail. These LSI circuits are the foundation of personal computers today. It would have been possible to build the TRS-80 Model 4 computer in the fifties, but it would have been made of vacuum tubes, capacitors, resistors, and relays and would have filled a room at least thirty feet square and cost several million dollars.

LSI technology alone could not have produced the current level of computer interest. Even small computers can be difficult to operate without extensive training. In the eighties we are in the midst of another dramatic development: user-friendly computers.

In the days before personal computers, most of the people who worked directly with a computer had extensive training. Computers in those days were a lot like the early automobiles. The beginning models had so many design problems and were so prone to mechanical failure

that drivers frequently found it necessary to make roadside repairs. The driver needed a good understanding of how the car operated, as well as an ability to diagnose problems and perform repairs.

Early personal computers carried over this approach, with disastrous results. Personal computers are for people who, while perhaps highly trained in other fields, do not have extensive computer backgrounds. The term "user-friendly" was coined to describe computers, programs, and manuals developed for this group of computer users. When the user-friendly revolution is complete, we will have small, inexpensive, powerful computers developed with you and me, the non-computer scientist, in mind. The TRS-80 Model 4 is not a completely user-friendly computer, but it is a vast improvement over the first and second generation personal computers. You can still find some cryptic passages in manuals, *bugs* in the programs that cause unexpected results, and programs that are difficult to follow. However, we are to a point where computers are useful, relatively friendly devices that let us have more fun, do more work, and become more efficient in the way we use our time.

Before moving on to a discussion of the TRS-80 Model 4 and its parts, we would like to discuss the type of computer user you may want to become. Many people think using a computer involves learning to write programs for the machine. That is one thing you can do, but well over eight-five percent of the people who use a personal computer never write a single program. Here are some categories of users:

Program User

If you are a program user, you learn how to run several programs that are useful. You'll know how to turn on

the machine, run the programs, and deal with minor problems. It takes a few days of effort to become a good program user.

Informed User

If you become an informed user, you will do all the program user does, but also learn more about the equipment available and what it will and will not do. You'll be able to select intelligently and set up a computer and its accessories. And you'll be able to choose appropriate programs to accomplish a job (or have fun). Becoming an informed user requires a few weeks of part-time effort plus some continuing reading (for instance, computer magazines in areas of interest) to keep current on new developments. This book is written especially for people who want to become informed users.

Adaptive User

If you're an adaptive user, you can do all that the informed user can do. You'll also learn a bit about how to program a computer. You may not write complete programs, but you can modify or adapt many programs other people have written. If a program doesn't do quite what you want it to, you can change it. You may even be able to take care of routine maintenance and set-up tasks (for instance, rewiring cable to connect a new printer to the computer). Becoming an adaptive user takes several months of part-time effort, perhaps spread over a year or more. Adaptive users generally read quite a few books on personal computing and subscribe to a number of magazines.

Area or Model Expert

Many computer owners fall into this category. They become interested in a particular area, like word processing, video games, or accounting, or they become devoted owners of a particular brand or model of computer. These people spend a great deal of time keeping up with their own area of interest. You will want to know several of these people because they are valuable resources. If you become a model or area expert, plan to make a considerable, and continuing, investment of time.

The Hacker

If you're a hacker, you are *into computers*! You can program a computer in at least one language (like BASIC or Pascal) and can start with a blank piece of paper (or a blank video display screen) and end up with a complete program. Becoming a hacker requires lots of time and an emotional attachment to computers that goes beyond viewing them as useful tools. Many hackers have gone on to full-time jobs in the computer industry. Several have become millionaires because the skills they have are in short supply. The opportunities for talented hackers is almost unlimited. Some have written video games that sold hundreds of thousands of copies; others have developed business programs that became very popular.

Elitists in the personal computer field, particularly those whose training happens to be in computer science or engineering, tend to look down on people who are not programmers (that is, hackers). But don't be intimidated by hackers who try to question your worthiness in the computer world. Wanting to use the computer for a particular job or for playing games is perfectly acceptable. You don't have to fall in love with the thing or spend

most of your weekends slouched over a keyboard. Select the level of use and involvement that fits your needs and go to it! Using a personal computer like the TRS-80 Model 4 can take as little or as much of your time as you want.

THE ESSENTIAL Model 4

The information provided in this section is not absolutely necessary if you want to buy programs and start using the computer. However, we feel that some understanding of the Model 4 and its components is helpful, especially if you are thinking of buying accessories.

Fig 1.2 TRS-80 Model 4 computer

The TRS-80 Model 4, like any other computer, is an electronic device that can be *programmed* to perform a variety of different tasks. That is, if you understand one of the languages the TRS-80 Model 4 understands, you can develop a set of instructions for the computer. When you tell the TRS-80 Model 4 to *execute* the instructions you type in, it loads the electronic signals that represent your instructions into a special section of its memory and performs the operations associated with each instruction. The instruction PRINT "Hello, how are you?", for example, tells the computer to print the sentence *Hello, how are you*? on the video screen. The programs you buy and use on the Model 4 are really sets of instructions written by programmers. Sets of instructions that do a particular job, such as play a fast game of blackjack, are called *programs*. The general term *software* is used to refer to computer programs.

You can either write or purchase software, or computer programs. Store-bought software comes in several different forms. Much of the video game software for the TRS-80 Model 4 is available on cassette. Cassette software is no more than the electronic codes that represent instructions recorded in much the same way music is recorded. The TRS-80 Model 4 can *listen*, electronically speaking, to the signals on the cassette and convert the signals into instructions that are stored in memory. If you buy a program that comes on a cassette, you must *load* the program into the memory of the computer through a cassette recorder, then tell the computer to execute those instructions.

Another way you can buy software is on a disk. Disks are flexible platters of coated mylar plastic enclosed in a protective envelope. Disks look a lot like 45 RPM records. The coating on these disks is magnetic. A special device called a disk drive can record or read information stored on the surface.

If you learn to program the TRS-80 Model 4, you can use a cassette recorder or disk drive to make a permanent copy of your programs for later use.

A computer is tremendously versatile because it understands and uses thousands of different programs. The computer is not at all prejudiced about what it does. If you write or buy a program that helps you keep an up-to-date list of your family possessions for insurance purposes, the computer will execute that program just as happily as it executes the instructions of your teenager's favorite video game program.

Software is what makes a computer versatile. Hardware, the nuts and bolts of the computer, is what most of us think of when we talk about computers.

The Power Supply

The TRS-80 Model 4 power supply is a well-designed unit that sits just under the video monitor inside the case. It converts the 120 volt AC house current into direct current (DC) voltage. Most of the internal circuits operate on 5 volts DC although some circuits have to have 12 volts DC.

I/O Ports

I/O is an abbreviation for input/output. If a computer is to be of any use, it must be able to receive information and communicate back to you. This basic function is called input/output. The places on the computer circuit board where I/O occurs are often called *ports*. The TRS-80 Model 4 has several ports that allow you to communicate with it.

The keyboard is your primary means of giving information and instructions to the computer. The press of a

key is converted into a pattern of electrical signals. Each key has a unique signal or code that is sent to the computer. The Model 4 interprets the signals it gets from the keyboard as instructions to do something (for example, pressing the CLEAR key deletes everything from the screen) or as codes for a letter, number, or graphics symbol. The keyboard on the TRS-80 Model 4 is a very good one, particularly compared with the keyboards on other computers in its price range.

The video I/O port is also very good. It connects to the video monitor that is in the same case as the main computer circuit board. This computer displays 24 lines of text, each with up to 80 characters, on the screen. The 24-by-80 format is a very good one for business and professional uses. The Model 4's biggest competitor, the Apple IIe, has a 24-line by 40-character display. However, the Apple IIe has color and sound, while the Model 4 has neither. The Model 4 uses a *monochrome* (black and white) display and has only limited graphics features. That makes it less satisfactory for video games. Most Model 4 buyers make business, professional, or home finance applications their first priority, rather than recreational uses like video games.

The second means of output is a printer. You must buy a printer separately from the computer, but the Model 4 comes with an I/O port for a printer. Printers generally connect to either *serial* or *parallel* I/O ports and the Model 4 has a standard parallel port. All you need to do is buy a printer that uses a parallel interface, a special cable, and plug it in.

With a keyboard, a printer, and a video display you can communicate with your computer and it with you. You also need some way for the computer to communicate with itself. For example, it sometimes needs to store data in a safe place and then retrieve it later. Com-

puter-to-computer communication is done with a cassette interface or with disk drives. The computer can store data or programs on a cassette or disk and then retrieve it anytime you tell it to. If you haven't done so already, you may want to buy a cassette recorder or disk drives for your Model 4. Storing information on a cassette or disk is sometimes called *mass storage*. Another form of computer-to-computer communication called *telecommunications* is discussed in a later chapter.

Memory

When you press a key on the keyboard or load a program into the computer from a cassette or disk, you must have somewhere to put that information. Each letter or number you type on the keyboard is converted to a code and stored in the memory of the computer. All computers convert characters into ones and zeros (on and off electrical signals). The letter A, for example, has the code 01000001. Such a set of eight digits is called a *byte*, and each of the ones and zeros is called a *bit*. Seven of those bits are used to define the code for each character the Model 4 understands. The eighth is usually added to the character code so the computer can check for errors. This process, called *parity checking*, will not be discussed here. Bytes, the eight-bit patterns, are the fundamental code units for the Model 4 and for most small computers.

Memory inside the computer is also divided into bytes. One byte of memory can hold the electrical impulses that represent eight ones and zeros. Every letter, digit, graphic symbol, and punctuation mark the Model 4 understands has a unique code of one byte (eight bits). This means there is not a place in the computer where an A or B or 7 or + is stored. Instead, each of those symbols has its own one-byte code.

The standard Model 4 comes with over 80000 bytes of memory, but not all of it is available for general use. There are actually two different types of memory in the Model 4: RAM and ROM. ROM stands for Read Only Memory, which is generally programmed at the factory and cannot be changed by the user. The Model 4 ROM contains thousands of instructions for the computer, including those for BASIC, a popular computer language. When the Model 4 is turned on, it automatically goes to the section of ROM where the instructions for BASIC are stored and understands your commands in BASIC. If you have a Model 4 with disk drives, the computer follows instructions in its ROM to load programs stored on disk.

All computer memory cannot be ROM, however. Much of the memory in the Model 4 is RAM, or Random Access Memory. RAM is general-purpose memory, available for use by the computer operator. The standard Model 4 has a little over 64000 bytes of RAM. Since each byte can store the code for one character, the 64000 bytes of RAM can hold up to 64000 characters. That is quite a bit of RAM memory. Some of its competitors come with much less RAM memory, and the manufacturers generally charge a stiff price to add extra memory. You can add a little over 64000 bytes of RAM to the Model 4, which means you have a maximum of over 128,000 bytes.

RAM is also known as *volatile* memory. You can store data or instructions in RAM, tell the computer to use the information you've stored there, and then replace the material in RAM with something new. You can put data in RAM (write to memory) and you can see what is stored there (read from memory). You can only read ROM. The biggest problem with RAM is the fact that whatever is there disappears when the computer is turned off. If you need to save something in RAM for later use, you must

store it on a cassette or disk before turning the computer off. Material in ROM, on the other hand, remains there essentially forever and cannot be changed or modified.

Thus far we've talked about the number of bytes of memory the Model 4 has. Computer buffs generally do not talk about memory in terms of bytes, but in terms of Ks for kilobytes. Each K of memory is 1024 bytes. Thus 16K would be 1024 times 16, or 16384 bytes. Just multiply the number of K by 1024 to determine the number of bytes of memory. The Model 4 can use as much as 128K of RAM and comes with 64K already installed.

The CPU

The CPU, or Central Processing Unit, is the heart of a computer system. Although most CPUs are smaller than a half dollar, the electronic components they contain would have filled a room a few decades ago. LSI technology permits manufacturers to cram thousands of circuits into tiny silicon chips that work dependably and use less power than an electric razor. There are several popular CPU chips today with names like Z80, 8088, 6502, and 68000.

There are real differences among these chips, but the differences are mainly of interest to computer designers, experienced programmers, and to people who need the special capabilities of some of the chips (for example, the ability to use large amounts of memory or to work very rapidly). The Model 4 uses a Z80 CPU, the same chip used in many inexpensive business computers like the Osborne I, Morrow MicroDecision, Eagle II, and Cromemco C10. Because the Z80 has been on the market for several years, thousands of programs have been written for computers with Z80 CPUs. That does not mean, unfortunately, that Osborne programs will run on the

Model 4 because their CPUs are the same. But it does make the process of converting programs to operate on other computers easier.

All the components that make up the Model 4—the I/O ports, power supply, memory circuits, keyboard, and CPU—make up one of the least expensive, most versatile computers available today. The Model 4 can carry its weight in the office, at home, and in the classroom. It is quite a bit of computing power for the money.

CHAPTER TWO

Games and Entertainment

OK, so you finally made the big decision. You signed your life away to the finance company and brought home a TRS-80 Model 4 computer with all the accessories. You've astounded your friends (and appeased your spouse, or tried to) by demonstrating how it can analyze real estate investments, improve Junior's spelling, and store your favorite recipe for chocolate-covered cabbage. That's all well and good, but now that the friends have gone home and everyone except you is in bed, it's time to get down to business. Time to put your computer through its paces and use it for something *really* important: it's time to play computer games!

COMPUTER GAMES ARE VERY POPULAR

While it's true that computers can be useful for many tasks in the home, it's also a fact that they are most often used for game-playing. Computer magazines and software catalogs are filled to overflowing with ads for game software.

That's not hard to understand when you consider the popularity of arcade games that cost a quarter to play. They're everywhere you go these days: grocery stores, convenience markets, restaurants, malls! Several home computers can run games strikingly similar to those arcade games. Some experienced gamers even *prefer* the better small computer games over the coin-operated arcade ones. The fact that home computer games are becoming so good is astonishing when you consider that arcade games often cost more than $3500 and use a custom-designed video screen.

There's good news and bad news about playing computer games on the Model 4. The good news is that you can have a lot of fun playing games on your computer. The bad news is that the TRS-80 Model 4 is not one of the computers that can compete with the quality of arcade games.

The primary reason the Model 4 does not measure up to the Coleco Adam, the ATARI, or the Apple when it comes to video games is that the Model 4 was not designed primarily for recreational uses. It can't produce very high-quality color pictures (called *graphics* by programmers). If you have ever played an arcade game, you know that much of the appeal lies in the use of colorful, imaginative graphics. The Model 4 can produce some graphics, but does not have a color display. Not all computer games require color graphics, and you can certainly have a lot of fun playing games of all kinds on your Model 4. But if that's your *primary* reason for wanting a computer, the Model 4 is not your best choice.

A Word of Caution

We have not attempted to review every, or even most, of the games available for the Model 4. There are too

many of them, and quite a few are so poor they don't deserve mention. It would take many pages to review all the bad recreational software for the Model 4, so we decided to use the space in this book to describe software we found at least acceptable, if not excellent. Even with that limitation, we can't describe all the good software that is available. We've reviewed many of the good programs to give you an idea of the types of games you can find for the Model 4.

Because the Model 4 is a new computer, most of the software available when we wrote this book was created for the Model III. These programs run on a Model 4 with no modification. By the time you read this, you may be able to buy versions written specifically to take advantage of the Model 4's new features.

TYPES OF GAMES FOR THE TRS-80 MODEL 4

When we first planned this chapter, we thought it would be easy to organize our discussion around several distinct categories of games. We came up with a system of categories but we have since found they're not as clear-cut as we originally thought. As gaming gets more sophisticated, the divisions between categories blur. Nevertheless, we will discuss computer gaming on the TRS-80 Model 4 computer in the following categories: action games; fantasy games; simulation games; card games; Las Vegas-type games and board games; and sports games.

Action Games

Some of the most popular computer games are action games. If you have played an arcade game, chances are

it was an action game. Actually, there are several types of action games. The most popular type pits your spaceship/missile base/tank against hordes of attacking enemy ships/creatures/tanks. Insiders in the computer industry sometimes refer to these games as *bang-bang-shoot-'em-up* games. That certainly sums it up! You spend your time zapping alien spaceships or blasting asteroids. In other types of action games, you guide race cars around a track or play tennis or hockey. Without intricate color graphics, the Model 4 is less suited for action games than for some of the other categories. We'll review a few action games we think you'll enjoy, then go on to other games more suited to the Model 4.

Fig 2.1 An *Action* game

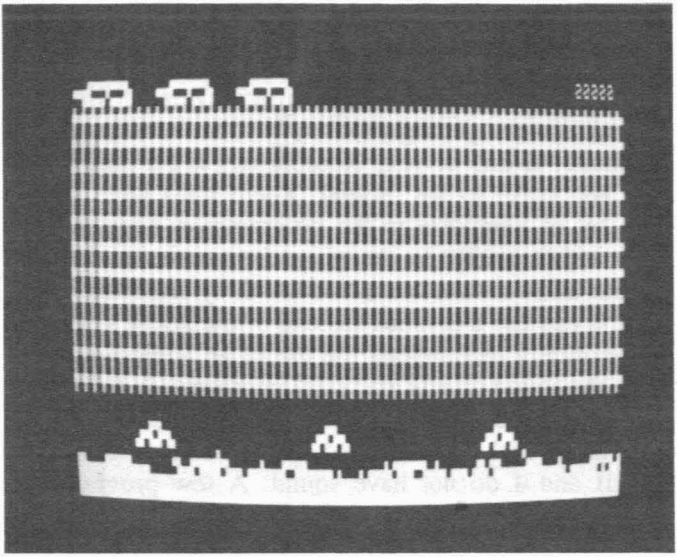

Fig 2.2 Three rotoblasters in upper left corner with three hovertanks stationed below. From *Phaser Blast*

Phaser Blast

Phaser Blast is an excellent action game available on diskette or cassette ($19.95) from Instant Software. It is set in the not-too-distant future; the world is at war but has realized nuclear conflict is impractical. Instead, conventional weapons are being used. You are in charge of a fleet of four Rotoblasters, flying craft you can maneuver up or down, right or left, with the arrow keys on your computer. You use your Rotoblasters one at a time until each one is destroyed. You can aim and fire lasers at three Eastern Bloc Hovertanks. These ground-based craft are slow but deadly accurate as they track and fire at you. Since they're slow, your only hope is to keep mov-

ing, pausing only long enough to fire. You aim your laser gun with the right and left arrow keys, arm the gun by pressing the space bar, and fire by releasing the space bar. This is a somewhat unusual arrangement for firing and takes some getting used to, but that adds interest to the game. If one of your Rotoblasters is hit (and it will be), you crash to the ground. There must have been a little bit of kamikaze in the programmer, because even as you fall crazily to the ground, you retain right-left control and can take out a Hovertank by crashing into it.

You can use a joystick instead of the arrow keys, and we definitely recommend the use of an audio amplifier, since the sound effects are really impressive in this game. Since the Model III computer, the computer the Model 4 replaces, had no built-in sound, most video games for the III and 4 do not have sound. A few programmers took advantage of the cassette circuits on the computer, however, and wrote sound effects instructions in their software. Plug a small speaker into the computer through one of the cassette recorder cables, and you'll get sounds in quadraphonic stereo that aren't bad.

The graphics in this program are better than average, and the game is fast with three skill levels. At the harder skill levels, the Hovertanks fire more quickly and more accurately.

Planetoids

Planetoids is another high-quality action game, available on tape ($19.95) or disk ($20.95) from Adventure International. It is very much like the arcade game called *Asteroids*, but without color graphics or sound effects.

If you're familiar with the *Asteroids* arcade game, you know the basic dilemma. Your ship is in a gigantic asteroid field. To play the game, you move the ship or fire

your laser to avoid colliding with the moving asteroids. You earn points by destroying asteroids, with the smaller asteroids worth more points than the larger ones.

Just to make things a little more uncomfortable for you, while all this is going on, a variety of enemy spaceships try to shoot you; you have to get them first. You can control your ship by rotating it, firing its engines, or escaping to hyperspace, which should be your last resort: there's no way to tell where you will be when you come out. You may find yourself in a worse fix than before you went in!

The game gets more and more difficult as it goes on. Asteroids and enemy ships come faster and faster, and the enemy ships fire more and more shots at you. If you survive long enough to pile up a score of 90,000 or more, consider yourself an expert.

If things get too tough, you can stop the action temporarily. Several other options include a super-fast and a super-slow action mode, and modes you can use to perfect your piloting and shooting skills. The arcade version of this game has been a huge success with both children and adults and continues to attract quarters. The TRS-80 version is fast and challenging, and the graphics are about as good as you can expect to find in a Model 4 action game. You'll be taking a chance with some games, but *Planetoids* is almost certain to be a hit with the whole family.

Regilian Worm

Regilian Worm is a good example of an action game that is a little different from the *bang-bang-shoot-'em-up* variety. Shoot-'em-ups are fun, but you can blast only so many thousands of enemy fleets before terminal boredom begins to set in. *Regilian Worm* is a variable speed

game. It can be very fast, but doesn't use a single laser or guided missile.

You use the arrow keys to guide the *Regilian Worm* around the screen so he can eat a crew of nasties known as *Zansbards*. As he eats each *Zansbard*, points mount up. "Great," you say. "Let me at 'em." Fine, but as in real life, there is no such thing as a free lunch for the *Regilian Worm*. The more the worm eats, the longer he grows and the harder it is to move him around the screen without running into a wall or touching his own tail. When you do either of these things, you lose.

This is a good action game with ten different speeds at each of four difficulty levels. This ensures a level for players of almost any age. As you get better, you can increase the difficulty level and keep the play challenging. The game also has good sound effects if you have an audio amplifier (Radio Shack part number 2771008A—$11.95). *Regilian Worm* is a welcome new wrinkle (or wiggle) in the world of action gaming.

Leaper

Leaper is an action game similar to the popular arcade game called *Frogger*. It's available on cassette only ($15.95) from Bob Krottson. In this game, you guide a frog through dangerous situations and try to reach one of six safe cubbyholes at the top of the screen. When the game begins, you have three frogs. You must move the first one across a highway of speeding automobiles. If you make it, the next challenge is getting the frog across a river by jumping from lily pads to logs. The only problem is the lily pads may sink, or the logs may actually be hungry crocodiles. To make things a little more difficult, you have only thirty seconds to guide each frog to safety.

Once you get six frogs into the safe havens at the top of the screen, you earn a bonus frog and move up to the next level of difficulty. As you reach each new level, there are fewer lily pads, more crocodiles and faster and more numerous cars.

Leaper is a good action game for your Model 4. It's inexpensive, interesting, and should keep your interest for quite a while as you move from easier to more difficult levels.

Boxer

Boxer is a free action game printed in the February 1983 issue of *80 Micro* magazine. In this game you chase and punch a punching bag. The bag can appear at any position on the screen. You move around the screen by using the arrow keys. The game is really a test of how fast you react. *Boxer* lacks the complex graphics and numerous skill levels you get from expensive commercial games written by experts. On the other hand, it's fun for a short while and it has the added attraction of being free.

Boxer is typical of the free games printed in computer magazines. There's a catch, though. Before you can play *Boxer*, you have to type in the entire program (approximately 150 lines). This is time-consuming, and if you make errors, the game doesn't work right. Nevertheless, there is satisfaction in getting an enjoyable game for nothing, even if it takes some effort.

If you aren't interested in typing in the program yourself, there is an alternative. Several computer magazines sell cassette tapes or diskettes containing the major programs listed in each issue. *80 Micro* has such a service and calls it *Load 80*. A yearly subscription is $99.97 for cassettes and $199.97 for diskettes. If you don't want to shell out that much money for programs you haven't seen,

you can also order the tapes or diskettes for specific issues. *Load 80* is available on cassette for all issues of *80 Micro* from April, 1981 to the present, and on diskette from March, 1982 to the present. Send $9.97 for each cassette and $19.97 for disks (add $1.50 shipping and handling charges for each cassette or diskette).

Load 80 cassettes and diskettes are sold without manuals or any kind of documentation. So you often need a copy of the *80 Micro* issue that listed the program. You can order back issues of *80 Micro* for $3.50 per copy. When this chapter was written, back issues for most copies since 1982, as well as selected earlier back issues, were available. Yearly subscriptions to *80 Micro* are $24.97, and individual copies sell at newsstands for $2.95.

Another computer magazine dealing exclusively with TRS-80 computers is called *Basic Computing* (prior to July of 1983, it was called *80 U.S.*). This magazine often publishes listings of game programs, as well as other programs, and offers them on cassette only. They are available only from January 1983 to the present and sell for $9.95 for all programs over a three-month period. They can be ordered from *Basic Computing*. The journal itself sells for $3 per copy at the newsstand. Subscriptions are $16 for one year or $31 for two years. You can also get selected back issues.

Roadrace

Another excellent way to buy inexpensive computer software is to buy it in book form. *Roadrace* is one of thirty-two programs available in the book *32 BASIC Programs for the TRS-80 Computer*, a highly-rated book by Tom Rugg and Phil Feldman, published by dilithium Press.

In this game you are at the wheel of a high-speed race

car winding your way along a treacherous course. The road curves unpredictably. To stay on course, you must steer accurately (using the arrow keys) or risk collision. Instructions for changing the program are in the book, so you can set your own level of difficulty. If you don't want to type the program in, it is also available on disk. The book sells for $19.95 and the book-disk combination sells for $34.95. *Roadrace* is only one of the thirty-two programs in this book, which includes educational programs, several other games, and programs for home record keeping and business use.

Adventure Simulations (Fantasy Games)

Adventure simulations are strategy oriented. You must think your way through the simulation rather than act your way through. Excellent eye/hand coordination, fast reflexes, and good peripheral vision are all essential ingredients for success on most of the arcade-style video games discussed thus far. These assets are not necessary for most adventure simulations. Many of the adventure simulations do not even have graphics displays. Instead, they rely primarily on text displayed on the screen. A game is likely to begin with a paragraph that sets the scene for the simulation: *You are standing on the edge of a forest. There is a narrow winding road that leads out of the forest. The road winds through the hills to a large stone house, shrouded in fog, that stands on the edge of a cliff. You see a bootprint!*

All adventure simulations put you in an environment (forest, cave with many chambers, castle with many rooms, an island inhabited by pirates), give you a task to perform (stay alive, get out, find the treasure, rescue the prisoners), and put all sorts of dangers in your way

(monsters, cliffs, sorcerers, enemy soldiers, bombs, pirates). Two final ingredients of an adventure simulation are incomplete information and ways of getting that information. That means you must begin the adventure without all the information you need. But there are ways to learn more about your surroundings and about how to succeed. In most adventures you move through a series of *rooms*, which refers to different segments of the simulation, like cities or chambers in a cave.

You move about the rooms by typing instructions to the computer (for example, GO AHEAD, TURN LEFT, CLIMB STAIRS, DIG OUT, PICK UP KEY, ASK MRS. PAUDERT ABOUT AMY). The adventure may understand only a few instructions or several hundred. In some games you can create your own characters, can move them independently, and give them different powers. The characters can then go against foes they are likely to overcome (for instance, a sorcerer against a wicked magician or a powerful Samson type against a giant). Things do not always work out as you hope, though. It is not usual to lose some of your characters in an adventure.

Not everyone enjoys playing adventure simulations. Some games take several hours, even days, to learn. Playing a complete game through to the end might take ten hours, if not longer. Because they take quite a bit of time, some let you save your position in the game. You can play for several hours today, save the game, and resume play later at the point where you stopped. If you like strategy, enjoy solving intricate puzzles, and have time to devote to the task, playing adventure games can be a pleasant addiction. Here are some of the popular games for the Model 4.

Pirate Adventure

A good example of this type of game is the popular series from Adventure International written by Scott Adams, one of the most famous authors of adventure games. *Pirate Adventure* is one of these. In it you are searching for clues to the whereabouts of Long John Silver's treasure, which is hidden somewhere on a strange island. Once you find a map of the island, you can begin using some of the items you have been given to help you find the treasure. This is a text-only game—there are no graphics. As you move through the adventure, the screen describes what is happening to you. You move about the island by giving a series of two-word commands such as LOOK TREES (for look in the trees). The computer responds with answers such as I SEE NOTHING OF INTEREST.

The Adams Adventure series has adventures for beginners, those with moderate skill, and advanced players. *Pirate Adventure* is for beginners. Text-only adventure games require logic and patience beyond most children (and many adults) and are really not appropriate for most children younger than thirteen or so.

Voyage of the Valkyrie

Recently, another type of fantasy or adventure game has emerged—one that still relies on magic, demons, and wizards, but also uses detailed graphics and sometimes sound. A good example of this variation is *Voyage of the Valkyrie*, available from Advanced Operating Systems on cassette ($34.95) or disk ($39.95). It may be representative of the wave of the future in fantasy-adventure games. It has some characteristics of classic action games and some aspects of the typical fantasy games.

The object is to find and capture ten castles in an imaginary kingdom called Fugloy. Finding the castles is difficult enough in itself, and takes up the first part of this game. This part of the game is similar to the classic fantasy-adventure game. All sorts of perils lie in wait as you conduct your search. The game comes with over ten pages of instructions and an assortment of maps of Fugloy. If you find your way to a castle, you must attack it. The castles are defended by flocks of birds that try to crash into you and kill you. You must use your number keys to center crosshairs on each one before firing. Since the castles are located on islands, you must return to your base periodically to refuel. There are ten levels of difficulty in *Voyage of the Valkyrie*. As the game gets harder, there are more crazy birds. This means you have to use more fuel. If you run out of fuel over the ocean, you're a goner.

In the second part, the play is much more like an action game. In fact, this part of the game is similar to the *bang-bang-shoot-'em-up* variety found in arcades. Graphics are obviously important, and they are quite good. Sound effects, including music, are included for those who have an audio amplifier.

As we mentioned before, fantasy games have traditionally depended more on strategy and logic and less on fine muscle coordination and quick reactions. However, we suspect that many future games will, like *Voyage of the Valkyrie*, merge some of the aspects of action games with fantasy games. Fantasy games will probably continue to appeal mostly to older children and adults, because of the logic required.

Other companies selling adventure-fantasy software for the Model 4 include Epyx, Nelson Software Systems, and Med Systems Software.

Simulations

Simulation games are designed to mirror real-life or make-believe experiences, like flying an airplane or running a large corporation. Some computerized simulations actually do help people prepare for real experiences. The ones we discuss here are generally fun, but several also have considerable educational potential.

Oil Tycoon

Oil Tycoon is a popular simulation program for the Model 4 computer. In this game, two players get into the oil drilling business and play until one earns several million dollars in profits or goes bankrupt.

This is a text-only simulation. At the beginning of each game you are asked to name the two companies that compete against each other. The first display is a table of information about each company. The beginning total net worth of each company is the same as that company's cash holdings: $2,000,000. The table lists other information such as number of wells, oil flow in barrels, oil reserves, oil sales, net oil profit, percent of return on initial investment, and current drill depth. These read 0 at the beginning of the game, since no drilling or other business activity has taken place. For both companies, the price per 100 barrels of oil is set at $500, and drilling cost is set at $100,000 per 2000 feet.

The message line at the bottom of the screen asks if you would like to invest in research and development (R&D), explore for oil, drill for oil, reprice your oil, or pass up your turn. The only options at the beginning of the game are to choose R&D or to explore. (As in real life, you can't drill without exploring first.) You'll soon

discover that it pays to invest in R&D. The more money you put into research and development, the better your chances of striking oil, and the cheaper your drilling costs. In one recent session of *Oil Tycoon*, one of the authors invested $500,000 in R&D, and the drilling cost for his company immediately dropped from $100,000 to $84,305 per 2000 feet.

When you choose to explore, the program displays a geologist's report listing the report cost (around $50,000 is typical), expected depth of any oil on the property, the flow to be expected if oil is found, and the likelihood in percentage points that the well will be a dry hole. After the geology report is displayed, you are asked if you want to drill the well. Only one well can be drilled at a time so you must weigh the cost of drilling and the likelihood of a dry hole against your cash reserves and the potential profit. If you choose to drill, the drill depth is 2000 feet for each turn. The program then presents your opponent with similar choices on a different tract of land.

The game can continue for hours, and you will soon find that it is more sophisticated than it may seem at first glance. Once you bring in several wells (if you're lucky enough to do that without going bankrupt), you can afford to take extra chances and invest more capital in research and development. If you've drilled a few good wells, your capital increases with each turn as the oil continues to flow in.

You may be tempted to start a price war with your opponent, but remember that as you cut prices, you will also be cutting your own incoming revenue. Can you last longer than your opponent? That depends partly on your respective financial conditions. But it also depends on some uncontrollable variables that can sneak up and get you! Oil spills and well blowouts can occur at any time. These can spell disaster for you or your opponent, es-

pecially if either one of you is in financial deep water.

This is an excellent text-only simulation that can be enjoyed at many different levels. Although children aren't generally as turned on by text-only simulations as they are by games that have fancy graphics, some children enjoy *Oil Tycoon*. It has the added benefit of teaching something about business in general and the oil business in particular.

Deadline

Deadline, a unique game from Infocom, is widely available and has been adapted for many popular computers. Actually, we could have discussed this game in the fantasy-adventure category, but we really couldn't decide where to put it. It *is* an adventure, but in a sense it's also a simulation. It's a simulation of a detective's work, and it's really fun! It is a text-only game, but it's head and shoulders above the early text-only games. Traditionally, text-only computer games for microcomputers could understand, at best, only two-word sentences containing a verb and a noun. It can be terribly frustrating to continue to ask the same question in as many different two-word combinations as you can think of, only to have the program continue to tell you it doesn't understand your question. What makes *Deadline* so much fun is the way it can understand so many different things you type in. You aren't restricted to two-word commands. PUT THE KNIFE IN THE TROPHY CASE or UNLOCK THE DOOR WITH THE KEY are examples of sentences the program understands perfectly. Of course, you can't talk to this program as you would to a friend, but its ability to understand a variety of commands and sentence structures is truly amazing!

Deadline puts you in the role of a tough detective out

to solve the mystery of the death of Mr. Marshall Robner, millionaire industrialist and philanthropist. Robner was found dead on the floor of his library, the victim of an apparent overdose of a drug he had been taking. The door was locked from the inside. Robner had experienced recent business setbacks and had been suffering from severe bouts of depression. It seems to be an open-and-shut case of suicide. But is it? It's up to you to find out.

You are a private detective and you have been hired by Robner's attorney to investigate this presumed suicide. The attorney is convinced there is no foul play, but he feels an investigation is in order since Robner was in the process of changing his will when he died. Mrs. Robner is reluctant to cooperate, but grudgingly agrees to let you spend one day in the Robner mansion. Therefore, you have a deadline of one day to complete your investigation and solve the case.

Each turn consumes one minute, and a line at the top of the screen tells you how much time you have left. You are free to move around the Robner mansion and examine anything or anybody you please.

At first, the people you meet seem ordinary enough, but are they? There's Mrs. Robner, who was frequently visited by gentlemen callers and who is obviously NOT grief stricken over her husband's death. Then there is Ms. Dunbar, Robner's personal secretary, who seems to have been unusually close to Robner. And George, the spoiled son who often quarrelled with his father. You wonder too about Mr. Baxter, Robner's business partner. He may have more to gain from Robner's death than anyone suspects. There is also Mrs. Rourke, the housekeeper, who seems innocent enough. She manages, though, to take an unnatural interest in the personal affairs of everyone in the Robner household. There are other characters as well.

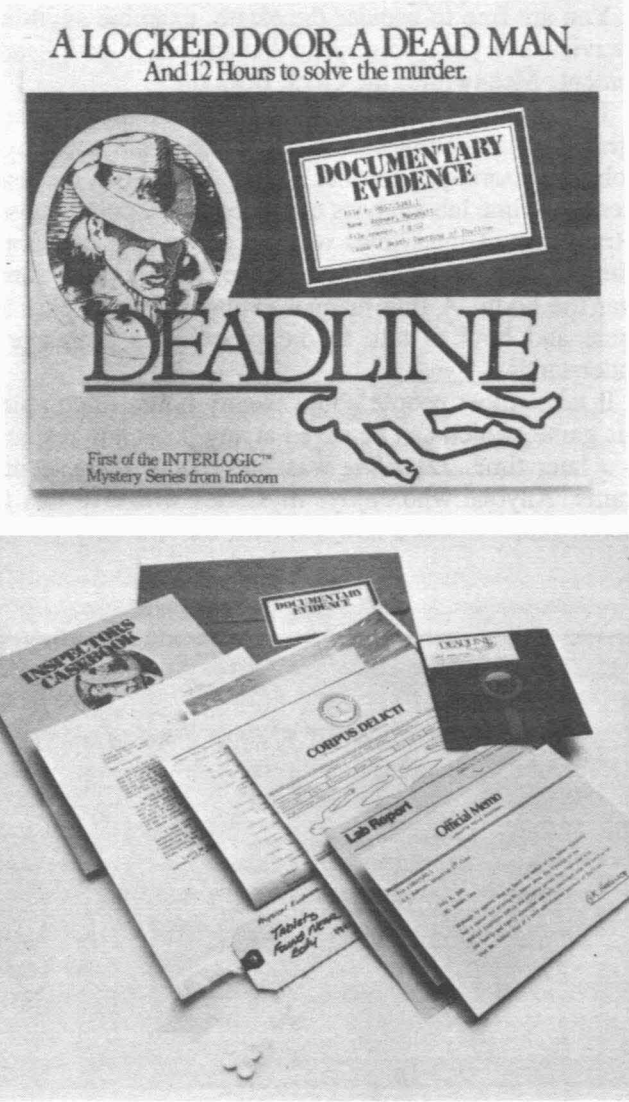

Fig 2.3 The *Deadline* package

You are free to wander the estate, examine anything, interview everyone, fingerprint and analyze to your heart's content. Meanwhile, the clock ticks on.

This is an elegant game, beautifully and artfully packaged. It comes complete with a letter of employment from Robner's attorney, a coroner's report, a photo of the death scene, a crime lab analysis of the teacup, a police report, a transcript of interviews with all the people concerned with the case, and even three of the "deadly pills" found near the body. A fine manual explains how to play the game and how to talk to the program in language it understands.

It takes most people about twenty hours to complete this game, which can be saved at any point and resumed at a later time. *Deadline* was one of our favorite programs. Anyone who enjoys mysteries will love this Infocom game. It sets a new standard for text-only games.

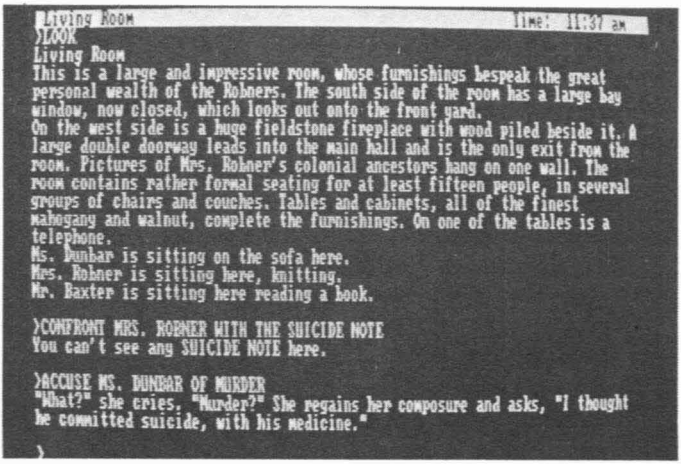

Fig 2.4 The mystery begins here. From *Deadline*

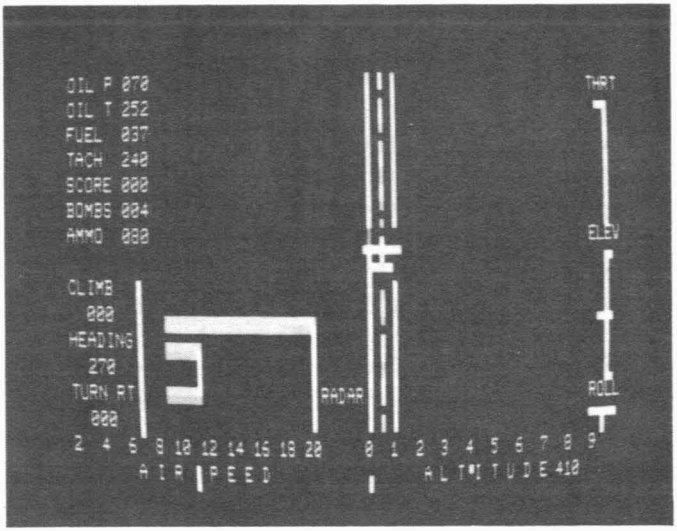

Fig 2.5 *Flight Simulator*

Other Simulation Games

There are many other, more traditional simulation games for the TRS-80 Model 4 computer. Instant Software markets a number of flight simulations that are realistic and fun. *Mountain Pilot* and *O'Hare* can be purchased along with two other flying simulations for $14.95, on cassette only. In *Mountain Pilot* you must fly your plane over a mountain. *O'Hare* puts you in charge of the control tower at a busy airport where you must direct twenty planes to a safe landing. *Air Flight Simulation* (cassette—$14.95) is designed to give you a taste of flying a light aircraft. *Space Shuttle* (cassette—$19.95) puts you in charge of the *Columbia* for orbiting, re-entry and landing maneuvers. *Jet Fighter Pilot* (cassette—$14.95) gives you a taste of combat flying and simul-

taneously displays graphic representations of your plane, the enemy plane and your flight instruments. *Night Flight* (cassette—$24.95) gives you a chance to experience flying by instruments only.

Two excellent simulations are available from Sublogic Communications Corporation. *Flight Simulator* gives you a startlingly realistic out-the-window view from an aircraft. The program is more than a toy and can be enjoyed by beginners as well as by seasoned pilots. The program is $22.50 on cassette and $33.50 on diskette. (The diskette program is superior, by the way.)

The other program from Sublogic is *Forest Fire Dispatcher*, a unique simulation in which you plan the strategy for fighting mountain forest fires ($24.95 on cassette, $29.95 on diskette).

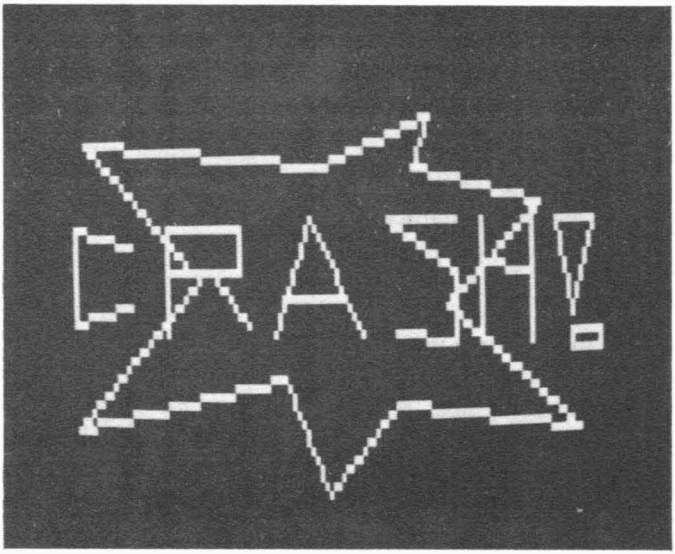

Fig 2.6 Inexperienced pilot using *Flight Simulator*

Card Games, Las Vegas Style Games and Board Games

Programs that simulate all sorts of games of chance are readily available from a variety of software vendors and are a staple of computer games. In some games you just play the game, while others train you to play. Still others do both.

Casino Games is a cassette from Radio Shack ($19.95) featuring good computer versions of Craps, Keno, Slot Machine, Roulette, Wheel of Fortune, and Baccarat.

Board Games

Another staple of computer games are programs that are like the various board games. The chess programs are quite well developed, but even with all of modern technology, no one has managed to come up with a chess program equal to a true chess master.

Microchess (cassette—$19.95) is available from Radio Shack and pits you against the computer at three levels of difficulty. It's challenging for both novices and advanced players.

Cyberchess Chess Improvement System (diskette—$29.95) is more than chess improvement; it's a chess tutor for the serious student of chess. As you play games that have been played by chess masters, your moves are analyzed and corrected by the program. Each disk contains four games, and you can purchase additional disks as you need them.

Gammon Gambler Backgammon (cassette—$19.95) is a Radio Shack program that pits you against a backgammon opponent who's always ready and always sharp.

This program includes a doubling cube for betting, and it graphically displays the board and the pieces. There are ten skill levels to choose from.

Monty Plays Monopoly and *Monty Plays Scrabble* are available from Radio Shack on diskette for $34.95 each and are excellent versions of these two popular board games.

Z-80 Checkers is an excellent version of computer checkers available on cassette ($14.95) from Instant Software. The program has seven different skill levels.

Sports Games

There are many sports games available for your computer. These games are suitable for both children and adults, but they do assume a knowledge of the rules of each game.

Computer Football Strategy and *Computer Statis Pro Baseball* are available from Avalon Hill Microcomputer Games. The football game is on diskette and allows you to play against a friend or the computer. One player enters offensive plays, the other defensive plays, and the computer displays the result.

Computer Statis Pro Baseball is also a one- or two-player game and allows you to assume the role of coach of any major league team for any season since 1952. The statistics for all teams for each season since that time are entered on disk, and you may purchase the ones you want. One team disk comes with the game.

PRO Football—the Gold Edition is available on diskette for $195.00 from Computer Sports Systems. This program is not really a game but a system for handicapping professional football games using your computer. The program is intended for the serious gambler. You

can get a similar program for handicapping horseracing from the same company for $49.95.

WHERE TO LOOK FOR SOFTWARE

Probably the best way to find good new game software is to read some of the computer magazines, which carry advertisements and reviews for many games. As we mentioned earlier, perhaps the best magazines for the Radio Shack computer are *80 Micro* and *Basic Computing*, which regularly carry reviews of game programs for the Model 4.

CHAPTER THREE

Arts and Crafts

Most people don't think of their computer as a musical instrument or an artist's canvas. Computers are machines and machines aren't artistic. If you think of your computer like that, you may be missing an opportunity to use the computer in many interesting ways. Sculptors have hammers and chisels, painters have pallettes and brushes, and musicians have pianos, electric guitars or whatever. These are all tools used to create or play. The Model 4 can also be a useful tool for budding (or not so budding) artists and musicians.

It won't take the place of a baby grand piano or an electric organ. You won't be able to press a button and get a Picasso to hang on your wall. It probably won't take the place of music or art lessons either, but you can do some interesting things in the areas of music and art. You can even create business graphics for reports and meetings more quickly, less expensively, and more professionally on a computer than in the traditional way.

The major ways of using the computer for *arts and crafts* include:

- As an actual compositional medium—the computer and its peripherals serve as the musical instrument or the drawing pad.
- As a teaching machine—the computer assists in teaching basic music and visual arts skills, as well as improving your understanding of music and art.
- As an expressive medium—the computer displays or plays what you have created.

MUSIC

The first home computers had no built-in ability to generate sounds or music. A few companies did offer add-on kits to make it possible to create crude sounds controlled by the computer. Some of these early music synthesizers for personal computers were simply little boards with about $2.00 worth of parts on them. From these early systems came some tinny but recognizable renditions of old favorites like *Boogie Woogie Bugle Boy*.

Today, computer-generated music is serious business. Many college music departments have added computers to their assortment of pianos, tubas, and violins. A magazine called *The Computer Music Journal* is devoted solely to reporting on serious computer-generated music.

Much of the electronic music you hear on movie soundtracks and in concert performances is generated by very expensive, specially designed computers that use sophisticated electronic music synthesizers. These systems cost $15,000 and up. When we talk about computer-generated music, we are not limiting ourselves to these large systems. Small inexpensive personal computers can also generate music. Much of this capability depends on the software that is available, but some very serious mu-

sicians are using TRS-80 and other personal computers in a very serious way. Peter Nero not only writes music for his TRS-80 Model III computer; he also uses it to keep track of nearly 400 musical scores for his concerts around the country. He can keep records of score changes, where scores have been sent, and when they've been returned.

Another serious musician who came to appreciate what a small computer could do for music was John Lennon. Producer Jack Douglas, in the June 1983 issue of *Popular Computing*, had this to say about Lennon's encounter with a personal computer:

> John was an incredible perfectionist. He once told me that he'd recorded only one vocal in the entire Beatle period that fully satisfied him—"Come Together" on the *Abbey Road* album. During the making of *Double Fantasy* in 1980, John would just sit with his head in his hands rejecting take after take. He got very frustrated, so I said, "I'm going to use the computer to merge the best parts from all these takes, and you'll never be able to tell it wasn't a great one-take performance." And John said, "Aw, go on—it's impossible," so I did the computer editing in about 10 minutes. He couldn't believe it. He stopped sulking and then did something that was really rare in a Lennon mixing session—he smiled!

A Little Computer Music Theory

Any sound, musical or otherwise, has several characteristics:

• *Pitch* is determined by the frequency (cycles per second) of the sound. We hear cycles or waves created

by vibrations in the air. These are measured in cycles per second, or Hertz. The typical human can hear sounds between 20 and 15,000 Hertz. Notes on a piano or any other musical instrument are organized by pitch. The sound created by a piano is organized into *octaves*. A piano has slightly more than an eight-octave range from deep or bass sounds to high pitched notes. An octave is a group of eight sounds, rather than a single sound. An octave might begin with the C note and progress up through notes D, E, F, G, A, and B. The next C note ends that octave and begins the next higher octave. Composers and musicians have created a complicated system of naming sounds of different pitch and duration, but the primary difference between one note on a piano and another is the pitch (the frequency, or Hertz, of the sound).

- *Amplitude* or *loudness* of the sound. We experience this as variations in the volume of sound.
- *Duration* is the amount of time the sound is made. Musical symbols tell the musician exactly how much time to play each note in a composition.
- The *envelope* of the sound is the variation in loudness over the period it can be heard. Different sounds have different *attack* and *decay* patterns. Some reach their maximum loudness gradually and then trail off. Others begin at maximum loudness and stop abruptly. The pattern of changes in loudness of a tone help determine the *timbre*.
- *Timbre* is a musician's term for the complexity of the sound. Some sounds are pure tones (that is, they have only one pitch). Others have a major tone at a particular frequency, with harmonic or secondary frequencies that add richness. These secondary sounds are part of what gives each musical instrument its own personality.

The Model 4 has a rather simple sound generation system. The manual that comes with the computer sug-

gests it can be used to generate beeps and warning signals but doesn't mention music generation. However, several companies other than Radio Shack sell products that let you generate much more sophisticated sounds on the Model 4.

With a good sound or music synthesis system, you can control several aspects of sound. With simple systems, you may control no more than the pitch and duration, but with others, you can control pitch, duration, timbre, loudness, and the attack/decay pattern. You may have read ads that talk about the number of *voices* in a system. A one-voice system can play only one tone at a time—not very interesting music. A three- or four-voice synthesizer, on the other hand, can create beautiful music, especially if it controls many different aspects of each tone.

Music with the TRS-80 Model 4

One way to get your TRS-80 Model 4 to make music is to learn a computer language and use it to tell the computer what musical notes you want it to play. Because it has a built-in sound generator, you can use any programming language the computer understands to give it instructions for making musical notes. Each language has its own way of controlling and manipulating the sound capabilities of the computer. In BASIC, the most commonly used computer language, a simple statement, SOUND, tells the computer to make a sound. This BASIC instruction can be expanded to tell the computer such things as pitch and duration of the sound. Once you can control these factors, the amount and quality of music you get from the computer depends on your musical skill and creativity.

There are two problems with the do-it-yourself approach:

- You will have to learn a programming language before you can write music programs. Some people don't want to do that. Others investigate writing music programs in a language like BASIC and decide it just isn't suited to the task. Much of what you learn in the process doesn't transfer to other methods of composing or playing music.
- Even if you write music programs in BASIC, the fidelity of the sound synthesis system built into the Model 4 is low. Your composition won't sound like a 120 piece orchestra.

Because of these limitations many Radio Shack owners add software specially written to generate music, and more sophisticated music synthesizers. Then they can create some very sophisticated music on the Model 4.

Since the Model 4 is new, many of the programs we review were originally developed for the Model III. Most will run without modification on the Model 4, and many are being rewritten specifically for it.

Software and Peripherals for Music

There are software packages available for most computers that allow you to learn a lot about computer-generated music. Most of these software packages are relatively inexpensive, and none will turn the Model 4 into a $50,000 electronic synthesizer, but some of the software and hardware products are very good.

Orchestra-90

One of the best systems for turning the TRS-80 Model 4 into a good music computer is *Orchestra-90*, sold by Software Affair. It costs $149.95 and is designed to let you compose, arrange, and play your own compositions.

Orchestra-90 is a program stored on floppy disk, plus an attachment called an interface board that plugs into the bottom of the computer and allows you to connect the computer to a home stereo system. With the program, the interface board, and the stereo, you get stereo music.

One obvious difference between using a computer to make music and using a piano or organ is the lack of a standard keyboard. When you sit down to any standard keyboard instrument, you don't have to worry about how to make a single note sound long or short. You just hold down a key for as long as you want the note to sound. The computer, on the other hand, has to be told everything about each note it generates: what pitch, how loud, and how long. This can get very complicated. The problem is partially solved for you by *Orchestra-90*. This program does three things that make composing music on the computer much easier than it would be if you had to write the music program yourself:

- It puts a musical staff on the computer screen and allows you to place notes and other musical instructions on the staff just as you would if you were writing music with pencil and paper. You do this by pressing keys on the regular Model 4 keyboard. Then you can edit the information you put on the musical staff until you have it just right.
- It gives you easy instructions for writing your musical compositions without learning a computer language.
- When you are ready to have your composition played

on the stereo system, the program translates your notes into sounds heard through the stereo.

Your musical pieces can be relatively simple compositions or fairly complex. This is a five-*voice* system. You can tell the computer to play between one and five notes at the same time, with up to five different timbre settings for each note. *Orchestra-90* comes with a well-organized and helpful forty-three page instruction manual.

Music-80

A less expensive way to turn the Model 4 into a musical instrument is to type in or buy on cassette tape a program called *Music-80*, which was published in the March 1983 issue of *80 Micro* magazine. *Music-80* does basically the same thing that *Orchestra-90* does, only not as well. The old saying, "You get what you pay for" is certainly true in this case. You may not want to spend $150 on making music with your computer. *Music-80* lets you have fun with computer music at almost no cost.

The biggest disadvantage of *Music-80* is the quality of sound. Instead of getting stereo sound, you get sounds from a small amplifier (available for $11.95 at local Radio Shack dealers) that plugs into the back of the computer. *Music-80* was written for the Model III computer, which does not have a built-in amplifier. *80 Micro* may publish a Model 4 version that doesn't require an external amplifier.

Micro Chord

Micro Chord is a program available on cassette or disk from The Cornsoft Group (disk—$24.95, cassette—

$19.95). Don't laugh at the name of this company: they have a number of very good programs for Radio Shack computers.

Like the other programs we've mentioned, this one was written for the Model III. After loading the program into the computer's memory, you can compose a new piece of music by typing notes on the keyboard. You type in instructions to play notes in a four-octave range (two above and two below middle C), and the notes appear on the screen in a standard musical staff. This two-voice program lets you control many aspects of the music, including tempo. You can save your music on cassette or disk and edit it later. You can also combine musical creations. You can play your music on the cassette recorder, with a speaker on the computer, or through a regular stereo.

Micro Chord is an inexpensive and useful program for exploring music synthesis. Because it uses the same terminology as traditional music, you learn to computerize signatures, sharps, flats, quarter notes, half notes, and so on. It is well worth the price.

Music Training

Some software packages use the music capabilities of the computer for teaching music principles. Educational applications are discussed in Chapter Four, so we refer only briefly to the educational programs here.

Programs that use the computer as a music teaching tool are generally the drill and practice type. For example, a program may sound a note and ask you to name the note. Or, it may play a short melody and then ask you to play the same melody by typing it on the keyboard.

One of the most interesting programs we found for the TRS-80 Model 4 was one that acts as a music tutor and

takes much of the tedium out of learning to play the guitar. This program was written by Edward Louis and published in the May 1982 *80 Micro*, in an article called "Fret No More!".

In this program, you begin by typing in the names of the notes for a song you want to learn. The program allows you to describe each chord and each melody note of the song with regular keyboard letters. For example, if you wanted to enter a C chord, you would just type the letter C on the keyboard. You can change the chords and melody notes to get the song just as you want it. When you have entered the song, the computer will display the fingering pattern for each chord and melody note on the screen. Instead of having to figure out how to place your fingers on the strings from the notes on the music script, you can see the fingering pattern on the screen. You control the speed at which the computer scrolls the fingering patterns across the screen.

The program will also automatically transpose the fingering patterns from one key to another. If you type in a song written in the key of B flat, and the only key you can play is C, you can ask the computer to show you the song in the key of C.

This program can be used in two ways. First, it can be used for basic practice by beginning guitarists. If you are just learning to play the guitar, you can practice getting your fingers on the right strings and making the right sounds as the fingering patterns appear on the screen. You determine what level of difficulty the music is. A second way you can use the program is as an aid to learning new songs. You simply practice the new song in whatever key you want, playing it while the computer shows the fingering patterns.

If you would like a copy of this program to use on your TRS-80 Model 4, you can buy it from E. J. Louis for $25 on tape or $30 on disk.

THE COMPUTER AND GRAPHIC ARTS

The Model 4 divides its screen into 1920 little squares. There are 80 squares on each of 24 different lines. This computer displays upper and lowercase letters, numbers, punctuation marks, and several special symbols in any of those 1920 squares. A screen that is divided into only a few thousand squares is called a *low-resolution* screen. A particular square on the Model 4's screen may have a capital A, a lowercase h, a comma, or some other symbol in it. There is even a set of special graphics characters. What the computer is actually displaying on the screen is a set of dots. If you look carefully at the information on the screen, you can probably see that each letter and character is not really a solid image but a pattern of closely-spaced dots. Each character square on the screen is made up of a table of dot locations. A character square on the Model 4 is eight dots wide and eight dots deep. All low-resolution graphics and character displays are created by sending patterns of dots to the screen. Each of the 1920 possible locations on the screen can display anything from a square where all of the 64 dots (eight rows of eight dots) are *off* (a blank square) to a square where all 64 dots are *on* (a solid square). By turning some of the dots *on* and some *off*, the Model 4 creates patterns for all sorts of letters, numbers, symbols, and graphic characters.

The disadvantage of low-resolution graphics is that you must use the characters the Model 4 already understands to draw pictures. This means you have to deal with all 64 dots in each square at once. With high-resolution graphics, you can control each dot on the screen inde-

pendently. If a picture you are creating calls for one particular dot in a square to be turned on, high-resolution lets you turn on that one without turning on the others. High-resolution graphics lets you control tens of thousands of individual dots on the screen instead of sets of 64 dots.

*Hi*gh-*res*olution (HI-RES) graphics are possible on the standard Model 4, but it requires some fancy programming. There are no instructions in BASIC that let you control individual dots (which means you can't do *dot addressable* graphics). The older Model III has the same problem and cannot be improved with Radio Shack accessories. Radio Shack does have a HI-RES system for the Model 4, although that costs several hundred dollars. With it installed, you can use the computer to create excellent graphics. However, the graphics are not in color, and that is a significant drawback. A few companies sold color graphics boards for the Model III, and they are likely to sell similar products for the Model 4. We think buying a color graphics board for the Model 4 may not be something most of you will want to do, though, because these boards generally cost between $275 and $400. For that price you can buy any of the five or six home computers with great color graphics built-in. If you buy a popular computer like the Commodore 64, ATARI 600, Timex Sinclair 2000, or Commodore VIC, their color graphics are as good as or better than those on the Model 4 with a color adaptor board.

If the applications you have in mind don't require color, the high-resolution graphics options for the Model 4 may be appealing. With them the computer can create excellent charts and figures for all sorts of business and professional applications. Be sure to buy the software in a Model 4 version, so the screen display is 24 lines of 80 squares instead of 16 by 64, as it is on the Model III.

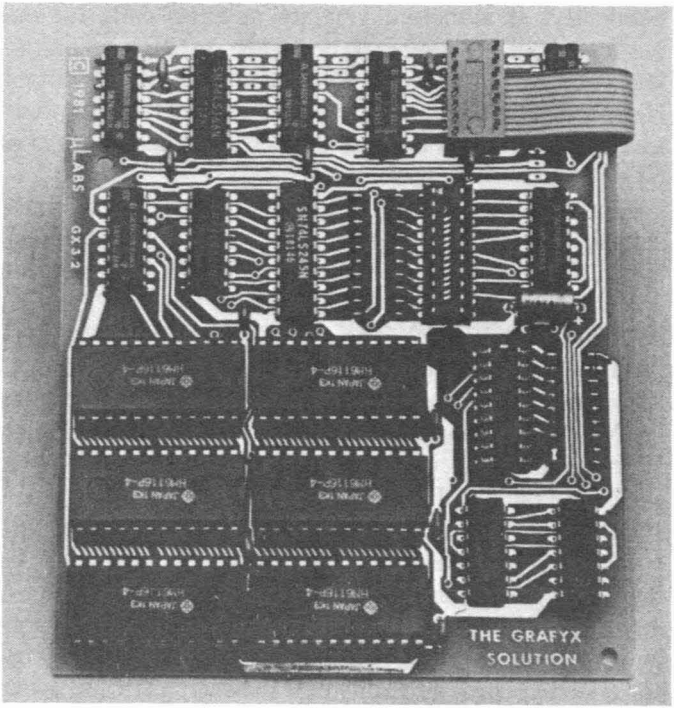

Fig 3.1 ***Grafyx Solution*** **circuit board**

Grafyx Solution

Grafyx Solution is a $299 set of hardware and software developed for the Model III computer by Micro-Labs, Inc. When the circuit board that comes with the program is installed in your computer, the screen is divided into 192 lines of 512 dots. This means you control a total of 98,304 dots! That is definitely HI-RES graphics. Each dot in HI-RES graphics is called a picture element or *pixel*. With almost 100,000 pixels you can create very fine-grained, detailed images on the screen. The software

that comes with this product adds fourteen new keywords to BASIC, making it much easier to create HI-RES graphics. The keyword BOX, for example, lets you create anything from a tiny square less than a half inch across to a large square that nearly fills the screen. There are similar keywords for circles and lines.

Micro-Labs also sells several software packages that work with the *Grafyx Solution*. *Bizgraph* is a $98 program that lets you design and print histograms, pie charts, bar charts, and graphs. *Draw* ($40) helps you draw pictures and illustrations with amazing detail. There are several plotting programs that help you graphically illustrate many math and geometry concepts. With this program, like most of its type, you can create sophisticated graphics on the screen and then generate a copy of that screen on a dot matrix printer. It works with many popular printers that create letters and characters in patterns of dots.

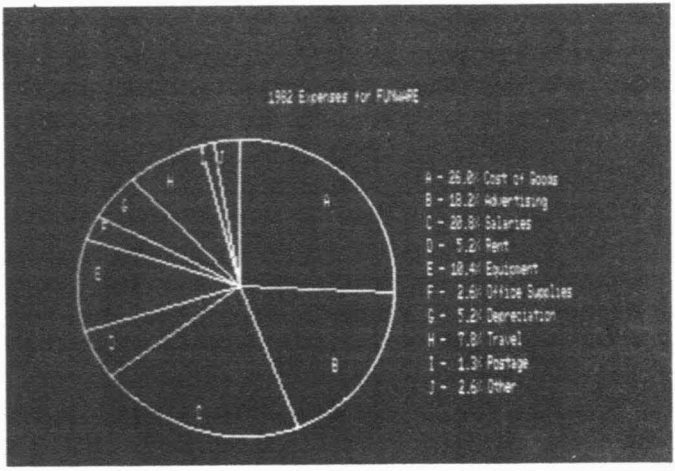

Fig 3.2 A pie chart from *Bizgraph*

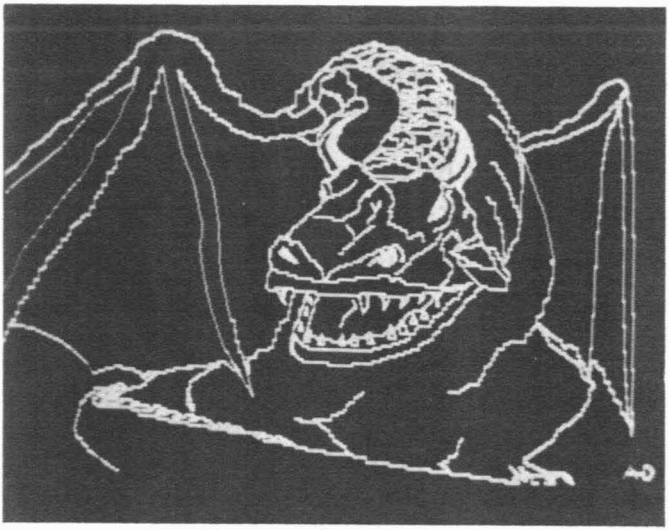

Fig 3.3 ***Draw*** **graphics**

There is even a program called *Dot Writer* that was developed for printing special graphics on dot matrix printers. The program is $100 from RCM Computers. If you want to print letters or reports in Old English Script or large block letters, you can do that, with this program, using printers like the Epson series, C.Itoh, ProWriter, Gemini 10, NEC 8023, and many others.

Dot Writer is really three different programs: a word processor that works but is not great; a printing program for material like form letters and reports created with another program; and a program that lets you create your own set of printing characters and screen graphics.

This program offers you some very useful features. For example, you can use *Dot Writer* to type a report with double or triple size headings. Suppose you want a quote to stand out from the rest of a report: Dot Writer can print tiny, boldfaced letters.

Another good graphics software package for the TRS-80 Model 4 is *ZGRAPH*, $40 from Serious Software. With *ZGRAPH*, you use the numeric key pad instead of the arrow keys to move the cursor. *ZGRAPH* can be used along with a companion software package called *GRASP* from the same company ($50); it gives the computer instructions to print graphics on paper.

Printer/Plotters and Plotters

You can do a lot with a good graphics software package and a dot matrix printer that has *dot addressable* capability. A dot addressable printer lets you control each of the dots that make up a letter or character. It is the printing equivalent to high-resolution graphics.

Some graphics, particularly business graphics, need more than can be produced conveniently on a dot matrix printer. When you need high-quality graphics, there are two popular options—printer/plotters and plotters. Radio Shack sells *Business Graphics Analysis Pak*, a $175 program for creating all sorts of graphs and charts for business. This program, and several others, can be used with a device called a plotter to design and label pie charts, histograms, and other graphs. The plotter creates a copy of a graph on paper or acetate sheets by moving a special pen across the surface. It's fascinating to see one of these plotters work. The pen whizzes around drawing circles, lines, and letters of several sizes. If part of the graph is in blue and another in red, the plotter draws the blue sections first and then goes over to the edge of the device where pens are stored. It puts the blue pen in its storage slot and moves down to pick up the red pen. As you watch, a professional quality multi-colored graph is created.

The $1995 Radio Shack plotter is manufactured by Houston Instruments, a division of Bausch and Lomb,

and one of the better known plotter companies. Radio Shack also sells a one-pen plotter for just under $1000 and a combination printer/plotter for around $250. The printer/plotter is less versatile than regular plotters and uses narrow paper (four and a half inches).

Graphics Tablets

Plotters are special output devices for graphics. You can also get special devices to give graphics information to the computer. Several computers accept input from graphics tablets. Radio Shack sells a $350, seven-by-nine inch graphics tablet for its Color Computer. As you draw on the surface of the pad with a special stylus, the pattern is duplicated on the screen. That means you can put an illustration or drawing on the pad and trace over it, creating the same illustration on the screen. This is a very convenient method of creating computer graphics. Several tablets have software that let you incorporate graphics into other programs.

At present we know of no tablet compatible with the Model 4, but we think there may be several in the near future since tablets are increasing in popularity. Whether you are interested in a hobby or looking for help with professional tasks, the Model 4 may be of use for both music and graphic arts. This is particularly true if you are willing to spend some money on extra hardware or software.

CHAPTER FOUR

The Model 4 as Teacher

Much is made of the ability of small computers such as the Model 4 to function as educational devices in the home and classroom. However, the computer is only the latest in a long list of technological inventions that were supposed to revolutionize education in the twentieth century. In spite of the attention computers receive in the educational press, we believe they are unlikely to revolutionize the little red schoolhouse overnight. However, we expect education will evolve quickly in the coming years, for two reasons. First, we will have to continue to learn, regardless of our age, if we are to cope with change. Second, learning will occur someplace other than public school classrooms.

THE DESCHOOLING OF LEARNING

Education has been institutionalized for most of the twentieth century. Learning has been something children do in a classroom supervised by one or more adults. That model will continue to be important through the end of

this century, but by the year 2000 it will play a smaller role than it does today. More people will spend time learning at home, in the office, in the factory, and at adult learning centers. Learning will be a lifelong task rather than something children do to prepare for adulthood. Because we live in a time of accelerated change, information is outdated quickly, and new information appears at a faster and faster rate.

In earlier times you could learn a trade or profession and then earn your livelihood for the rest of your life with the skills you acquired. Today virtually every job is being changed or eliminated by new information, new social trends, or new technology. Physicians cannot practice medicine for years without keeping up with new discoveries that affect the way they practice. Other jobs disappear and are replaced by new ones. Like the wagon wheel factory that converts to hubcaps, many of us will have to learn a different profession or trade at least once in our lifetime. Most of us will find ourselves learning throughout our lives to keep up with change. Many of us will return to some sort of adult training program to retool for a new profession.

Even if your job is stable, there are many other aspects of your life that will change. It's like our federal income tax. Changes in the federal income tax laws can mean thousands of dollars to families with modest incomes. Failure to keep up with these changes can be an expensive oversight.

Fortunately, small computers like the Model 4 can be helpful in both traditional and nontraditional learning environments. For example, families will be able to buy computer programs that teach them about new income tax laws. At least six programs for the Model 4 can computerize record keeping for income tax and the actual completion of the forms.

THE SMALL COMPUTER AS A LEARNING MACHINE

There are many ways computers can help you and your children learn. Currently most students, from elementary school to college, have little or no contact with computers during their educational careers. This will change drastically in the coming years because computers are becoming integral parts of thousands of jobs. Few people will be able to find jobs that are not influenced, in one way or another, by computers.

Computer Literacy

Although children tend to take to computers naturally, many adults are not at ease with them. They feel uncomfortable around them and do not look forward to the time when computers are appliances in their homes and offices.

Buying and using a computer like the Model 4 is one effective way of overcoming that initial feeling of discomfort. It is a good way to learn how the computer operates, what it can and can't do. Becoming computer literate is perhaps the most important educational benefit of owning a computer.

You may think computer literacy is silly because it implies understanding computers and being able to use them is like learning to read. Reading is an essential skill in this society, while computer literacy is not. However, the universal need to be able to read is a relatively modern concept. Two hundred years ago well over 99 percent of the world's population could not read. Yet these illiterate

people were able to deal with their day-to-day demands. Arguing that everyone should be taught to read probably sounded silly in the 1600's. Today we believe the next generation should be taught to read because our society requires it. You cannot cope with life today as a responsible adult without that skill.

The shift from an *industrial* to an *information* orientation will continue. That development will bring us rapidly to the point where computer literacy is just as essential to modern living as reading literacy.

Computer-Assisted Instruction

Computer-Assisted Instruction (CAI), Computer-Aided Learning (CAL), and Computer-Aided Instruction (CAI) are all terms that refer to the use of a computer in education. We will use the abbreviation CAI to refer to several types of computer-based teaching approaches that give the computer some of the responsibility for teaching. There are three general types of CAI: drill and practice, tutorial, and simulations.

Drill and Practice

The simplest type of computer-assisted instruction is drill and practice. Drill and practice programs don't really teach you anything, they just help you practice something you've already learned. A common type helps you practice basic math skills. The computer generates a problem and asks the student to type in the answer. When you answer, the computer checks the answer for accuracy and lets you know whether the answer was correct or incorrect.

A more sophisticated type of drill and practice program keeps track of the student's errors. Errors are explained,

help is provided, and new problems are adjusted to the student's current needs. The program remembers errors and gives the student extra practice in particularly difficult areas.

Tutorial Programs

A tutorial program does more than just give you practice on something you already know. It actually teaches you. Educational programs that use the tutorial format are more difficult to write than those that use the drill and practice format. You must teach the skill, evaluate learning, and provide practice. There are few good tutorial programs for the Model 4.

Simulations

When you drop a quarter into an arcade game and control an interstellar fighter with laser guns and force field shields, you are participating in a computer simulation.

Simulations are models of often complex events or conditions. You take a role in the simulation and help determine what happens next by your decisions. A computer simulation is an imaginary environment with its own rules developed by the people who created the program. You take a role in the imaginary environment (as the king of an ancient kingdom, the president of a large manufacturing company, or the operator of a small retail business). For example, there is a Model 4 version of a popular simulation called *Hammurabi*. In this simulation, you are the ruler of an ancient city that has 100 citizens, 1000 acres of land for cultivation, and 3000 bushels of grain in storage. As ruler you must decide how much grain to give the people to eat, how much to save for

seed, and how many acres to plant. Your decisions determine whether the kindgom starves, or grows and develops (and requires more grain next year).

Simulations are widely used in business and industry. Nuclear and chemical plant workers are trained by computer simulations. It is much less expensive to have a trainee blow up a make believe plant on the computer screen than to make a real mistake.

Some simulations are not only effective training tools, they are also fun. Many of the popular computer and arcade games are simulations designed for fun rather than as learning aids. But there are some educational aspects of many of the popular video games.

Other Educational Applications

Computer literacy, drill and practice, tutorial programs, and simulations account for the majority of computer applications in education today. Another approach, Computer Managed Instruction (CMI), uses the computer as a manager or overseer of learning. For example, students may be given assignments that require them to read a text and do some work in the library. As each assignment is finished, the student sits at the computer and takes a test on the assignment. A "pass" means the student can go on to the next assignment. If a student doesn't pass, the computer provides suggestions for further study.

CMI requires quite a lot of work from the teacher to set up, but it does not require the teacher to actually write programs that teach the student. The teacher can use an *authoring language* to develop both CAI and CMI programs, rather than learning to program the computer. Several authoring languages (for instance, *Author I*) are available for the Model 4. The PILOT language, which is available for the Model 4, is often used by teachers who want to develop their own CAI or CMI.

A popular computer language called Logo, developed at the Massachusetts Institute of Technology, is considered by many to be an ideal first computer language for children. Advocates say it not only gives children an enjoyable, even exciting, way to learn to program a computer. It also helps them develop better, more sophisticated ways of thinking and solving problems. Radio Shack does not sell a version of Logo for the Model 4, but Digital Research has announced a sophisticated Logo for computers that run CP/M. Since CP/M is an optional operating system for the Model 4, you may be able to run the Digital Research version of Logo on it.

Parents and teachers who want to read a strong statement of support for Logo by its developer should read Seymour Papert's book, *Mindstorms*. A less enthusiastic, but still positive, view of the language is given in *Computers, Teaching, and Learning*, written by Jerry Willis, LaMont Johnson, and Paul Dixon, and published by dilithium Press.

Another educational use of the computer is as a versatile *tool* in the classroom or at home. We use many tools as we learn: pens, pencils, tablets, rulers, and protractors. Specialized classes like chemistry, biology, or typing also have their own sets of tools: Bunsen burners, flasks, test tubes, scales, scalpels, and typewriters.

The computer will be an important educational tool in the future. High school students will use its word processing power to write term papers and reports, students in physics and chemistry will use it to calculate complicated formulas, math students will find it integrated into math courses.

EDUCATIONAL SOFTWARE

Educational programs currently available for the Model 4 include drill and practice, tutorial, and simulations.

Drill and Practice and Tutorial Programs

Good drill and practice programs are easier to find than tutorial programs. We will review both types of software.

Mindwarp

Mindwarp, available from Quality Software and Consulting Inc., ($18.95 on tape or disk) requires at least 32K of memory. This is a good, solid math game for your Model 4. The graphics are not excellent, but the program does what it is supposed to do: drill you on math facts in an entertaining way.

The game is intended for two players who compete with each other. You type in your name and your opponent's name, the number of points a player must earn to win and end the game, and the time limit for answering questions.

The game combines math drill with a memory game. When it's your turn, you see a display of twelve numbered squares and a math problem. The problems range from simple multiplication facts to problems like (8 + 6) X 4. You type in the answer to the problem and wait for a message from the computer. If you respond correctly within the time limit, you are praised and given the opportunity to choose two of the squares. You type in the numbers of the squares you choose, and a picture appears

briefly in each of the chosen squares. The object is to match up the pictures, just like the old *Concentration* television program. You are awarded a point when you succeed in matching up two pictures.

Children enjoy this program because it makes the tedious chore of math drill a fairly pleasant pastime. But drill and practice computer programs should be used sparingly, because children tire of them quickly.

College Board SAT Exam Preparation Series

This six-disk series ($299.95) includes over forty programs designed to help you improve your score on the Scholastic Aptitude Test (SAT). These programs let you practice answering the types of questions used on the SAT. The computer is also programmed to give you quick feedback on how you're doing.

Krell Software Corporation has produced one of the most user-friendly drill and practice educational programs we have ever seen. The disks are ready to run on the Model 4. (Software for the Model 4 is seldom ready to run when you take it out of the package. It always *should* be, but most software vendors produce TRS-80 programs that are ready to run only on the old TRS-80 Model I computer.)

Once the disk is loaded into the computer, the program is simple to use. *Menus* (lists of what's in the lesson) are presented when lessons are started or finished, and instructions are easy to understand. These programs are *so* user-friendly that we're certain someone with *no* previous experience with computers would find them easy to use.

Krell is so sure that their program will result in improved performance on the SAT, they issue a warranty promising to refund the full purchase price of the software if you use the programs and fail to increase your score by at least seventy points.

The six disks contain drill and practice on skill areas tested by the SAT, including math, vocabulary, written English, word relationships, reading comprehension, and sentence completion.

You may choose to use the *automatic learning strategy* for any of the programs. If you choose this option, the program analyzes your performance on an ongoing basis and uses that information to change the way problems are selected. This helps give you practice at the level you need it: not too hard and not too easy.

You can use another option, the *worksheet generator*, if you have a printer and want to produce a written copy of the problems rather than a screen display of them. The *worksheet generator* also prints an answer sheet.

At the end of each session, you can choose to be shown a screen display or a printout telling you how you did on each type of skill covered by that lesson.

This is an excellent way to practice for the SAT. If you are hoping to improve your score, we wouldn't be surprised if this program helps you do it. In addition, Krell is planning another interesting package for release in 1984. Called *Complete Classroom Tutorial Package*, this series will go beyond drill and practice to provide detailed instruction in the skill areas you need to do well on the SAT. If Krell does as good a job on this tutorial package as it has done on its drill and practice package, this one will be another winner!

Essential Mathematics

Micro School Programs—Bertamax, Inc., produces a large number of excellent drill and practice math programs. There are more than 490 lessons in this series of approximately 35 diskettes or cassettes. Most parents will not be interested in purchasing the entire series, but you

can buy individual programs (most contain ten lessons) on cassette or diskette for $24.95 each. The areas covered range from first-grade number concepts to junior high school pre-algebraic concepts. The programs are divided into six elementary grade levels and two junior high school levels. For example, you might choose to purchase the subtraction disk at the fifth grade level.

These lessons use some graphic displays, but they are not highly sophisticated. The emphasis is on the mathematical content rather than on arcade-like features. Graphics are used, for example, in the lessons for grades one and two for visual hints. If you press a certain key, objects are pictured on the screen. You may count them to help get the answer to a problem.

These lessons are typical drill and practice programs—not inspiring or revolutionary, but with some continuity and thorough practice.

If you are interested in educational software, write to this company for a catalog. They have a large number of educational programs for sale, and the ones we have seen are adequate.

There is no shortage of drill and practice math software. Thumb through any computer magazine, and you will find many different types for many subject areas. We'll include a list of companies you might want a catalog from at the end of this chapter.

Typing Teacher

Instant Software produces *Typing Teacher*, a tutorial program that requires at least 32K of memory and sells for $17.95 on diskette. This excellent program is written in BASIC and does a good job of providing typing instruction to anyone who is old enough to read the screen displays.

The program comes in seven parts. The introduction presents the home keys and begins with an excellent graphic display. This graphic display shows the *asdf jkl;* keys. A code system under each letter shows you which finger should be placed on each key. When you are ready to proceed, you press ENTER. The program tells you how to place your thumbs above the space bar. When you press ENTER again, it tells you that in each typing session, a line of letters or groups of letters will be displayed. You are to type the letters exactly as they are shown. The computer then checks your typing and prints a question mark under any mis-typed letters.

The computer then displays a row of letters and letter combinations, using only *asdfjkl;*. You type them in and press ENTER. An interesting feature of the program is that errors cannot be corrected. That keeps you from glancing down at your hands or worrying about whether you are right or wrong. The objective is to keep you typing while you look at the screen. After you press ENTER, the program displays a question mark under any mistakes you made. If you were correct, the computer displays another line of letters for you to type.

When you finish typing five different lines, the program asks you if you would like to repeat the lesson. If not, you can return to the main menu and select another lesson.

Lesson Two is in two parts. Part One presents twenty drills on letter combinations using the home keys as well as the row of letters above the home keys. Part Two is similar, but you type actual words instead of letter combinations. Lesson Three introduces the bottom row of keys and teaches you which fingers you should use. There is more drill, this time with real sentences. Lesson Four introduces the number keys. Lesson Five introduces the special characters accessed by striking the number keys

while holding down the SHIFT key. Lesson Six presents more drill on special characters and commonly used words, and turns the computer into a very simple word processor called *The Bottomless Page*. If you choose *The Bottomless Page*, you can practice typing material of your own choosing for as long as you like.

This is an excellent, inexpensive typing tutor, but there are no diagnostics or measures of speed. Another program that does incorporate these features is *Microtyping* by Hayden Book Company. This is also an inexpensive program ($10.95). You might like to have both this program and *Typing Teacher*. We like *Typing Teacher* better as an introduction, because it provides more drill in the early stages. If you want to learn to type, you can do so with this simple program. The price is right and we recommend it highly.

Math Hangman

Math Hangman is a free drill and practice program by Tim Knight, a sixteen-year-old high school student. The program is listed in the *80 Micro* Anniversary Issue, 1983. As we explained in Chapter Two, most computer magazines print free programs from time to time. If you are willing to type them in, you can get some useful software for the cost of the magazine. If you want the program but don't want to spend the time or effort to type it in, some computer magazines, including *80 Micro*, sell disks or cassettes with all the major programs from each issue.

Math Hangman is less than 100 lines long and is worth the short time it takes to type it into your computer. The program gives you the choice of practicing simple addition, subtraction, multiplication, or division problems. It lets you specify how many problems you want. If you

ask for more than fifty problems, the program says, "Wow, I think that's a little too much!" If you ask for six problems, the screen displays: "Aww, you can give it a better shot than that!".

As each problem is displayed, you enter an answer. If you're right, the computer tells you so and goes on to the next problem. If you're wrong, it says so, and a piece of the hangman appears. If the hangman is completed (when you miss six problems), you lose the game.

When the game is over, you are told how many problems were right, how many were wrong, and the percentage of correct answers.

This is an excellent free drill and practice program. Children ages ten or older can sometimes type this program into the computer themselves. We recommend this because it exposes them to some programming and shows that programming can be used to create some things that are fun.

Preschool and Early Education Programs

Learning to Count Money is a good drill and practice program intended to help your preschooler master money skills. This program uses graphics extensively to hold young children's attention. It is available on cassette for $19.95 from Mercer Systems Inc.

The same company sells six other educational programs for young children. *Alpha* uses very large letters to teach children the letters of the alphabet. *Alpha II* goes further and has the child practice finding duplicate letters, letters before and after a given letter, and simple alphabetizing skills. *Sigma* is a drill and practice program in addition skills for grades one to three, and *Sigma-Ex* is an addition drill for slow learning students. *Sigma 82* drills on addition, subtraction, multiplication, and divi-

sion at nine speed levels. This program displays the amount of time remaining and total time used. *SPE-L* provides spelling drill for grades two to four. All six programs are on cassette only and sell for $6.95 each, two for $12.00, or four for $21.00.

Spelling Challenger

Spelling Challenger is a free program by Larry Krengel that appeared in the February 1983 issue of *80 Micro*. If you're willing to take the time to type in this program (approximately 150 lines), you'll have a useful program to help your child study spelling words. One of the features of this program is that it allows you to change the words your child is drilled on. After you type in the new words, the program scrambles the letters and presents them randomly, either on the screen or on a printout. The second part of the program presents words with some letters replaced with asterisks. The child types in the missing letter. The third part of the program is a synonym quiz. When you type in the original words, you also enter a list of synonyms. The child must match words with these synonyms.

M-SS-NG L-NKS and Other Programs

Sunburst Communications sells over fifty language arts program for your TRS-80 computer. *M-SS-NG L-NKS* (disk, $45.00) is a game aimed at teaching language skills to children and adults. It's really a language puzzle that lets you discover and put to work language skills you may not even know you have. The program comes in four versions: Young People's Literature, Literary MicroAnthology, MicroEncyclopedia, and English Editor. In all versions, you fill in the blanks in words and

sentences using knowledge about the succession of letters in words, words in sentences, and the meaning of the whole.

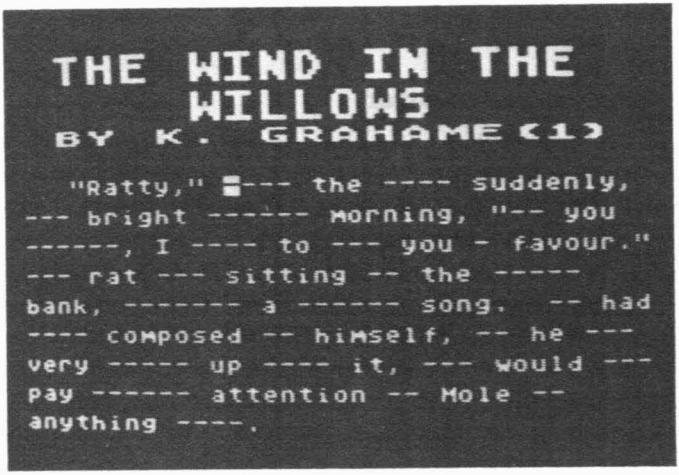

Fig 4.1. Screen from *M-ss-ng L-nks*

This series of language programs was designed by a group of people who are experts in the way we acquire language. The theory behind these programs is sound, the lessons are interesting, and we recommend them highly.

Other TRS-80 programs available from Sunburst are *Survival Math* (disk—$50.00) and *Teasers by Tobbs* (disk—$35.00). *Survival Math* presents interesting simulations like putting your child in charge of managing a hot dog stand. *Teasers by Tobbs* presents logic and math puzzles and problem solving exercises. Sunburst has a large number of other educational programs available in the $25–$60 price range. If you're interested in more information, you can write to Sunburst for a catalog.

How to Program in Basic Language

This set of tutorial programs is available on cassette or diskette ($74.95) from Sterling Swift Publishing Company. The set is designed to teach your child how to program using the BASIC language. Student workbooks are included. The program received the *Learning Magazine* award for Best Microcomputer Software of 1982.

Shelby Lyman Chess Tutorial Series

These modules are computer implementations of the Socrates Chess Corporation's *Shelby Lyman Chess Tutorial Series*, published by Krell Software Corp. Lyman is a chess expert and TV commentator and is well known to chess buffs. Most people won't be laying out the nearly $1500 this series costs, but you may want to order a few of these excellent tutorials to help you with specific parts of your game. We suspect that the main market for this series will be chess clubs and schools.

Krell's new series of thirty-nine modules are not for casual chess players. This is not the typical chess program that lets you play a game against the computer. The parts of this series sell for $39.95 *each* and are designed to help the serious student of chess improve his or her game. Space doesn't permit a complete listing of all the modules, but some examples are *The Premature Attack: How to Refute It*, *Exploiting Pawn Weaknesses*, and *The Use of the King in Chess*.

We've reviewed only a tiny percentage of the thousands of educational programs that run on the Model 4. Radio Shack has invested quite a bit of corporate energy in the field of education. There are programs on algebra, geometry, chemistry, remedial reading, history, and computer literacy. We suggest you visit a Radio Shack

store and get a catalog of their educational software. There are also hundreds of other companies that sell drill and practice and tutorial software for the Model 4. We will list some sources of additional information at the end of this chapter.

Simulations

Simulations give learners experience or training doing something without taking part in the real-life activity. Simulations are necessary because some things are either too expensive or too dangerous to try in real life, or not possible for some other reason. We have already discussed several simulation programs in the chapter on computer games.

There are several good flight simulations. *Aircraft Instrument Approach Simulator* displays the instrument panel of a light aircraft and allows you to make six different airport approaches from eight miles out. Each landing is different because the program varies wind speed and turbulence. The program sells for $9.95 and is available on cassette from J. C. Sprott.

Air Traffic Controller (cassette—$11.95) and *Advanced Air Traffic Controller* (diskette—$19.95) are available from Creative Computing Software. These programs put you in control of the airport tower. There are six different skill levels. The advanced program presents more flight restrictions and four more airspace radar-map situations.

Trucker and *Streets of the City* are both available from Creative Computing Software on one diskette (diskette—$24.95). *Trucker* is a simulation that puts you in charge of a long-haul trucking company. You make decisions about cargos, destinations, and so on. In *Streets of the*

City, you are responsible for the transportation budget of a large city.

Social and Economic Simulations (diskette or cassette—$24.95) contain three simulations, again from Creative Computing Software. Our favorite is called US-POP. This program simulates population growth in the United States after you determine certain conditions known to affect population.

Creative Computing also sells an excellent political simulation entitled *Hail to the Chief* (diskette—$24.95). It simulates a U.S. presidential election campaign, and you are a campaign manager. You can arrange for your candidate to conduct news conferences, take part in debates, and generally try to get elected. Intended for high school students, this program has four levels of difficulty.

Basics and Beyond, Inc. also sells a number of interesting simulations. *Tightrope Politics* is another political simulation designed to show how difficult it is for politicians to commit themselves to real issues during an election year. This program comes on cassette only and sells for $14.95.

Prime Time and *Bulls and Bears* are two excellent simulations by Krell Software Corporation. Both programs can be purchased on one cassette or disk ($49.95) called *Game Package II*. *Prime Time* is a competitive game for up to three players who act as TV network executives. You schedule programming for your network, taking FCC regulations and public sentiment into account. The program tells you and the other players how each network fares in ratings and advertising sales.

Million$ is an investment simulation (tape or diskette—$19.95, plus $1.50 shipping) from Vinzant & Associates. You and up to four players begin the game with a million dollars. You carry out financial transactions, and the program figures out the results. You may choose games of three different lengths.

Simulation programs are difficult to write, and therefore, good ones are scarce. We hope to see more use made of this promising area of computer education.

CHILDREN AND WORD PROCESSING

Word processing programs can also be used educationally. (Chapter Seven discusses word processing.) Children or anyone else who wishes to improve their writing skills, or mechanical skills like grammar, spelling, and punctuation, can use word processing to do so. Word processing makes the mechanics of revision easy and encourages you to experiment. Then, too, spelling and grammar checkers find mechanical errors easily and help you correct them without submitting the paper to the critical eye and red pencil of a teacher.

To benefit the most from word processing, you need to be at least an adequate touch-typist, so we recommend using a good typing tutor program along with a word processor package.

For more information about educational programs, you may want to read current issues of magazines like *Computers in the Schools*, *The Computing Teacher*, and *Educational Computer Magazine*.

Books you may be interested in include *Computers, Teaching, and Learning*, by Willis, Johnson, and Dixon (write for a catalog from dilithium Press), and *The Computer in the School: Tutor, Tool, Tutee*, edited by Robert P. Taylor.

Some publishers of educational software will furnish you with a catalog upon request. Try Britannica Com-

puter Based Learning, PMC Software, CLS Associates, Precision People, Inc., and Bertamax Inc.

Another handy way to find educational software for your Model 4 is by consulting the Radio Shack *Educational Software Sourcebook*. This 228-page sourcebook lists thousands of programs of every type. Your Radio Shack store should have the latest copy.

Our final suggestion is that you consider joining the Educational Software Library, a nonprofit organization that operates by mail order. They buy, evaluate, and rent a large number of TRS-80 educational programs for your Model 4. You can join for $25 for one year, and you will receive a catalog of software (with reviews) and a bimonthly newsletter containing a list and reviews of new software. Best of all, you can borrow software from the Library for $2.00 per program. If you want the catalog but aren't interested in parting with $25.00, you can buy it for $4.95. If you want to join, buy the catalog, or just get a free sample newsletter, write to Educational Software Library, Inc. If you want only the sample newsletter, enclose a stamped, self-addressed envelope.

CHAPTER FIVE

Home Finance, Record Keeping, and Health Care

Most people don't buy a computer specifically for the uses described in this chapter but for other reasons, like word processing, telecommunications, and playing games. You probably will get a computer for something else and then begin looking for more ways to use it. You'll find many good programs for home applications.

THE TRS-80 AS A HOME FINANCIAL MANAGER

There are more and more programs to help home computer owners with personal finance: budget control, financial planning, checkbook balancing, analysis of loan options, and filing income tax forms.

Interface Age magazine led the way in describing home applications of the microcomputer. Their December 1977 issue has two articles by Francis Ascolillo on "A Household Finance System." Written in BASIC, the program can give your family an overview of spending and earning patterns. When you write your family checks each month, you simultaneously give the computer the data for an

analysis of monthly and yearly spending patterns. This program can also predict your spending trends. The same issue has a personal accounts payable program written in BASIC by Kevin Redden. With it you can keep track of bills received, payments made, and information like time between receipt and payment, minimum payment due, total amount owed on each account, and interest paid on each account. These BASIC programs are adapted for your TRS-80 (see Chapter Nine on Programming), or you may purchase similar programs written especially for the TRS-80.

In addition, many of the popular computer magazines regularly publish home finance programs for the Model 4. A well-stocked newsstand will carry at least two or three magazines with listings of software for the Model 4.

Koupon Keeper

Do you save cash-off product coupons? If so, and if you're like most coupon savers, you probably have trouble keeping track of your coupons. You just can't remember if you have a coupon good for fifty cents off a box of Soggysweet Cereal. The only thing you can find is a coupon good for half off a five-color *Don't Mess With Me* tattoo at the Happy Sailor tattoo parlor! Just when you've decided to settle for the tattoo, you discover the coupon expired seven years ago! Finding the right coupon can be a real hassle. If you're like us, you would like to save some money with coupons, but the problem of keeping everything organized makes it too much bother.

Koupon Keeper (cassette—$9.75) from Kensoft is designed to help you avoid these problems. It helps you keep a well-organized, up-to-date list of 250 coupons you have stashed away.

Koupon Keeper is really seven different programs. Use

it to store records of all coupons as you get them and as you use them or throw them away. As you get each coupon, you type in and save four pieces of information about each one: product name, product type, coupon amount, and expiration date. The product type is a number from 1 to 12. This number identifies the product as cereal, personal care, paper goods, cleaning items, vegetables, beverages, fish/poultry, fruits, meats, condiments, candy/snacks, or miscellaneous. If you don't like any of these categories, you can change them to suit your specific needs. Anytime you want, you can get a display of all information about your coupons in any of these twelve categories. You can also get a display of all coupons worth more than an amount you specify. That should be handy on double-coupon day at the local market. Another option is to display information on all coupons due to expire on a given date, to make sure a valuable coupon doesn't expire before you use it. By displaying all coupons on products with a certain brand name, you can quickly find out if you have a coupon good for products you buy on a regular basis, such as *Sumptuous Brand Candied Ants* or the like.

This is a useful program that should prove invaluable for anyone who saves coupons. Our only complaint is that it comes only on cassette tape. Cassettes are slow, and we don't like the hassle of finding just the right volume and tone control setting. Too bad Kensoft doesn't make this program available on disk. Overall, though, this is a good program for the coupon saver.

Refunder's Relief

Refunder's Relief is similar to the coupon manager and is designed to help you organize sixty different refund offers and 250 different proofs-of-purchase. The program is available on cassette for $15.95 from Kensoft.

To use *Refunder's Relief*, you enter the product names for all the proofs of purchase you have, then type in information on all the different refund offers. You must enter a title for each offer, a short description, whether or not a special form is needed, and how many proofs of purchase are required. The program automatically matches the proofs of purchase with the offers. You can use the program at any time to see if offers are ready to be mailed and if proofs of purchase are still needed. You add proofs of purchase and refund offers as you collect them and delete the ones you mail.

This should be a handy package for anyone who is really *into* refund offers. The program is slow because it is on cassette, but it should be a great improvement over keeping all those records by hand.

Loan

In these days of high interest rates, it's a good idea to be careful when you borrow money. This program helps you decide whether or not you should borrow money and how much interest you have to pay if you do. After you have entered the loan amount, interest rate and number of months, the computer tells you the monthly payment. At this point you have four options: a monthly analysis, a plan for *balloon* payments, or you can start the program over or quit.

Loan is a program in the book *32 BASIC Programs for the TRS-80 Computer* available for $19.95 from dilithium Press. If you don't want to type in the programs, you can get a book/diskette package for $34.95.

Dollar Sense

This home money management program is available on cassette only from Kensoft. It can help you find and

reduce unnecessary spending. *Dollar Sense* can monitor your financial affairs for any time period, but works best for one month. You begin by entering all expected income for the month. Next, you enter all expected expenses, along with the date payment is due and the date you expect to make the payment. *Dollar Sense* then calculates a budget for you. Each expected transaction is displayed in order of the date, and the amount is added to or deducted from the current balance. The balance is displayed in the lower right-hand corner of the screen. After eight transactions, you can elect to continue the process or exit from the program.

As money comes in or is paid out, you enter the amounts and the date in the program. You can get a fully up-to-date report of the balance of your checking, savings, or any other account. *Dollar Sense* is a useful way to keep track of where your money is going. If you have problems staying within your means, this program could be a real life-saver.

Commodity Package

This set of programs is available on disk for $50 from Thomas Lenz. They are typical of a number of programs that help investors keep track of investments. This one includes fourteen different data files on the price of commodities like gold, silver, copper, cotton, corn, wheat, and soybeans, with at least thirteen years of data on each commodity. This data is helpful to many investors who want to look at price trends. *Commodity Package* also includes programs that help you analyze trends and evaluate the risk and potential profit to be made from different commodity investment strategies. Mr. Lenz also has programs for the stock market that sell for $50.

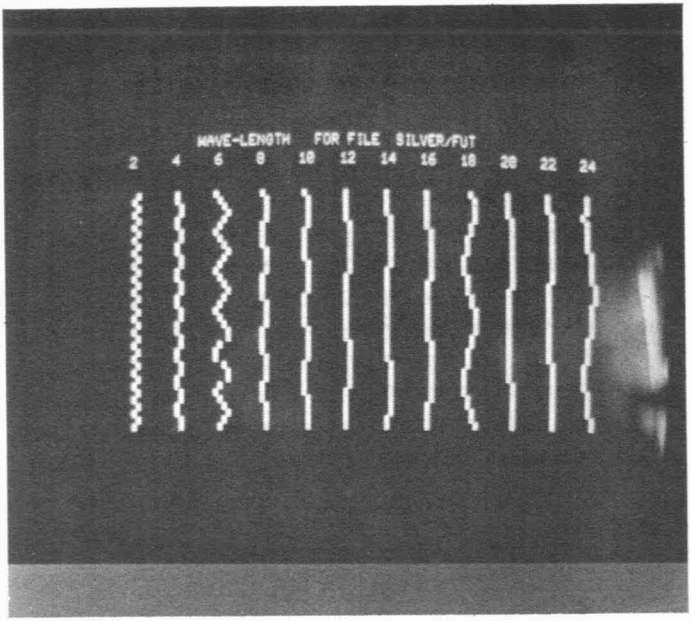

Fig 5.1 One of 10 programs in *Commodity Package: Price Frequency Scanner*

Tax/Saver I, Tax/Saver II, and Tax/Forecaster

These three income tax programs from Micromatic Programming Co. are updated yearly to reflect changes in tax law. You'll have to pay for each update, although Micromatic gives you a forty percent discount if you bought the previous year's package.

Tax/Saver I sold for $89.95 last year and is designed for relatively uncomplicated individual returns. You can use it before turning your records over to your accountant, or even to use it to check on your accountant's work. The built-in tax aids are designed to lead you by the

hand. A glossary of tax terms is included. You can complete the long and short form, itemize deductions, handle interest, dividends, and income averaging with this handy program.

Tax/Saver II, ($139.95) has all the features of the previous program plus the ability to handle business income and capital gains.

Tax/Forecaster ($59.95) prompts you for each line of the tax form. You can change one or two items to see what effect the change would have on your final tax bill. You can have your tax figured with and without investing in an IRA, or you can play around with various hypothetical charitable contributions. This interesting program is intended mainly to help you do the right things to keep next year's taxes as low as possible.

The Model 4 Computer As A Home Record-Keeper

Your computer can be used for a lot of record-keeping functions. You can buy software for everything from converting recipes to tracking tax records to storing bartending instructions.

Arranger

Arranger is a good, inexpensive disk organizing system available on diskette for $29.95 from Triple-D Software. It's designed to bring order into your computing life. If you only have ten or fifteen disks, keeping track of which disk holds what is probably no problem. But if home computing has become important to you, it won't be long before you have fifty or more disks, and that's when you'll need a disk catalog.

You can either name or number your disks (up to 255 of them with up to forty-four files on each disk). The program writes the name into a file and catalogs the contents of each one. You can then use *Arranger* to find a program, tell you what files are on any one diskette, print an alphabetical list of all or some of your files, or locate a disk with a given amount of empty space.

A unique feature of *Arranger* is that the program reads the name of each of your disks. You simply load *Arranger* and choose the add-disk option. As you insert each disk you want cataloged into drive 1 and press ENTER, *Arranger* reads the name of the disk and records the contents.

Arranger is a very *user-friendly* program. We figured out how to use it in about ten minutes without even looking at the manual. Menus are used to help you get to the program options, and everything works exactly as it should. We give this program very high marks. It's well thought out, useful, inexpensive, and friendly. What more could you ask?

Hexman

Hexman is a more sophisticated disk management program available on diskette for $79.95 from Hexagon Systems. You need a copy of the disk operating system called LDOS to use this program. (LDOS can be purchased from your local Radio Shack store.) You can also use *Hexman* if you have *DOSPLUS* or *Newdos*, two other popular disk operating systems.

When you use the *Hexman* system, you first create a set of *Filestore* disks. The files you use most often, as well as the Hexman programs, are on the filestore disks. When you need a file that is not on one of the filestore disks, you give *Hexman* the name of the file, and the screen displays the code number of the disk with the file.

Hexman automatically makes a copy (called a *backup* in computer jargon) of any files you add or change. This means you always have a copy of all files. If you need a file but are not sure exactly what you named it, you can give just part of the name to *Hexman* and all files with similar names are displayed. In addition, the code number of the disk where the file is located is displayed.

Hexman can save you money on new disks, since it automatically uses all the space on your existing diskettes. *Hexman* analyzes your pattern of file usage and makes sure that the most frequently used files are on the disks you keep in your computer disk drives.

Hexman is an excellent program if your disk organization system (or lack of it) is a problem. The larger your disk library, the more you need a system like *Hexman*.

Data-Writer

Data-Writer is a personal record-keeping system from Software Options, Inc., on diskette for $145. This is a computer-based filing system you can use by itself or with a word processor to set up a database or a form-letter file and mailing list. The program gives you a fast, easy way to create, maintain, and use your own customized files. Because it's a general record-keeper, you can tailor it to fit your own needs.

You can use *Data-Writer* to organize and set up customized files, as well as update and rearrange existing files. You can print or display selected lists of file data or create a subset of a larger list. For example, if you have created a file of your exotic pressed flower collection, you could call up the files for all red orchids gathered on South Pacific atolls between 1:00 and 2:00 A.M. during a full lunar eclipse! The program can also alphabetize or sort items (for example, by zip code) into ascending or

descending order (great for bulk mailings). There is also a program for printing mailing labels.

If you use the *Electric Pencil* word processing program, you will find *Data-Writer* especially easy to learn since many of the commands are the same. You shouldn't have trouble with too much data and too little memory in the computer with this program. The size is limited only by what your disk will hold.

YOUR COMPUTER AS A HOME HEALTH CARE ASSISTANT

Home health care is a promising new area for home computer use. Although there isn't a great deal of software available in this area, there are a few very good programs.

Nutri-Man

Nutri-Man is a food and nutrition analysis and inventory program available for $250 from Quant-m Corp. At first, this program seems expensive. But it might be a wise purchase for organizations preparing food for large numbers of people, or for families who have members with special dietary requirements.

The program has several different parts. You can use it to enter information like sex, age, weight, and what you've been eating. It produces a detailed nutritional analysis, including information on twenty nutrients, water, fats, and calories. The program prints balanced diets, taking this information as well as personal food preferences or special dietary needs into account.

The program also maintains a complete inventory of

groceries; you can use it to print out a shopping list. It also acts as a complete recipe manager, automatically adjusting food amounts to feed as many people as you choose. The more people you are feeding, the more helpful this program is. It's expensive, but it does a lot, and it does it well.

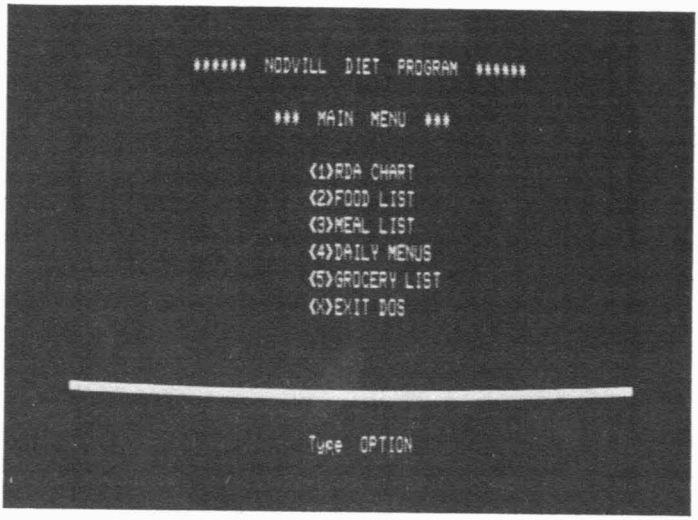

Fig 5.2 *Nodvill Diet Program*

NODVILL DIET PROGRAM

This handy diet program is available on disk for $69.95 from NODVILL Software. The program is intended to help you be sure you are getting a healthy diet by planning nutritious meals.

First you must determine your approximate energy expenditure and enter it in the program. The manual lists a variety of activities under the low, medium, and high

energy levels. For example, sleeping is a low energy level activity. It burns off only about eighty calories per hour. Running is a high energy level activity because it requires about 900 calories per hour. (There are no statistics listed for compulsive computing.) The program also prompts you for less interesting but more objective data like name, age, weight, and height. The program then shows you what your nutritional requirements are in terms of units of vitamins and minerals.

There is a subprogram you can use to enter the types of food you like. It displays the nutritional content of the food, including calories. Over 700 foods are included, and you can add the data for sauteed hummingbird wings or other personal favorites not included in the program. Another subprogram assists with menu planning. The third subprogram uses the menus you have generated to print out a shopping list to take to the supermarket.

Split Calculator

Split Calculator is for the serious runner. Split times refer to elapsed time since the race began, measured each mile during the race. For example, if your goal is to run five miles in forty minutes, your split times must be eight minutes at the end of one mile, sixteen minutes after two miles, twenty-four minutes after three miles, and thirty-two minutes after four miles.

Split Calculator is a free program by G. Michael Vose listed in the April 1983 issue of *80 Micro*. If you're a runner and if you're willing to type in this fifty line program, you'll find it a wonderful improvement over trying to calculate split times by hand.

Another interesting free program for runners is called *Runner's Logbook*, by the same author, published in the December 1981 issue of *80 Micro*. It is designed to keep

track of dates you run, distance, time, weather conditions, pulse rate, overall health evaluations, and general comments. The program figures your average pace per mile in minutes and seconds, and total mileage since the log was started. It even has two programs intended to be crude estimates of your maximal oxygen use (an important index of fitness) and percent of body fat.

CHAPTER SIX

Tapping into the World: Telecommunications

You already know the recreational potential of personal computers. You also know that those desktop marvels that play space games can do an honest day's work as word processors, accounting machines, and educational tools. The subject of this chapter is not so well known. Telecomputing involves connecting your home computer to other computers over standard phone lines. Your computer becomes a link to hundreds, perhaps thousands of other computers that are programmed to provide various services. You can sit back in your easy chair, get a comfortable grip on your Model 4's keyboard and do everything from paying bills to reading weather reports for Colorado ski resorts.

Telecomputing is one of the fastest growing areas of personal computer use; many Model 4 owners use their computer to talk to other computers. Telecomputing is simple, you need only four things: your computer, a special device called a *modem*, a telephone system, and a telecommunication software package. You connect the computer to the modem with a cable. When the modem and telephone are connected, you've got all the hardware you need to telecommunicate! The Model 4 is an excellent computer for telecommunications because of its large-

capacity display and the availability of several inexpensive modems and software packages.

To communicate with another computer, you dial the other computer's number. When it answers, you talk to the other computer by typing on your Model 4 keyboard. The computer on the other end of the phone line responds by sending you information that is displayed on your television or monitor screen.

Telecommunications is not a topic most people are familiar with, so we have included an extended introduction to this topic. We also give specific examples of services available to Model 4 owners and information on exactly what equipment and software you need to get started.

Telecommunications is complicated. There are many aspects of the phenomenon and many ways you can take advantage of the services available. It is a little like reading, which is really a *tool*. If you can read, you can do many different things: read the morning paper or decode the assembly instructions that came with the Christmas bicycle.

Through telecommunications you have many ways to acquire and use information. Over the last century the development of wireless communication technology (such as radio, television, and satellite transmission) changed the way we get much of our information and changed the type of information we get. Homes with cable television are able to tune to an all-news channel and get instant information on current news stories. Cable channels now or soon available will provide specific types of information in areas such as health and nutrition and business news.

Cable-based information systems all share one problem, however. You have no direct control over the topic of the show. Yes, you can tune to the channel that pro-

vides health and nutrition news, but the topic may not be the particular one you want to see. In telecommunications, you take a much more active role in the selection of information.

MAJOR TELECOMMUNICATIONS APPLICATIONS FOR HOME COMPUTERS

Local Area Networks and Computer Bulletin Boards

There are hundreds of local computer *networks*, many of which use regular phone lines for communication. They're run by universities and colleges, computer clubs, amateur radio clubs, and special interest groups. Members of the sponsoring organization (or, in some cases, anyone who knows the phone number) interact with the network's computer. In some systems you are limited to reading the local electronic bulletin board. Others let you use a large computer system's power from your own home.

Typically, local area networks are sponsored by a computer club. The club pays for a phone line connected to a computer owned by the club. When you call, the computer answers the phone electronically and often asks what information you want sent to your computer. There may be options such as reading the latest issue of the club's newsletter, browsing through want ads for used equipment, or looking at material written by other Model

4 owners about new products or problems. The type of network and the services offered vary greatly from one locale to the other. Local computer stores and computer clubs are usually aware of the networks operating in the area and what they offer. Many local networks are the electronic equivalent of the bulletin board down at the laundromat or at the factory, with notices of events, want ads, offers of free puppies or kittens, and descriptions of new computer equipment.

In addition to local computer bulletin boards, several national systems (some with toll-free numbers) are available for the cost of the phone call. National bulletin boards are generally intended for a special audience and some charge for their use. HEX (Handicapped Education Exchange), reached by dialing (301) 593-7033, is used by individuals and organizations to exchange information on how technology can be used to help the handicapped. There are also national networks for owners of a particular brand of computer. Radio Shack's network is described in a later section of this chapter.

If you would like information on all computer bulletin board systems (CBBS) there is, appropriately, an electronic way to do it. Novation, one of the larger manufacturers of modems, has a bulletin board that provides information on the hundreds of free CBBSs across the country. When your Model 4 is set up for telecomputing, you can dial (213) 881-6880. When Novation's computer answers the phone, hit the ENTER key on your Model 4 once or twice. The Novation computer should respond with:

```
Logon Please
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Most networks require you to sign on. In this case, all you need to do is type CAT (Novation makes CAT

modems) and press ENTER. You then have access to this CBBS, which has a list of hundreds of other CBBSs, organized by area code. The system also has many other services such as games you can play (but remember the call is long distance unless you live in Los Angeles).

Recreational Games

Both *CompuServe* and *The Source*, telecomputing department stores discussed later in this chapter, have provisions for playing games. Dial their numbers, type in your personal identification code, and play any of over 100 different games. Most games are the adventure or strategy type with little or no graphics, because it is difficult to transmit graphics quickly over phone lines and almost impossible, without lots of specialized software, to transmit usable graphics to all the personal computers on the market today.

Downloading Programs

Several networks sell programs by *downloading* them to your computer and billing the cost to a credit card. Some services even let you try the program first; if you like it, the program is yours for a small fee. Before you can download programs, you must buy a special program that lets you store the programs you buy on a cassette or disk. Of course, you select only programs that run on the Model 4, a program for the Apple is not likely to run on your machine. A number of services have software for the Model 4.

Information Utilities

If you need to know the current price of Tandy stock or the time of the next plane to Lubbock, this information—and much more—is available from one of the many information utilities accessible by computer. Both *The Source* and *CompuServe* have extensive data banks. A doctor can check on a recommended treatment for a new disease, a farmer can get predictions on the wheat crop in South America, a consumer can check discount prices on a dishwasher or color television.

Some writers predict computerized information utilities will replace traditional sources of news and information such as newspapers and television newscasts. We doubt that. Newspapers are sources of professionally packaged and conveniently presented information. We think information utilities will supplement, rather than replace, our existing sources of information.

The reason for this is that information utilities are not easy to access; it takes some effort to get information from them. In addition, they are not convenient sources of general information. The morning paper or the nightly news gives us that. What information utilities do is give us access to specific information.

Suppose you are á member of a local group force formed to fight for modifications in local laws governing waste disposal near your neighborhood. One of the group's first tasks is to write a booklet on the problem, which you will distribute to citizens and local officials. You want it to be technically accurate and to include information on what has happened in other areas that faced a similar problem.

The group could gather background and support information by going to the library and searching through the relevant indexes for articles and books on the topic.

A hand search would probably take several days of hard work at the library and probably wouldn't be as comprehensive as you really need.

An alternative to a hand search is a computerized search through one of the databases available from DIALOG (described later). A DIALOG search provides you with a list of articles (with abstracts or summaries of the articles) and books on your chosen topics. A typical DIALOG search takes less than an hour and is sure to be more comprehensive than a hand search.

Even a DIALOG search is unlikely to point you to recent news stories on the topic. Those can be accessed through one of the information utilities. If you want a summary of all the federal court cases relevant to the pollution issue you are concerned with, there is a database that can give you that information. A *database* is a file of information stored in the computer's memory or on disk drives attached to the computer. A database may contain millions of references to books, articles, and technical papers. It can be searched electronically by telling the computer to look for references with information about a particular topic. When you use a computer to find the information you need, your research time is reduced and its quality improves.

There are hundreds of databases for you to use with your computer. Virtually every field of interest is covered by a database somewhere. You can use your Model 4 to find information on new metallurgical patents, federal court cases, space games, college scholarships and much more.

Banking and Shopping

Several banks, led by the troubled United American Bank of Knoxville, have systems that let customers trans-

fer funds and pay bills by computer. Dial the bank's phone number, type in your account number, then type in your instructions on how much to pay and to whom. If you bank at the Chemical Bank of New York, you can buy things like airline tickets over the phone lines. The tickets are mailed to you, and your account at the bank is automatically debited. Some experts think *banking by computer* will become the norm rather than the exception. Now, though, it is being tested in only a few cities across the country.

Shopping by computer has caught the public's eye. Several shopping services let you order items that are charged to your credit card and mailed to your home or office. Both *The Source* and *CompuServe* have shopping services that are discussed later. In addition, many services provide consumer information, for example, movie and book reviews.

Electronic Mail and Teleconferencing

Electronic mail means different things to different people. A large corporation may have computers that store messages written in the Dallas office ready to go to the staff in the Chicago office. Late at night the Dallas computer automatically calls the Chicago computer and sends the messages. If you are the recipient of a message, a flashing light on the computer console on your desk indicates there is a message waiting in the computer's memory. That is one form of electronic mail.

Public access electronic mail is a little different. After you type a message to a friend in on your keyboard, your message is sent to a company that handles electronic mail. The company transmits the message to the city where your friend lives. The message may then be printed out and delivered by the Post Office the next day. In the

future your friend may have a home computer always connected to the phone line. You can then transmit messages directly to your friend's home, and they'll be printed out on a printer attached to the computer.

Today a type of electronic mail is possible through the information utilities. Each person who has an account with a utility such as *The Source* has a user number, which serves as an electronic address. If you need to send a report to a friend or colleague who lives across the country, you can transmit the report (which you typed on a word processor) from your copy on a disk or cassette through the computer to *The Source*. When your friend next uses *The Source*, there would be a message waiting. The report could then be transmitted from *The Source* to your friend's computer and from the computer's memory to a disk or cassette.

MAJOR INFORMATION UTILITIES

Currently there are two established national general-purpose information utilities: *The Source* and *CompuServe*. Both can be used by anyone with a small computer, a credit card (so they can bill you), and a telephone. Calls to the two major networks are local in many major cities. You are connected to the service through a special electronic communication network, usually Telenet or Tymnet.

The Source

The Source is a service of Source Telecomputing Corporation, a subsidiary of Reader's Digest. If you want to sign up with *The Source*, you can do so through the mail or at many computer stores. As with cable television,

there is an initial hookup charge, of $100. After that, *The Source* charges $7.75 per hour during non-business hours, less for late night use, $5.75, and during office hours, $20.75. There is a minimum monthly charge of $10 whether you use the system or not. The phone call to *The Source* is a local one in over 300 cities.

Few people will want every service offered by *The Source*, but it's nice to know they're there. Here are some of the most interesting services:

Consumer Services

You can check airline schedules worldwide and make hotel, car rental, and airline reservations. There is a classified ad bulletin board where you can check for bargains from all across the country (or sell a bargain yourself). A discount buying service lets you select brand name products and pay for them with your credit card. A real estate service helps you buy and sell your house.

The service also has restaurant guides, restaurant and movie reviews for most large cities.

Computing Services

You can write and run programs in a variety of languages, including BASIC, COBOL, Pascal, and FORTRAN. *The Source* also makes available many canned programs of their own. Many are free; some involve a small extra charge. The programs include games, business software, and software for special applications, like statistical analysis of large amounts of data. You cannot buy these programs and run them without being connected to the service. In essence you *rent* them by connecting to *The Source* by phone and typing in the name of the program you want to use.

Databases

Many subscribers will want to use the many databases available from *The Source*. One of the more popular databases is the United Press International (UPI) wire service. You can tell *The Source* to put the UPI output on the screen and watch the news scroll by a line at a time. Or, more efficiently, you can tell the UPI database exactly which stories you want to read. If you want information on the latest crisis in any country, you type in the name of the country, and all the recent, relevant stories filed with UPI are displayed. It is easy to get in-depth reports on any subject you are interested in. Best of all, you can have up-to-date information any time you want it. The UPI database is only one of a large number of databases available on *The Source*. It takes some effort to learn how to use them effectively, but the effort is well worth it.

Many of the databases available on the system are oriented toward a particular topic. If you are interested in the stock market, for example, you can get detailed news and background information about the companies you are interested in. There are databases on commodities, stocks, bonds, precious metals and more. There's an electronic version of the magazine *U.S. News and World Report*, as well as abstracts of articles from magazines like *Forbes* and *Harvard Business Review*.

Electronic Mail

In addition to the method of electronic mail described earlier, it is possible to dial a toll-free number and dictate a letter over the phone. Your letter is put in the electronic mail file and is available to the recipient the next time that person signs on. Special interest groups can also use the electronic mail feature by placing information in a

sort of electronic bulletin board that can be read by subscribers with similar interests. With an electronic equivalent of junk mail, you type in a letter or report and tell the system to send it to as many *Source* subscribers as you wish.

Educational Applications

The Source has quite a few drill and practice programs on a variety of topics, suitable for both children and adults. In addition, there is a directory of financial support possibilities for college students and a job service that lets you type in your resume so prospective employers can review it. There is also a jobs-available listing.

CompuServe

The major competitor to *The Source* is *CompuServe Information Service*, now a subsidiary of H & R Block. There are many similarities between the two major information utilities, and some differences. *CompuServe* has an initiation fee of around $30 and charges $5 per hour during non-business hours. *CompuServe* is not available during normal working hours since the company that runs this service uses its computers to serve commercial customers during that time. The connect call is a local one in over 300 cities.

CompuServe offers services similar to those of *The Source*. Instead of UPI, *CompuServe* uses the Associated Press newswire, and it has electronic editions of papers such as the *St. Louis Post-Dispatch*. There are also electronic editions of popular magazines like *Computers and Electronics*, *Better Homes and Gardens*, and *Popular Science*. *CompuServe* also has a special interest group for Radio Shack computer owners. A tremendous amount

of information is available on Radio Shack computers, with a special section devoted to the Model 4. It is one way to get up-to-date information on these computers.

CompuServe also offers information on topics as diverse as home repair, personal health, and recipes. Like *The Source*, it has book and movie reviews, and sports information. There is even a file of computer art that can be copied on your printer.

Like *The Source*, *CompuServe* has a number of financial databases you can use to investigate and track the performance of stocks and commodities. You can also bank electronically on *CompuServe* through a bank in Boston or Knoxville. The service also has an electronically searchable version of the *World Book Encyclopedia* on line, a program that helps you select a college, and a service called *Refundle Bundle* for coupon clippers.

CompuServe sign-up kits are available from several sources, including Radio Shack stores and from *CompuServe*. The base fee is $20 but most people buy at least $10 worth of manuals to help them learn how to use *CompuServe*. A *CompuServe* Starter Kit, which includes manuals and several hours of time, is $40.

Both *CompuServe* and *The Source* add new services regularly, and both offer value for the money you pay.

Other Databases

In addition to the general-purpose information supermarkets, there are many specialized services that offer a more limited range of information. What they lack in breadth is more than offset by their depth. A financial data service like *Dow Jones News/Retrieval Service* may not have information on Paris fashions, but it does provide detailed information on the performance of thousands of corporations. Current stock prices and stock

performance patterns are just a starting point. Corporate history, recent news items relating to products, management policies, merger possibilities, and technological status are covered.

The Dow Jones service may not be a good example of a specialized service. It is rapidly adding features, such as a sports and weather information, a method for purchasing consumer items, movie reviews, and an online encyclopedia. Information on signing up for the Dow Jones service is available at many Apple and Radio Shack dealers or from Dow Jones News/Retrieval Service.

Another special service is DIALOG, a division of Lockheed Missile and Space Company. Most major university libraries offer DIALOG services, which is really eighty databases. There are databases for chemists, patent attorneys, philosophers, special education teachers, anthropologists, physicists, and many more.

DIALOG lets you define a topic and use the DIALOG computers to search through relevant journal and magazine articles. If you use a database like DIALOG only occasionally, you may find it easier to go to a library and get a specially trained librarian to talk to DIALOG on your behalf.

DIALOG uses a complicated but powerful system of instructions to find exactly the information you need. You must first tell it which of the many databases you want to search, then the specific data you need. You can bring up abstracts of articles on the screen to see if they cover your topic. You can then copy abstracts and references on your printer, or DIALOG can print out the results of the search and mail it to you.

DIALOG is not cheap. Connect time averages around $50 an hour and can be much higher, depending on the database you use. However, recently Lockheed created a new evening and weekend service called *Knowledge Index* that provides access to some, but not all, the da-

tabases available on DIALOG. Connect time on *Knowledge Index* is $24 an hour, around half the cost of DIALOG time. You can learn more about the *Knowledge Index* by writing DIALOG Information Services. There is a one time sign-up fee of $36.

A service similar to *Knowledge Index* is *After Dark*, an information service developed by Bibliographic Retrieval Services, an established supplier of computer-based information. The base cost of *After Dark* is $6 per hour (after a $50 sign-up fee), but it can be higher, depending on which of the service's databases you use. *After Dark* plans to add several new services and may well turn out to be more like *The Source* and *CompuServe* than DIALOG and *Knowledge Index*.

GETTING ON LINE

Do any of the possibilities in telelecommunications interest you? Would you like to use your Model 4 to connect to a bulletin board or information utility? It really isn't difficult to get on line with the Model 4. All you need are a *serial port*, a *modem*, access to another computer, and a *telecommunications software package*.

The cassette version of the Model 4 computer doesn't have a standard serial port built in, but you can add one for around $100. The two-disk-drive version of the computer comes with a serial port, which you need to connect a modem to the computer.

A modem (short for *modulator demodulator*) takes the signals from your computer and converts them into tones that can be transmitted over phone lines. It also converts tones transmitted to your computer into signals the computer can process.

There are at least a hundred different modems compatible with the Model 4. Prices begin at around $80 and go all the way up to $1000. Even the most inexpensive modem should do a good job for you, but there are important differences between models. Here is a brief explanation of some of the major differences:

Direct-connect Versus Acoustic

Acoustic modems, such as the Novation Cat, Lexicon Lex-11, and Radio Shack AC-3 ($150), all have two rubber cuffs for the telephone handset. They convert computer signals into audible tones, which are picked up by the microphone in the telephone handset. Acoustic modems used to be cheaper than direct-connect models, but they generally aren't anymore. They don't work as reliably as direct-connect models, because they may pick up noise up in the room and treat it as data. Many emit an annoying hum.

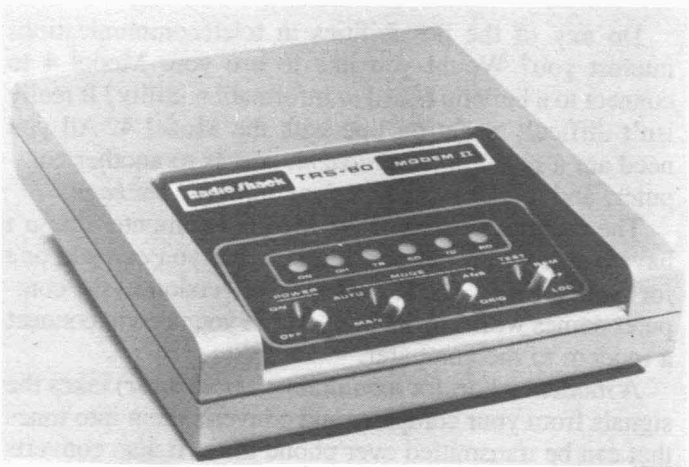

Fig 6.1 Radio Shack direct-connect modem

Direct-connect modems such as the Radio Shack I ($150) and II ($249) plug into a phone jack just like a telephone. They are increasing in popularity as their prices become competitive with acoustic models.

We prefer direct-connect modems. However, a person who uses a computer in many different environments will find some hotel rooms do not have standard phone jacks where a direct-connect modem can be plugged in. If you are likely to want to use the computer where standard phone jacks aren't available, you may want to get an acoustic modem instead. Remember, most acoustic modems were designed for telephones with ordinary handsets. If you have a *Winnie the Pooh* decorator phone, getting the handset to fit the modem may be a problem. Modems haven't gotten to the 100 acre woods yet.

Answer, Originate, or Both

An answer modem is generally used by the host (network) computer, and an originate modem by people who call the network. Two answer modems or two originate modems can't talk to each other, so you'll need an originate modem if you plan to use networks like *The Source*. That presents a problem when you want to call up a friend in another state and transmit a program over the phone. If both of you have an originate model, you can't do it. Why not buy a modem that can be switched from answer to originate as the need arises? They cost a bit more but don't lock you into only one type of telecommunicating. Radio Shack built both answer and originate options into all the modems they sell.

Half Versus Full Duplex

Some networks require computers to take turns—that is, when one is talking, the other must listen. This is

called half duplex. Full duplex lets computers transmit and receive data at the same time. Look for both modems and software that let you select the format the other computer expects. Again, all the Radio Shack modems can be switched to half or full duplex.

Speed

Modems transmit signals at a specific speed, measured in bits per second (bps). This is also referred to as the *baud rate*. All popular networks will transmit data at 300 bps, so be sure your modem is capable of operating at that speed. Faster speeds, such as 1200 bps, may eventually become the standard, but current practices make a less-expensive 300 bps modem the best for most buyers today. Radio Shack's DC-1200 modem, for example, will work on the Model 4 at 1200 bps, but it costs $700. Most people will not want to spend that much to communicate faster. However, businesses that use telecommunications regularly (stock brokers, lawyers) may find the $700 invested in a faster modem is recouped in just a few months.

Fancy features and frills

Modems are also available with many special features. Some will automatically dial the number you specify or automatically answer the phone when another computer calls. These features naturally raise the cost of the modem, but may be worth it to someone who does a lot of telecommunicating. The Radio Shack Model I modem, for example, costs $150 and has the same basic features as the Modem II, except the II is an auto answer and auto dial model and costs $250.

If you have a serial port and a modem, you still need access to a network. We've talked about several, but we should mention that Radio Shack has a special package that includes the fees for access to *CompuServe* and the Dow Jones News/Retrieval services. When this chapter was written, the cost of signing up at Radio Shack was lower than it was when you went directly to the services.

Finally, you need a telecommunications software package. Your Model 4 is capable of doing a lot of sophisticated computing, but when you connect it to a network, you're actually asking it to *play dumb* and let another computer on the other end of the phone line do the work. A device called a *terminal* is generally used to communicate with a computer over phone lines. You can convert your computer into a terminal by loading instructions—called terminal software or communications software into its memory.

The Model 4 has a functional telecommunications program built into the disk operating system software that comes with the disk versions. It may be all the software you need to get started. There are also some very sophisticated communications software packages for this computer. *Omniterm* and *Microterm* worked well on the Model III and will probably be available in late 1983 or 84 for the Model 4. Expect to pay between $60 and $180 for a sophisticated communications program. If you don't need special features, the program that comes with the Model 4 may do nicely.

CHAPTER SEVEN

Word Processing

When you think of a computer, you may think of numbers, numbers, and more numbers. Are computers *number crunchers*, machines capable of performing thousands of calculations a second? Yes, they are, and the next chapter on business applications deals with the ability of the computer to manipulate and massage all sorts of numbers for you.

Computers are also for word people. We feel, in fact, that computers, particularly personal computers, may well turn out to do more work with words than with numbers. The preceding chapter on telecommunications showed you how to harness the power of the computer to acquire and communicate information. That is called *information processing*. This chapter focuses on the role of the computer in helping you create written documents—from a quick note to the folks back East to that great American novel you always wanted to write. Using a computer to write your own material is called *word processing*.

In the past eight years we have used word processors exclusively to write and edit over twenty books about computers and related topics. That experience, you would think, should give us an excellent perspective from which to evaluate the relative merits of the TRS-80 Model 4 as

a word processor and to critique word processing programs. There is a problem with the perspective we have. We probably use our computers an average of eight to ten hours a day, day after day, for word processing, which places rigorous demands on the machine and the software. Although we didn't, we could have used the TRS-80 Model 4 to write this book. It has some limitations, as do all computers today, but the Model 4 is an excellent choice for people who plan to do a lot of word processing on their computer either at home or the office.

WHY USE A WORD PROCESSOR?

If you are an accomplished typist and own a typewriter, why should you learn to use a word processor? If you type documents that are used only once and you always type them perfectly, there is little reason to learn word processing. If you make errors, if you find yourself typing the same thing several times (for example, a letter to be mailed to several people), or if you must regularly revise and retype documents, a word processor can help you do more work in less time.

A friend of ours is the chairman of a scholarship committee that awards eight college scholarships each year and receives between 50 and 150 applications. Each year he must send out eight letters congratulating those who received the awards, eight letters to the alternates who might still get the award if some of the first eight decide not to attend college, and a larger number of letters to the people who were turned down. He has three standard letters that he modifies slightly each year. Before he began using the word processor, he or his secretary had to type each letter, check it for errors, retype if errors

were found, and finally sign and mail each one. With a word processor, he tells the program to load the file containing the sample letter into the computer's memory, the computer displays the letter on the screen, and he edits it to reflect circumstances related to the current year's competition, adding any personal messages he wants. Then he types the correct address at the top of the letter (actually at the top of the screen) and presses the keys to tell the computer to print out a copy on a *letter quality* printer, one with print that looks as good as that produced by a standard office typewriter.

Once the current version of the letter is in the computer's memory, he needs only add the address and salutation and individual comments. If eighty percent of the letter remains the same, that part need not be retyped for each person who receives the letter. So you don't waste time typing the same thing over and over, and you don't increase the likelihood of making a new error when you retype material that has already been typed correctly.

As our friend adds comments and the address to the standard letter, he occasionally makes a mistake. On a typewriter he would have to stop and correct the error. If the typewriter is a self-correcting model, he might be able to make the correction cleanly and quickly. But if he leaves out a line or wants to add a word in the middle of a sentence, he would have to retype the entire letter.

With virtually all word processing programs you can *insert* and *delete* material electronically. If you typed *Thkis* when you wanted *This*, it is very easy to use the cursor control keys (the ones with the arrows on them) to move the cursor over the top of the *k* in *Tkhis*. Press the DEL key, and the *k* disappears. In addition, the word processor fills in the space. Instead of *T his* you have *This*. Most word processors let you delete material a character at a time, some allow deletion of words, sen-

tences, even paragraphs by pressing one or two keys. The insert function works much like the delete function. If you type *Your application was one of the best* and then decide that you want to add the word *very* after *the*, it is a simple matter for a word processor. Move the cursor to the space just after *the* and press the INSERT key. Most word processors then create a *window* at that point on the screen, and you can type in anything you want. When you've finished, press INSERT again and the window closes around the new material. On a typewriter you would have to type the entire letter again.

We find the ability to insert and delete material electronically does more than speed up the writing process. Because the process of editing and changing material is difficult on a typewriter, our manuscripts gradually turned into a mass of red pencil marks. Eventually the draft became unusable because it was difficult to follow all the changes and corrections. In addition, we often rejected the idea of going through another draft, and retyping the document yet another time because of the time it took. With a word processor, corrections occur as you make them. There is no need to have the document retyped to see how it reads with revisions. If you want to move a paragraph from page 2 to the middle of page 8, most programs let you mark that paragraph and tell the computer to transfer it electronically it to a new location. Insertions, deletions, and block moves are accomplished with a few keystrokes, and you see the result of your editing immediately. Some programs even have an *undo* command that lets you go back to the way the document was before the last change, just in case you decide it was better before. We can make revisions more quickly, and we can do more of them because the boring manual labor has been reduced. Now you can concentrate on the editing process rather than worrying about having the time to

retype that report yet another time. What takes only a few minutes on the word processor would take hours with a typewriter.

A GOOD WORD PROCESSING COMPUTER

Large-capacity Screen Display

The more you can see on the screen at once, the easier it is to compose and edit your document. An excellent word processor has at least a 24-line by 80-character display. In addition, it would be nice to have the ability to display the effect of special printing codes that underline or print words in bold.

Although the Model 4 has a 24-by-80 display, it is a relatively new computer so there aren't any software programs that display 80 characters. All the programs we know about were written for a Model III, which has a 64-character display. Software written for it has a 64-character display even when used on the Model 4. That problem should be corrected by early 1984 when new verions of the Model III word processors become available for the Model 4.

Another limitation is the Model 4's standard black and white monitor. Green or amber video screens produce less eye fatigue than standard black and white screens or color televisions. Amber is a particularly good color for screens and is required in many European countries on computers that will be used in office environments.

A Keyboard with Many Function Keys

The more function keys you have, the easier it is to learn and use a word processing program. Most of the special functions can be assigned to a key: just press the key for that operation and it happens. Without function keys you may have to remember a complicated routine. For example, to save something you have written on a TRS-80 Model 4 computer using the *Scripsit* word processor, you must first press the BREAK key. Then you type an S, a space, and the name you want to assign to the document. Then press ENTER. Each operation in that word processor requires several steps because the computer has no programmable function keys.

We wrote this book on an Eagle PC. On the Eagle, you press the SAVE key, and the computer asks you what you want to name the document. You type in a name and press RETURN. There is less to remember and fewer keystrokes.

The TRS-80 Model 4 has a good quality standard typewriter-style keyboard, with three programmable function keys. More programmable keys would improve it, however.

Fast, High-capacity, Reliable Mass Storage

Professional word processing calls for reliable, high-capacity disk drives to store documents. The least expensive version of the Model 4 comes with a cassette storage system. We advise against using word processors with cassette systems, because Radio Shack has a habit of designing unreliable cassette systems. However, you can get the Model 4 in a one-disk or two-disk version, and two additional disk drives are also available. The drives store less than 190K on each disk and are thus

considered medium- rather than high-capacity drives. They work reliably and are much less expensive than some of the high-capacity drives used on other computers.

Plenty of RAM

This may or may not be an issue for you. If you type material no longer than a typical business letter, you will not need lots of memory to hold the document as you type it in. If you type term papers, reports, magazine articles or books, however, you'll find it very inconvenient to work on a computer with limited RAM. On this point, the TRS-80 Model 4 gets high marks. It has 64K RAM. Another 64K can be added to the Model 4, but it will not be used by most of the word processing programs currently available. If you write very long documents, look for a word processing program that lets you use the full 128K of RAM in the Model 4. Our first four books were written on a computer with 32K of memory. You can do lots of work with very little memory, but it isn't as convenient, and errors are more likely. Our current system has 128K, which will be expanded to 512K soon. But a Model 4 with 64K or 128K can do adequate word processing even of long documents.

Freedom from Glitchitis

Glitchitis is a disease commonly found in all sorts of electronic equipment. It generally strikes when a malfunction will do the most damage. It frequently occurs for no known cause and cannot be duplicated when you try to figure out just what happened. Worse yet, it is least likely to happen when you are trying to explain the problem to someone who can fix it. Duplication is possible, however, if you use the computer again for an

important task (for instance, typing the term paper at 1:00 A.M. that is due at 9:00 A.M.)

The TRS-80 Model 4 is remarkably free of the glitch-itis disease, although some of its competitors are particularly prone to it. Some of the early TRS-80 computers had problems with keys sticking and repeating when they weren't supposed to. This problem seems to have been solved on the TRS-80 Model 4.

There are other features to look for when you shop for a professional word processor, but these are some of the most important ones. The TRS-80 Model 4 has many of the needed features but falls short of perfection in some areas. When you disregard price and compare the TRS-80 Model 4 with the Eagle PC we used to write this book, the TRS-80 Model 4 comes up lacking. In the real world, price must always be considered, however. The Eagle PC costs $3500, while the TRS-80 Model 4 with two disk drives costs about $2000. So it's a cost effective way to get good word processing power.

DESIRABLE WORD PROCESSING FEATURES

Hundreds of word processors are available for small computers. The price range starts at about $10 and goes up to well over $1000. Programs for the TRS-80 Model 4 are generally priced in the low end of that range. A lot of new or revised programs are coming on the market all the time, so by the time you read this, there may be many good programs not even mentioned here. For this reason, we will give you a brief checklist of features to look for in a word processor.

Delete Modes

Refers to ways you can delete text from the screen. Some simple programs permit nothing more than deleting material a character at a time. Others have many options. Here are the common options:

- Delete character.
- Delete word—Deletes material separated by spaces on each end.
- Delete sentence—Deletes material from a capital letter preceded by a space to a period or other end punctuation.
- Delete line—Deletes a line of text on the screen. A poor substitute for delete sentence, since lines on the screen rarely correspond with sentence length.
- Delete partial line—Deletes from cursor to end of line, for example.
- Delete paragraph—Deletes from beginning of indented sentence to beginning of another indented sentence.
- Delete block—See section on blocks for explanation.
- Delete everything—Deletes everything in the memory of the computer.
- Delete undo—Save me from the error of my ways because I didn't really mean to do that.
- Delete verify—If instructed to delete a lot of material, the program checks (by asking REALLY Y/N? or PRESS RETURN TO DELETE DOCUMENT) before executing the instruction.

Insert Modes

The methods of adding or inserting material in an existing document.

- Destructive insert—Replaces material by typing over it.
- Non-destructive insert—Pushes material out of the way as new material is typed in or creates a *window* of blank space where new material can be typed.

Block Modes

A block is a section of text you have marked electronically. You might press the down-arrow key at the beginning of a section and press it again at the end of that section. The computer can then be told to perform different operations on that block of text. Blocks of text can be moved, deleted or duplicated. Duplicating a block means you can put the same material in several places in the text. Reports often contain many complicated tables that have the same format and different numbers. A complicated table can be typed once, marked as a block of text, and inserted at any point in the text where you want the table. Once you have the table in place, all you have to do is fill in the numbers.

- Delete block—Can a block be deleted?
- Move block—Can a block be moved from one location to another?
- Duplicate block—Can a block be duplicated somewhere else in the document without erasing it from its original location?

• Multiple block—Can more than one block be marked, or is the program limited to one marked block at a time.

Cursor Control

The cursor is a solid or blinking rectangle that tells you where material you type will appear on the screen. It also tells you what will be affected by an instruction to insert or delete material. You must move the cursor over a letter to delete it in most programs. Simple word processing programs let you control cursor movement with arrow keys that point in the direction the cursor will move. On the TRS-80 Model 4, most programs use the cursor keys on the bottom right of the keyboard.

• Move by character—The cursor moves one character at a time.
• Move by character, auto repeat—Hold down a key, and the cursor keeps going until you release the key.
• Move by word—The cursor moves to the first letter in the next word.
• Move by sentence—The cursor moves to first letter after an ending punctuation mark.
• Move by paragraph—The cursor moves to beginning of next paragraph.
• End/beginning of line—The cursor moves to end or beginning of line.
• Home—The cursor moves to home position, the top left corner of screen.
• Beginning—The cursor moves to beginning of document.
• End—The cursor moves to end of document.
• Fast scroll—The cursor jumps forward or backward in document several lines at a time.

Search and Replace

If you misspell a word throughout a document, can you tell the computer to find and correct the error? If you have a large document in memory, can you find a particular section by telling the computer to search for a particular word or phrase? There are several variations on the search-and-replace theme:

- Search for keyword—Looks for a word you specify and moves the cursor to the point where it occurs.
- Replace, once—Finds the target word and replaces it with a new word you specify.
- Selective replace—Finds the target word and asks if you want it changed to the replacement word. You can say yes or no.
- Global replace—Finds multiple occurrences of the target word and changes them to the replacement word you specify.
- Selective global replace—Same as selective replace but checks entire document.
- Wild card search—Lets you specify the target word with *wild card* letters. Telling it to search for Th#mes, for example, means words like Themes and Thames would be found, because the third letter is a wild card, and any letter is acceptable in that position.

Page and Printing Features

Programmable page parameters—Can the number of lines, the length of line, and the amount of space left at the top and bottom margins be controlled?

- Printer selection—Will the program work with many

different types of printers, or is it limited to only one or two?

- Underline—Will it produce underlined text?
- Boldface—Will it produce boldfaced text?
- Large characters—Will it produce expanded or larger-than-normal characters on printers that support that option?
- Italics—Will it produce italicized print on printers that support that option?
- Justification—Will it print justified text, with the right and left hand margins straight?
- Sub/superscripts—Does it print subscripts and superscripts?
- Headers and footers—Will the program let you specify a message that will appear at the top or bottom of each page?
- Page numbering—Will the program automatically number pages for you?
- See/get—Will the program show you on the screen what you will get when the document is printed?
- Wraparound—Will the program automatically move to the next line when you run out of room on the current line? Does it take the word you are typing and move it down to the next line, or does it break the word and leave parts of it on different lines? Breaking words up is a poor substitute for true wraparound that automatically moves the last word typed on a line, the one that is too long to fit, to the beginning of the next line.

This list is not exhaustive. Some of the word processors for the TRS-80 Model 4 have most of these and many more. However, we feel the list does give you a starting point to evaluate potential programs. You may also want to consider two other types of programs. There are programs that check spelling, although they won't

tell you if you used *effective* when you really needed *affective*. Both effective and affective are correctly spelled words and will be accepted by a spelling checker. Words like *affeccived* or *therr* will be caught by the checker. There is also a program called *Grammatik* for correcting common grammar errors; it may even make suggestions for improving your writing.

WHAT WORD PROCESSING PROGRAMS ARE AVAILABLE?

There are many different word processing programs for the Model 4, but two of these, *Scripsit* and *Superscripsit* are far more common than any of the others. *Scripsit* is by far the best-selling word processing program for the TRS-80, so we'll begin by reviewing it in depth. *Superscripsit*, the newest Radio Shack word processing program, is an attempt to improve on *Scripsit*. We'll give a brief review of this program and then go on to describe other programs.

Scripsit

The *Scripsit* word processing program from Radio Shack sells for $99.95 on cassette or diskette and requires at least 32K of memory. This is an excellent, inexpensive word processing program, although the documentation that comes with it is terrible.

When you purchase *Scripsit*, you receive the *Scripsit Word Processing System Training Program*, a sixty-seven page book and six lessons recorded on three cassette tapes. The book states that you will need approximately six hours to work through the training package, incor-

rectly referred to as *programmed learning*. True programmed learning leads you through a series of lessons, with the pace and sequence of steps determined by your responses to various questions. Actually, the Radio Shack tapes contain nothing but a series of lectures.

While *Scripsit* is excellent, everyone we know who uses it complains about the poor quality of the training package and the lack of a true reference manual. If you thought Aunt Olive's slides of Yellowstone were boring, *you ain't seen nothin' yet*! Wait until you've tried to sit through these training tapes! In addition to being deadly boring, the tapes are poorly sequenced, incomplete, and confusing.

The printed portion of the training program is not a training or reference manual but is only useful if you are willing to sit through all six of the audio tapes. Many important points are covered on the cassettes, but not in the printed material. In addition, there's no index. We believe that alone is a fatal error in computer program documentation.

Does it sound as if *Scripsit* isn't worth the trouble of wading through the poor documentation? Actually, it's well worth it! As we've said before, this is an *excellent* word processing program for a relatively low price. If you don't care to spend the time and effort with the Radio Shack documentation, there are several books other authors have written about the *Scripsit* program. *How to Use Scripsit* by Maddux, Pederson, and Willis (dilithium Press) is a good one.

One of *Scripsit*'s endearing qualities is that it's very *user-friendly*, by which we mean that *Scripsit* is relatively easy to use. It has automatic word wraparound and permits complex editing and formatting. *Editing* means making changes in your text. You can insert (put in) or delete (take out) letters, words, sentences, paragraphs, or larger

blocks of text by using simple commands. For example, to insert text, you use the arrow keys to position the cursor at the spot where you want to add something, then hold down the CONTROL key while you press the S key. The computer opens a large blank space in the text. You type in what you want to add. When you're through, you press the CLEAR key and the computer closes up the text. You can either memorize the fact that the S key is the insert key, or you can use the stick-on key labels that come with the program.

Formatting tells the computer how you want your printout to look, using special printer commands in the text. These commands do not appear in a printout but control how they look. You can vary margins, page length, and line spacing. You can justify the right margin, add running headers or footers, number pages, center anything you want, and much more. Files can be saved on diskette or cassette, and *Scripsit* can merge two or more files. You can check on, or change screen widths, tabs, hyphenation, remaining memory, and file name.

Scripsit also includes procedures for searching for, replacing, or deleting material in your text. For example, you may discover that you spelled Mr. Schmidt's name as *Smith* every time it appeared in the text. *Scripsit* can be told to go through the document and change every *Smith* to *Schmidt*.

By now, *Scripsit* may sound like almost an ideal answer to your word processing needs. Unfortunately, there are a few important things you can do with a typewriter that you cannot do with *Scripsit*. Like the great Shakespearean tragic heroes, *Scripsit* is magnificent but imperfect. One of *Scripsit*'s tragic flaws is you cannot make it underline anything. Other weaknesses include the lack of subscripts and superscripts and certain important characters like brackets, braces, and carets. Another problem

is that it is impossible to check on a disk directory while in *Scripsit*.

There are several *Scripsit* enhancement programs on the market that correct some of these problems and add some other valuable features. One very good enhancement program (and the one that sells the best) is called *Superscript*, available for about $59.00 from Acorn Software Products, Inc. Remember, *Superscript* is not a complete word processing package. It is a supplement, or enhancement, to *Scripsit*. You must buy both.

Superscript makes it possible for *Scripsit* to print brackets, braces, and carets, and to underline, boldface, superscript, subscript, print in 12-pitch, and print in 10-pitch. *Superscript* also makes it possible to obtain a directory of all files, or kill (delete) selected files on your disks without exiting from *Scripsit*.

The only problem we have found is that customizing *Superscript* for certain printers can be difficult. If you use one of the printers listed in the manual, the task is fairly quick and simple even if you are a novice. Most of the Radio Shack printers suitable for word processing, popular daisy wheel printers from Diablo, Qume, and NEC, and popular dot-matrix printers from Epson, NEC, and Okidata are on the list. If your printer isn't on the list, you shouldn't purchase the program, or else you should get your dealer to customize it for you before you pay for it.

Even with the *Superscript* enhancement, *Scripsit* has a few problems. It is much too easy to wipe out a document by preparing a new document and accidentally saving the new document under the same name as the older one. If you do this, the new document replaces the older one, and the older document is lost. The program has no safeguards against this. On some word processors, if you save new material under a name that has already

been used, the computer will make the older copy a backup file instead of erasing it. In addition, preparing text with several columns of data is tedious and difficult. These are minor problems, however, and ones you will quickly learn to deal with.

In conclusion, we have found *Scripsit* to be an excellent word processing program for a relatively low price. The documentation is weak, but several good manuals are available from sources other than Radio Shack. You can get spelling and grammar checkers to use with *Scripsit*, with or without the *Superscript* enhancement. We recommend this popular word processing program for the TRS-80 Model 4.

Superscripsit

Superscripsit is Radio Shack's newest development for word processing and is advertised as their "most powerful word processing program." The program is Radio Shack's attempt to produce a new and improved version of *Scripsit*. It's true that *Superscripsit* is better than *Scripsit* in some ways, but we have some reservations about this program, mostly due to the fact that it sells for $199.00—twice the price of *Scripsit*! Radio Shack must also have some reservations, since *Scripsit* has not been withdrawn.

Unlike *Scripsit*, *Superscripsit* will underline, double underline, boldface, superscript and subscript. Other improvements include an easy way to print in two columns, and a feature called *true proportional-spaced printing* that gives wide letters like *w* more space than narrow ones like *l*. *Superscripsit* also guards against losing a document by accidentally giving a new file the same name as an old one. In *Superscripsit*, you must name a file before you can begin to type. If you type in a name you have already given to another document, the program

assumes you want to edit that document and immediately displays it. That's a nice touch that should keep you from committing some frustrating errors.

Another nice feature in *Superscripsit* is that you can identify a block of text and move it quickly into documents you previously wrote and saved. You can also identify a block of text you want to protect (freeze) against accidentally changing in any way. If there are words or phrases you know you use often, you can assign these to certain keys. When you need a certain phrase entered into your text, you simply press the assigned key.

A really useful improvement in *Superscripsit* is the ability to set up a variables list for producing form letters. You can use this to do things like make a list of customers, with the amount each owes you. You can then compose a form letter and instruct the program to run a copy for each customer. *Superscripsit* automatically inserts the proper name and amount for each customer.

Another useful feature is that *Superscripsit* can be used with Radio Shack's electronic filing system, *Profile III Plus*. You can tell *Superscripsit* to use data you have stored in *Profile*, setting up a variable list once in *Profile* and using it repeatedly.

There are other improvements in *Superscripsit*, but they are minor. As we have already said, we have reservations about this program. We think Radio Shack should have made an effort to make the program similar to *Scripsit*. Then *Scripsit* users would have an easy time switching to *Superscripsit*. Instead, *Superscripsit* is a completely different program. This makes it difficult to learn, even if you're already an accomplished *Scripsit* user.

The documentation for *Superscripsit* is better than for *Scripsit*, but it still seems needlessly complex. Unless you need some of the specialized improvements in *Su-*

perscripsit, such as the form letter features or compatibility with *Profile III Plus*, you might be better off with *Scripsit*, plus the *Superscript* enhancement package we have described. We found *Scripsit* easier to learn and, even with the *Superscript* enhancement, it is about $40 cheaper than *Superscripsit*. Then too, Radio Shack has made no effort to include information for using it with non-Radio Shack printers. Even several of the Radio Shack printers won't work with the program! If you own a printer not supported by *Superscripsit*, you may find yourself investing an additional $15–$50 for a special program called a *driver* to make your printer work with *Superscripsit*. Current computer magazines are full of ads for such drivers.

In conclusion, both *Scripsit* and *Superscripsit* are fine word processing programs for the Model 4. *Superscripsit* is a little better than *Scripsit* but considerably more expensive and more difficult to learn. If the specialized improvements in *Superscripsit* are important to you, it might be worth the extra trouble and expense. If not, we recommend you purchase *Scripsit* and the *Superscript* enhancement package.

TXMODE

This word processor was written by a well-known author of children's books, Sylvia Engdahl, who also has ten years of experience as an assembly language programmer. This inexpensive ($30) program was developed exclusively for people who have cassette versions of the Radio Shack computer. *TXMODE*, intended for home use, is easy to learn, but isn't as powerful as the other word processors we've reviewed. It is easy to use, partially because its editing conventions are the same as those used in Radio Shack's BASIC. If you have learned to

edit programs you write in BASIC, you already know many of the editing steps for this program as well. *TXMODE* is available from TOPS Programming Enterprises.

Newscript

Newscript is another popular word processing program, available for $124.95 from Prosoft. *Newscript* with the Mailing Labels Option sells for $139.95. Another excellent choice for the Model 4, this program has all the advanced features of *Scripsit* and *Superscripsit*, plus a good deal more! For example, creating tables is much easier with *Newscript* than with *Scripsit* or *Superscripsit*. Newscript has a *whoops* command. You can use it to give up on changes you have just made and return the text to its original state before you began tinkering with it. It prints form letters and mass mailings, automatically makes and prints tables of contents, automatically saves text after a certain number of lines have been typed in, and creates files of any length (even spanning more than one disk).

Our only objection to *Newscript* is that it is almost too good! By that, we mean *Newscript* is so sophisticated that it is more difficult to learn than *Scripsit* or *Superscripsit*. Also, the program is designed to be used with many different disk operating systems and must be *initialized*, or prepared for use with whatever disk operating system you are using. This procedure is quite involved and is not well explained in the manual. It's a fine word processing system, but it's a little too complex for beginners, because it does more than most people need.

Electric Pencil

One of the first word processing programs for small computers was the original *Electric Pencil* developed by Michael Shrayer. We wrote several books with this word processing program. It is now available from IJG, Inc. and a newer version, *Electric Pencil 2.0z*, is also available on cassette or diskette for $74.95. The program includes standard word processing features such as character, line, and block insertion and deletion, and search capability. An interesting feature helps you transcribe material recorded on an audio tape: you control a cassette recorder by striking certain keys as you type the text into *Electric Pencil*.

The company is planning several new related programs, such as one to help you to produce graphics while using *Electric Pencil* and a version called *Talking Pencil* for visually handicapped people. There are also programs that check spelling and grammar.

Electric Pencil has a good manual and is easy to learn. *Electric Pencil 2.0z* is not as sophisticated as the other word processing programs we have discussed, but it is inexpensive and has an excellent manual. It would be particularly good for home use or for offices where there is a high turnover in typists. New typists can begin using *Electric Pencil* in a matter of hours.

Zorlof

This program is described as "the magnificant word processing system" by its publisher, Anitek Software Products. Available on disk for $70, this program has several nice features including compatibility with many popular printers, a mail list and mail merge facility, and a print-to-screen option that lets you see on the screen

how material will look before sending it to the printer. This program has all the major insert, delete, and block commands a good word processor should have and is inexpensive.

Lazy Writer

Lazy Writer is the only word processing program we reviewed that had any information on the Model 4. A sheet enclosed with the program was titled "Straight Talk About the Model 4 Computer." It compared the Model III and 4, then told buyers that the current version of *Lazy Writer* would work fine on the 4 but in the 16-lines, 64-characters format used by the Model III. The letter promised people who bought the current version of the program they would be able to buy a new version with 24-by-80 display format at a reduced price as soon as it was available. We think that was a nice touch and reflects the concern and thoughtfulness of this company.

Lazy Writer, distributed by AlphaBit Communications, is expensive ($175), but many people are willing to pay that price for a word processor that gives them the power and versatility they need. The program combines three features not often found in a word processor: it is one of the more powerful word processors for the Radio Shack computers, it is easy to learn to use, and it is very flexible. Some programs don't have even one of these features, much less all three. The manual is large, well organized, and complete. It even includes a section called "If you're new to computers." And there's a HELP function that gives you additional instructions right on the screen in the middle of work.

This program has some sophisticated features. For example, if you want one header on even pages and a different one on odd pages, you can do that. The program

even compensates for the Model 4's lack of programmable keys by letting you define the output from up to ten different keys. You can put printer codes, word processing instructions, or commonly-used phrases or words on those keys, and generate them by holding down a special key and pressing the key to which they were assigned. We won't go through all the features of this program, but to give you an idea of its power, we will note that there are several types of cursor movement—right-left, up-down, to end of document, beginning of document, forward to next word, sentence, or paragraph, and back to last word, sentence, or paragraph. Three types of speed scrolling move you from one page of text to the next (or back). *Lazy Writer* even has a command that goes through the text and capitalizes the first letter in every sentence and every individual *i*. There are also two ways to retrieve accidentally deleted material.

If we sound enthusiastic about this program, we are. It's powerful but usable without hours and hours of studying. The section in the manual on inserting, for example, gives information on *simple insert* first. You get the feel of how the program works with an easy, uncomplicated example and then go on the five or six special types of insert applications. The program is sophisticated, the manual is well written, there is a good reference card that shows all the commands, and there are several special programs that work in conjunction with *Lazy Writer*. *LazyCalc* is a program that helps you organize and edit columns and rows of numbers. It performs simple math operations like adding a column and putting the total at the bottom. *LazyTab* lets you adjust the tab settings in documents you've already written, *LazyDraw* lets you create simple graphics that can be printed along with the text on a compatible dot matrix printer, and *LazyMerge* lets you merge names and addresses from its mailing list

file with form letters. Finally, there is *LazyFont*, a program that lets you print your documents in special typestyles such as Futura, Greek, or Gothic. *LazyFont* also lets you design your own typestyle and use it instead of the style that came on your printer. (The program works with several of the Epson models).

You could spend several paychecks on *Lazy* software. David Welsh and his wife Theresa Welsh have done an excellent job of writing good programs and packaging them with understandable documentation. Getting *Lazy* could be a step in the right direction.

CP/M Word Processors

Radio Shack has announced that CP/M will be available for the Model 4 as an alternative disk operating system. Thus far, it isn't available, and we couldn't find out enough details about how the Model 4 version of CP/M will work to hazard a guess about which of the CP/M word processing programs will work. But there are some outstanding word processing programs written for computers that run CP/M. Rather than reviewing programs that may not run correctly, we will provide brief reviews of several CP/M word processors we consider outstanding:

WordStar—A powerful wordprocessor but very difficult to learn. It is probably the best-selling CP/M word processor today.

Peachtext—Another powerful CP/M word processor, this one is easier to learn and comes with a good manual. *Peachtext* is a modification of *Magic Wand*, a program we liked when we used it several years ago on a Radio Shack Model II computer.

Spellbinder—This program doesn't get as much attention as the two named above, but we used it to write this book and feel it is one of the easier programs to learn to use, yet is as powerful as *WordStar* for our applications.

Each of these programs costs several hundred dollars and is designed primarily for very heavy duty word processing in a commercial or professional environment. For many applications, including commercial and professional ones, you may be able to use a program written specifically for the Radio Shack computer and do quite nicely. And you won't need to buy another operating system (CP/M).

Spelling and Grammar Checkers

Spelling and grammar checkers are helpful *add-ons* for your word processor. Spelling checkers look through your document and compare your spelling to thousands of words in the program's spelling dictionary. If you have used a word not listed in the dictionary, the program shows you the word and lets you change it, leave it alone, or enter the word into the dictionary.

Grammar checkers examine your sentence structure and make suggestions for improvements. Some grammar checkers also look for misplaced parentheses, quotation marks, or other incorrect punctuation and even alert you to sexist language.

Several companies have spelling or grammar checkers that work with documents written with word processing programs on the Model 4. Radio Shack's *Scripsit Spelling Dictionary* ($149.00) can be used with either *Scripsit* or *Superscripsit*. The program contains over 73,000 words, and you can add 2045 more.

Aspen Software Company sells an excellent grammar checker for use with *Scripsit* or *Superscripsit*. The program is called *Grammatik* and costs $75. *Grammatik* checks writing style, offers suggestions, and looks for typographical errors. It will also check for phrases most editors feel are poor or wordy, and compiles statistics about word and sentence length.

The Prosoft Company sells a very good (and very fast) spelling program for use with *Newscript*. It's called *Electric Webster* and sells for $149.50. A grammar checker can be added to the spelling program for an additional $39.95. The spelling program contains a 50,000-word dictionary and can be used without leaving the *Newscript* word processing program. The grammar checker looks for misplaced punctuation, long or awkward sentences, commonly misused words, and other common grammatical errors.

CHAPTER EIGHT

Business Applications

The two primary business uses of personal computers are in small business and for managerial tasks. The TRS-80 Model 4 is a good managerial computer and an adequate small business computer. Radio Shack manufactures two very good small business computers, the Model 12 and the Model 16, so we will concentrate on managerial applications of the Model 4. And we'll discuss business uses at the end of the chapter.

Before we start, there are several things you should know about the Model 4 as a business or managerial computer. First, you'll need some extra equipment. Managerial programs tend to be memory-hungry and to need computers with disk drives. So you'll probably want to buy at least the single-disk-drive version of the Model 4 with 64K of memory. We recommend the two-disk-drive version with 128K of memory. Some applications may require more floppy disk drives or a hard disk drive. Many managerial applications will require a modem, and a printer may be essential.

You may also want to investigate the use of CP/M on the Model 4. CP/M is a popular operating system for business computers. Thousands of business and mana-

gerial programs are available for computers that use CP/M. If you talk to your local Radio Shack dealer, you may be told that the Model 4 will run CP/M but "it's not ready yet." A computer that runs a good standard version of CP/M is certainly a useful managerial and business system. The Model 4 has the display format that matches the format used in most CP/M software (24-by-80), and it uses a CP/M-compatible microprocessor, the Z80. If Radio Shack and others supply many CP/M programs in a disk format that works on the Model 4, the computer will be more usable. There are still too many question marks about the *soon to be available* CP/M for the Model 4. It may be great for people who want to use some of the thousands of CP/M programs, but it may be more trouble than it is worth.

THE MODEL 4 AS A MANAGER'S COMPUTER

If you are a manager, you know the importance of information. If you can control and manage information better, you're likely to be a better manager. There are many different ways you can use the TRS-80 Model 4 to help you manage your business. We expect that telecommunications will be an extremely important managerial tool in the future. It is already helping managers communicate better and faster. If you plan to use your computer for telecommunications, we strongly suggest that you read Chapter Six. Pay particular attention to the comments about *The Source*. *The Source* has an option called *Management Contents* that's well worth the price of admission. It helps you research most of the popular business magazines and can even give you short abstracts

of articles. In one session of using *Management Contents*, you may be able to save enough time to pay for both your TRS-80 Model 4 and *The Source* subscription. Better yet, you will probably find things that you would have missed using any other method.

Most of what you do as a manager is concerned with either planning or word processing. We talked about word processing in Chapter Seven, so in this chapter we will concentrate on planning. In planning, your main concern is projections. You want the answers to questions like "What will happen if sales increase by ten percent?" The answers to questions beginning with "What if" can help you make decisions about the future.

Enhanced VisiCalc

The most useful managerial tool for small computers is probably the electronic spreadsheet. A spreadsheet analysis is tedious *if* you are doing it manually. But spreadsheet programs are available for nearly all small computers and have very wide use. You can avoid much of the tedium with your Model 4 and an electronic spreadsheet called *VisiCalc*, the first program of this type for personal computers. It became popular for business and has been adapted for many small computers. The current version for the Model 4 is called *Enhanced VisiCalc* and can be purchased at your local Radio Shack computer store for $199.00.

Accountants and others who analyze finances have been using spreadsheets for a long time. A spreadsheet is simply a rectangular worksheet with rows and columns of numbers. The most basic example of a spreadsheet is a column of numbers with a total.

Now what happens when one of the numbers is changed? The total is wrong! If you are doing your work

by hand and you change several numbers, you may have to recalculate the entire column. The larger the number of rows and columns on the work sheet, the more complicated it becomes to change any one number. Imagine how many hours of work would be involved in changing and updating a complicated financial forecast.

Electronic spreadsheets simply do the same thing hand made spreadsheets do, with the computer doing much of the work you would probably consider tedious and repetitive. In fact, if you have *VisiCalc*, most of what you have to do is get the numbers and information into the electronic spreadsheet. After that, simple commands tell the computer to rearrange the information in almost any way you want.

For example, assume that you are a district sales manager for a large company. You have been asked to prepare a sales estimate for the next fiscal year that gives three different levels of performance. You supervise twenty-five sales representatives, your company has 350 products ranging in price from $3.95 to $225, and you have nineteen different discount plans. Your regional manager wants your sales estimate by next week, and you just found out about it today. You have two choices: get a Model 4 and *VisiCalc* or get a different job! Believe it or not, you could probably do that complicated sales analysis in a single afternoon with *VisiCalc*.

How does *VisiCalc* do all this? Your computer screen becomes a window showing you a certain section of a giant spreadsheet made up of 255 rows and 63 columns. This window can be moved around with the direction keys on the computer so you can look at any portion of the spreadsheet. The screen can even be split so you can see two different parts of the spreadsheet at one time—a big help when you want to make comparisons. You can ask the computer to search for certain kinds of in-

formation, do some calculations, and show you the result. You can also find out what is in any portion of the worksheet at any time.

Once you have entered a formula, you never have to enter it again. You can copy formulas, headings (or titles), and numbers into as many columns as you want. Using our sales estimate as an example, suppose you want to show what would happen if ten of the sales reps had a twenty-five-percent increase and all the others had a five-percent decrease. All you have to do is tell the computer to multiply your first results by either twenty-five percent or minus five percent. The computer does all of the calculations.

A program that will do as much for you as *VisiCalc* takes a while to learn. But if you have to do any kind of financial projections, your time and effort will be very well spent. Even though you can get started quickly, it will take some practice before you can take full advantage of all of the things *VisiCalc* can do.

VisiCalc is so popular among small computer owners (sales of over $35 million) that a whole industry has grown up around it. In addition to programs that do the same type of work, there are many products that help you get the most from electronic spreadsheet programs. Padware Limited has a unique product designed to help you use *VisiCalc* more effectively. *CalcPad* ($10.95 for fifty sheets) is a sheet of paper designed to help you plan how you will use *VisiCalc*. These sheets could be a big help in getting the most out of your spreadsheet program. We find it interesting that the computer has made paper-and-pencil spreadsheets obsolete, but a paper-and-pencil planning sheet is the next development to help you use the electronic spreadsheet effectively!

VIZ-A-CON

VIZ-A-CON is a $99.95 disk program from Abacus Associates and is intended to supplement *VisiCalc*. You must have *VisiCalc* to use this consolidation program. It is designed primarily to make it easier to consolidate data. With it you can *roll up* days into weeks, weeks into months, departments into divisions, divisions into companies, or do any other consolidation of *VisiCalc* data. In addition, a custom-formatting feature allows *VisiCalc* with *VIZ-A-CON* to act as a report writer.

Visigraph

Visigraph is a handy program for printing out graphs and charts from data generated by *VisiCalc*. The program is available on diskette from Micro Software Systems for $89. It works with the Epson MX-80 and MX-100 and other popular printers. This is a complex program that you will probably not be ready for until you are very familiar with *VisiCalc*.

QuickCalc

One problem with the *very* large and *very* good spreadsheet programs like *VisiCalc*, is that they are *very* expensive. That's not so bad if you're really sold on what they can do for you. But if you are still wondering, it may hurt to spend $200 just to find out whether this is really for you! *QuickCalc* offers you an alternative. It's a type-it-in-yourself program that can give you some spreadsheet capabilities free! *QuickCalc* is by Kurt Leafstand and is listed in the October 1982 issue of *80 Micro*.

QuickCalc can help you make sales projections and perform some complicated calculations on your latest sales records. It gives you an 8-by-14 matrix of rows and

columns. You can move the cursor around on the screen with the computer's arrow keys. When you want to assign a value to a location in the matrix, you just position the cursor over the spot and type in the information. A program like this has many limitations; one of the most obvious is that it will only handle numbers and not words or letters. Despite this there are a number of interesting and useful things *QuickCalc* can do for you.

- You can get the total of the values of any series of locations. For example, all of the top row or all of the first column.
- You can get the average for any series of numbers.
- You can try different values on your data to get projections.
- You can see certain data organized in a graph, and the graph can be printed.

QuickCalc won't do all that *VisiCalc* will do, but it provides a quick and inexpensive way to get started. A program like this could give you a good idea as to whether you could use a more expensive spreadsheet program.

Profile III Plus

Profile III Plus is an electronic filing system designed to help managers keep track of data. The program is available from Radio Shack for $199 and comes on two diskettes.

Radio Shack advertises that you need no computer experience to use *Profile III Plus*. This is a bit of an exaggeration. The manual is good in most places, and a beginner could probably set up a useful filing system by studying it intensely. The system is powerful, however, and therefore complex. You'll need experience to get the most out of this program.

It's difficult to give you guidelines about how much can be stored in *Profile III Plus*, because that depends on so many different variables. The program divides data into *records*. Each record contains all the data on one item, such as a customer account, club member, mailing label, or inventory item. The program will allow you to type in up to 1,020 characters for each record in the file, but only 255 of these can be used for sorting and searching. If you used no more than 255 characters for each record, you could store about 250 records on the disk in drive 0 and about 600 on the disk in drive 1. That should be plenty for most purposes.

As an example, assume you are the manager of a large staff of retail sales reps. You are interested in starting a file of all customers who have purchased anything from any of your sales reps within the last five years. You use *Profile III Plus* to create the file system, entering each client's name, the name of the sales rep who handled the account, the date of the last purchase, the amount of the purchase, and the name of the products purchased.

It takes about four hours to create the filing system and enter the above data for 100 customers. Once that data is entered, you can get printouts of the information in many different formats. For example, if you want a list of sales made in the last four months, organized from the largest sale to the smallest, it is easy to get. If you need a list of sales organized by date, beginning with the most recent, you can get that in a few minutes. You could also have *Profile III Plus* print out all the sales of a particular rep or of a particular item or type of item. It takes a while to set up *Profile III Plus*, but once the format is designed, entering data is quicker than filing it in a filing cabinet, and generating special reports takes hours instead of days.

Profile III Plus is a very good electronic filing system. It can perform both simple and complicated tasks for you.

You can use it with Radio Shack's *Superscripsit* word processing program to produce form letters, and with *VisiCalc* if you need to include data from that spreadsheet in your file. A variety of supplementary programs are available to use along with *Profile III Plus* to allow specialized printing and editing procedures.

Prosort, for example, is a supplementary program for *Profile* and is available from The Small Computer Company. The two disks of programs and a large manual are $150. This program gives *Profile* more sorting and selection power and makes it possible to do some types of searching through the database that are not possible with *Profile*. The program also adds some calculation options.

ENBASE

ENBASE, sold by Allen Gelder Software, is a general-purpose data manager with two advantages. First, it is cheaper than most other data manager programs. Second, it is easier to use than most. Some data managing programs are so difficult to learn that they are almost like learning a programming language. *ENBASE* comes with a well-organized instruction manual that gets right into the heart of things by showing you some good examples of what the program will do.

Imagine a notebook in which you can jot down any item of information. You could put down numbers, words, facts or sentences. You might even have some information that relates one item of information in your notebook to another. Now imagine that this notebook is electronic, so you can rearrange your notes by giving the computer simple commands. You can also find your notes quickly and easily without endless searching back through every page.

You can use *ENBASE* in the following ways:

• *Customer Files*. You can keep track of names, addresses, mailing dates, subject of initial contact, purchase history.

• *Sales*. You can see a report on present orders and outstanding accounts.

• *Purchasing*. Supplier addresses, discount rates, and various products can be seen in a report format.

• *Real Estate Accounts*. You could get a list of properties with the characteristics and prices included.

The real working power of this type of data-manager program is that you can have the computer rearrange the information and organize it into the type of report you want. It can even combine various reports and form new relationships with the information in the reports. In this way you can get new reports that are actually combinations of single reports you have generated in the past.

Graphics

The old saying "One picture is worth a thousand words" is still very true in business. Well-organized, sharp color charts and graphs are an essential part of everything from selling products to motivating employees. Graphics software packages designed to help the businessperson design and produce pie and bar charts are available for most small computers. With the right kind of software and hardware, those color charts and graphs that used to take hours or days can now be done quickly and easily on the computer. When using the computer in this way, the screen becomes a drawing pad, and the printer or plotter gives you the final copy. With the right printer or copier, you can even get transparencies in full color.

The TRS-80 Model 4 is at some disadvantage in the area of color graphics since it doesn't have color, but it

can still be programmed to give a color plotter instructions to draw color charts and graphs. Radio Shack now sells a *Business Graphics Analysis Pak* for $174 that will let you do that. With this software package, you can make pie charts, bar graphs and scatter charts. The great advantage of using a graphics software package is that the software does much of the work for you. It already knows how to draw a pie chart, for example, and all you have to do is tell it things like how big, what color and what proportions. The program then does the rest and shows you the results. You can change whatever you don't like and take another look. When your chart is just the way you want it, you can tell the computer to print it out on either regular paper or on a transparency, providing you have a *multi-pen plotter*. These plotters have four pens containing different colored ink. Chapter Three has more information on graphics and the plotters available for the Model 4.

Business Mailing List

Mailing list programs are very common and are available in many different versions from several companies. This Radio Shack version (diskette—$99.95) stores, alphabetizes, sorts, and prints out mailing labels. It handles names, addresses, telephone numbers, and other related mailing information, and includes quick and easy ways of looking up information.

The program is actually five different programs. In order to use *Business Mailing List*, you enter disk BASIC and run the SETUP program. You are prompted for the name of the list to be created and asked to select either compressed or expanded record format. If you choose compressed format, you cannot enter as many characters in each address line, but the program will handle more

addresses than if you choose expanded format. In compressed format, the program will handle 990 names with two disk drives or 2,970 names with four drives.

After entering the return address, you can enter titles for up to eight mailing categories, for example, eight different states, or types of product purchases, or typical sizes of orders. It's important that you choose your categories wisely, because you can use them to get a list or to print mailing labels by category. For example, you might want mailing labels only for customers located in Texas. Or you might want labels for customers who have spent over $5,000 per month. Choose categories that will be useful later. If the situation changes, you can modify the categories later.

After you have set up the mailing list system (*initialized* it), you are shown a display of the data you typed in so that you can make sure it is correct. You can correct any errors at this time. You are then ready to begin typing in the addresses.

This is an extremely simple program to use, and the documentation is excellent. Some critics have suggested this program really isn't needed because *Profile III Plus* can be used to do the same things. That's true. But if all you need is a way to print mailing labels, you certainly don't need *Profile III Plus*. That would be like shooting squirrels with ballistic missiles!

Radio Shack's *Manager Series*

There are three separate packages in this series, each priced at $99.95. *Time Manager* is a personal calendar and electronic notebook. You can use it to remind you of each day's appointments and to keep track of your expenses on trips. If you know you have an appointment with Jones sometime in the next week, but can't remem-

ber the day or time, you can have the program search for "Jones." When the entry is found, all the information will be displayed.

Project Manager allows you enter project variables such as time, sequence, personnel, materials, or resources. If you have *Time Manager*, important dates from your project will appear there automatically.

Personnel Manager allows you to keep track of information on your employees. You can enter salaries, schedules, business contacts, and clients. You can do searches by these and other categories to prepare mailing or telephone lists.

Other Business Software from Radio Shack

Radio Shack markets a variety of business packages. We can't discuss all of them in a single chapter, but there are several you may want to consider. You can see a demonstration of them at your local Radio Shack store.

General Ledger is a disk program for small businessmen that sells for $99.95 and allows you to keep up with 100 accounts. *Inventory Control* ($99.95) keeps records on your inventory up to 100 items. *Accounts Payable* ($149.95) prints checks and analyzes cash flow. *Accounts Receivable* will handle up to 300 customers with 1000 transactions per month. The company also sells a payroll program ($200), business checkwriter program ($150), and an inventory program designed specifically for manufacturers ($200). Radio Shack has also developed sophisticated programs for farmers and investors. Their *AgriStar* system sells for $200 and gives people in agriculture access to many different types of information over the phone. (See the chapter on telecommunications for more information on how information networks work.)

More Business Software

Investors may also find the Standard and Poor's *Stockpak* ($50) and the *Disk Trendex* ($60) program useful. *Stockpak* keeps track of a stock portfolio of up to 100 different securities. It also has a database of information on the past performance of 900 stocks. The program can be used to create reports and analyze data on stocks to assist you in making buy or sell decisions. *Trendex* helps you chart trends in stock performance and predict future performance based on a statistical analysis of performance to date.

Autotrak is a free program by Robert Lloyd listed in the October 1982 issue of *80 Micro*. If you're in charge of putting together expense reports for up to ten company vehicles, this program's for you. You can enter records of cost for each car for gas, oil, tires, battery, lubrication, exhaust system, wheel alignment, brakes, and belts or hoses. You can create ten more categories of your own choosing. The program will also let you print the data when you want a report.

Other Sources of Information on Business Software

If your business and managerial software needs are similar to those of other people in your position, you can probably find most of the software you want at a local Radio Shack store and in ads from magazines such as *80 Micro* and *Basic Computing*. If your needs are relatively unique, you may find programs in *TRS-80 Applications Sourcebook*, a fat directory of software Radio Shack publishes for its computers. It lists over 4000 different programs, many of which will run on the Model 4. The

listings don't evaluate the programs however, and many are pure junk. We suggest you write for more information before ordering a program, even if it sounds as if it does just what you want.

CHAPTER NINE

The Model 4's Programming Languages

The TRS-80 Model 4 in your home or business understands several computer languages. No, it doesn't converse fluently in French or Spanish, but it does understand a language called BASIC, as well as PILOT and Pascal. The concept of a *computer language* is difficult for new computer owners. What is a computer language, and what role does it play in the computer?

The first thing you should know is that computer languages serve much the same purpose as human languages—as a means of communication. Consider the way two people communicate. For the moment, assume you are a cooking instructor. Today you are going to teach a student how to cook a souffle. Because you and the student both speak English, you can give your instructions in English. This means English is your language, or medium of communication. The information you communicate to the student in English is a specific, step-by-step set of instructions. *Recipe* is the special term used to describe such a set of directions when you are cooking.

If your student speaks French, and you speak only English, you may have a very strange looking souffle!

To get what you want, there must be a common language between the two of you. The same thing can happen with a computer. Computers like the Model 4 speak their own set of languages. Computers cannot learn English, so you will need to learn one of the languages the computer understands. When you learn a computer language like BASIC, you can communicate with the computer much as a master cook communicates with a student. Instead of communicating recipes, you will give the computer *programs*. A computer program is an organized set of instructions that tell the computer how to accomplish a particular goal. All the programs reviewed in this book are really instructions someone has written to tell the computer how to do a job. Programs, like recipes, are created by humans.

Learning to program a computer is not something everyone should do. Learning how to use the computer to do a job or play a game is just as honorable a goal as becoming an experienced computer programmer. Learn to program the computer only if you find programming interesting.

LEVELS OF COMPUTER LANGUAGE

Suppose you are thinking of learning a second human language. If your first language is English, some languages, like French and Spanish, are similar to yours. Others, like Greek and Latin, are not as similar, but contain some elements familiar to a person who speaks English. Still other languages, like Japanese and Chinese, are so different that few elements will be familiar to you. To learn Chinese, you need to learn a completely new alphabet that bears no resemblance to the one you learned

as a child. In addition, the way information is organized is quite different.

If you decide to learn a computer language, you will find the analogy relates. Some, like BASIC, are not exactly English, but there are enough similarities so you don't feel completely abandoned by your native tongue. Others, like FORTRAN or Pascal, are not so much like English, but they still contain some familiar phrases or terms. Still others, like Z80 machine or assembly language bear little resemblance, if any, to English. We would advise you to learn one of the more English-like languages before tackling an assembly or machine language.

Computer languages have two basic parts: the vocabulary and the rules for using the vocabulary. These rules are usually referred to as the grammar. The word PRINT, for example, is a part of the vocabulary used in the Model 4's BASIC. When the computer finds this word in a program, it looks for material to display on the screen. A rather extensive set of rules tells you how to organize and punctuate the material after PRINT. These instructions tell the computer exactly how you want your material displayed on the screen. However, it is relatively easy to remember that PRINT is one of the words in the vocabulary of BASIC and to remember what PRINT tells the computer to do. Things are not so easy with some languages.

High-Level Languages

BASIC is only one of several languages that make up the category of *high-level languages*. High-level computer languages like BASIC use English-like words and work with decimal numbers (the type we learned to add,

subtract, multiply, and divide in grade school). While the other two families of languages, machine and assembly languages, are written specifically for a particular *computer*, high-level languages are often developed for a particular *purpose*. One of the older computer languages, FORTRAN (FORmula TRANslator), is the language most used by universities and scientists. COBOL (COmmon Business Oriented Language) is a popular business language, and BASIC (Beginners All Purpose Symbolic Instruction Code) is the best known of the easy-to-learn general purpose computer languages. Every popular personal computer sold today understands at least one, if not several, dialects of BASIC.

The BASIC in the Model 4

BASIC is the first computer language most people learn because it's easy to learn, it's powerful, and it comes with the computer. Most programs for the Model 4 published in magazines are written in BASIC—another reason to learn this language first.

There are many critics of BASIC today who feel some other language should be the first one most people learn. They criticize the fact that the language allows people to write rather disorganized, sloppy programs and still get them to work. They prefer languages that force the programmer to be more structured and systematic. We like BASIC. Our desks are a mess most of the time, and our programs tend to develop more like weeds than carefully planted rows of corn. Perhaps BASIC fits the less formal, less systematic way we do things.

There must be a lot of sloppy programmers out there, because BASIC is as close as we have come to a universal programming language for personal computers. Computers from Atari, Apple, IBM, Mattel, Radio Shack,

and many other manufacturers all understand BASIC.

One fly in the BASIC ointment often creates a problem for beginners. Although some of the older languages like FORTRAN are now reasonably standardized, thanks to the work of ANSI (American National Standards Institute), the ANSI standard for BASIC is relatively new and has, in many cases, been ignored by manufacturers. That means a program written in the BASIC used by the Commodore 64 may not run on the Model 4 because the two computers understand different versions of BASIC. Fortunately, Radio Shack has seen fit to use a Microsoft BASIC in the Model III, 4, II, 12, and 16. Microsoft is the world leader in quality BASICs for small computers. Because Radio Shack used a Microsoft BASIC in the Model 4, the time you spend learning BASIC on it will help you if you ever have to write BASIC programs on another computer that uses a Microsoft BASIC (for example Apple or Commodore). Around eighty percent of the vocabulary and grammar of the Model 4's BASIC is the same as it is on other Microsoft-compatible computers. The differences are caused by the differences in the machines. For instance, BASIC for the Color Computer is different from BASIC for the Model 4, because the Model 4 doesn't have color.

Numerous dialects of BASIC sold by third-party software companies will run on the Model 4. But unless you have a very special need, you are safe to assume that the version of BASIC used in the disk version of the Model 4 is as good as any. One advantage to some versions of BASIC over Radio Shack's *TRSDOS BASIC Version 6* is speed. Some BASIC language programs are called *compiler programs*. A compiler program translates the instructions of a program written in BASIC back into machine language all at one time. The program, now in machine language, is then stored. When you run the

program, it runs very fast. *TRSDOS BASIC Version 6* on the other hand, is a *interpreter program*. An interpreter program translates the BASIC instructions to machine language as the program is running. The program is always stored in BASIC. Language programs that use interpreters are easier to work with than those that use compilers, but the interpreter programs are slower.

Several BASIC language programs use compilers instead of interpreters. Radio Shack sells its own version called *Compiler BASIC* for $149, and PDC Systems sells their *BASIC Compiler* for $225. The PDC System version has some features that the Radio Shack version doesn't, but the question you usually have to ask yourself is: do I need all of those things? The answer, of course, depends on how serious you are going to get about programming. Another company, Excalibur Software, sells a BASIC compiler called *Beyond BASIC*, which is actually a family of sophisticated languages (some interpreters and some compilers) that give you more programming bells and whistles than most people will ever need. The languages are reasonably priced, from $30 to $90, depending on the version you buy.

PILOT

PILOT was developed by John Starkweather because he felt BASIC let you manipulate numbers but was weak in manipulating words and symbols. PILOT, which is short for Programmed Inquiry Learning or Teaching, was intended to be a specialized language for educators who wanted to create teaching programs. Over the years, PILOT's popularity has grown, and it's now probably the second or third most popular computer language. PILOT is easy to learn, even easier than BASIC, and it can do many of the same things. Radio Shack's version of PILOT

is called *TRS-80 MicroPILOT*. It sells for $119.95 on disk.

FORTRAN

FORTRAN is popular with people who work with mathematical formulas. In fact, the name FORTRAN stands for FORmula TRANslation. The Radio Shack version of FORTRAN sells for $99.95 on disk and contains three systems: an editor, a compiler and a linker. You use the editor to write and edit FORTRAN programs, and the compiler to translate the FORTRAN program back into machine language so the computer can understand and carry out the instructions. The linker links a FORTRAN program with one or more special subprograms that come with the software package. These subprograms, or subroutines as they are called, are short programs you use frequently. Because they are preprogrammed and stored on the program disk, you don't have to recreate a subroutine every time you need to use it.

While FORTRAN has been popular for use on large computers for scientific and mathematical applications, its use with personal computers like the TRS-80 is limited. Some people will want to use it because they know it and can't quite get comfortable with another language. Others will want to use it because it is faster than BASIC or any of the highly specialized languages like PILOT.

Pascal and FORTH on the Model 4

Support for these languages comes from experienced programmers who want to make it easier to write high-quality well-organized programs. Both are very powerful

languages. However, they are not languages we would recommend for first-time programmers. They are more suitable for the person who has decided to get serious about programming and wants a language that, though difficult to learn, is more useful to the experienced programmer.

Radio Shack does not sell a Pascal language program, but there are several available. If you are interested in programming in Pascal with the TRS-80 Model 4, we suggest *TSC Pascal*, $200 from Frank Hogg Laboratory. Another Pascal language program that is widely used and will probably become popular with Model 4 owners is the *UCSD p-System* sold by PCD Systems. The UCSD part of the name means that it is a dialect of Pascal developed at the University of California at San Diego. It can cost as much as $650, but if you want to use Pascal for serious programming it might be the place to start. The Model 4 version of *UCSD p-System* Pascal requires no additional equipment. (The Model III version comes with an *Upgrade Board*, which you must install in your computer.)

The popularity of both Pascal and FORTH is increasing. You can find out who is selling the latest versions of both languages by looking through the ads in a current issue of *80 Micro*.

COBOL

COBOL is a popular language for large computers. It is intended for serious business applications. Some computers, such as the TRS-80 Model 4, can run COBOL. Radio Shack sells a compiled version of COBOL for $199.

Machine and Assembly Languages

The computer understands only one language: machine. Machine language is not a single language, however. Each computer chip has its own set of instructions built in by the designers. Instructions given the computer in any other language than its own machine language must first be translated into the machine language used by the microprocessor chip or CPU. The Model 4, which uses the Z80 microprocessor, can understand BASIC only because Radio Shack put a BASIC translator (called an *interpreter* in computer jargon) in the computer's permanent memory (ROM).

Although much of the software in a computer's ROM was written in machine language, most beginners will want to leave that language to the experienced programmer. It is hard to use, tedious, and time-consuming. To use it you would need to study Z80 machine language and have a clear understanding of just how the Model 4 is put together. The machine language for the Model 4 also uses unfamiliar number systems (hexadecimal and binary) instead of decimal. Here is an excerpt from a machine language program:

```
7F06    A5    12       LDA
7F08    F0    03       BEQ
7F0A    4C    00 BF    JMP
```

It takes tens of thousands of machine language instructions to perform even a simple job like keeping track of a list of names for mailing labels.

In between BASIC and machine language is something called *assembly language*. One of the most trying things about machine language programming is the fact that the

symbols used for the instructions are numbers, and not even decimal numbers at that. They give the human no indication of their meaning. Unless you memorize the numbers and their meaning, programming in machine language can be boring and slow-paced, punctuated by searches through the table of instruction codes. Assembly language has letter patterns that give a hint of what the instructions do. LDA in the example above stands for Load the Accumulator, for example. LDA, BEQ, and JMP are actually assembly language instructions that would not be shown in a pure machine language program. We recommend you put off learning both these languages until you are comfortable with one or two high-level languages.

There are advantages to programs written in machine or assembly language, however. They operate much faster than programs in BASIC, and once they are written, the actual program does not require as much memory as a BASIC program that does the same thing. Speed is sometimes necessary in a program (for instance, in a video game that uses animated color graphics), and then it will probably be written in something other than a high-level language. If you need speed or economic use of memory, machine and assembly language may be your cup of tea.

Your TRS-80 Model 4 computer is not ready to be programmed in assembly language when you turn it on. You will need to buy a software package for that. Software packages that allow you to program the TRS-80 Model 4 in assembly language are usually called editor/assembler packages. You will be able to write and edit programs in assembly language using the keyboard of your computer, and you will be able to see what you are writing on the computer screen. The software also contains a program that will change your instructions written in assembly language to machine language.

Often these editor/assembler packages contain other special programs as well, like short programs already written in assembly language that can be easily included in any assembly program you are writing. These short programs are called subroutines and are written to do things many programmers will want the computer to do, for example, a subroutine that will alphabetize a set of words. If an alphabetizing subroutine were included in an editor/assembler package, you could simply add it whenever you wanted to use it without programming it in yourself.

You can go down to your local Radio Shack Computer Center and buy the *Editor/Assembler, Series I*, for $34.95. This package has all the basics but not all the features you could get if you spent more money. A more expensive editor/assembler is the *MZAL* sold by Computer Applications Unlimited. *MZAL* stands for Modular Z80 Assembly Language. This piece of software costs more—$149—but you can do much more with it. Both of these software packages consist of floppy disks and instructions manuals. In order to use them, you will need to have a disk drive system in your Model 4 computer.

The Special Case of CP/M

The Model 4 will run something called CP/M, short for Control Program for Microprocessors. CP/M is an *operating system*, which means it controls the operation of all the elements of the computer system, including the disk drives. It was not written for a particular computer. Instead, there are versions of CP/M for hundreds of different computers. That is an important point for software developers because they can develop software that runs under the control of CP/M and sell it to owners of many

different computer models, so long as the computer can operate under CP/M control. A program written for the TRS-80 Model 4 or the Apple II will not run on a Panasonic or Coleco computer, because the operating systems that control these computer systems are different. However, with CP/M one program may well run on 200 different models with little or no modification.

Thousands of programs are available, most of them for business or professions, that run on CP/M computers. If you buy CP/M for your Model 4, you can run some of those programs. The problem is no one knows for sure when CP/M will be available for the Model 4. It is *announced but not yet available*.

Not all CP/M's are created equal, either. One family of CP/M software is for the smaller, less expensive machines that use CP/M version 2.2 or CP/M-80, and another family (CP/M-86) that runs on newer, more expensive computers like the IBM PC. You will not be able to use CP/M-86 programs on the Model 4.

Some Special Tools for Programming

Computer languages, like computers, can be thought of as tools. The question of what tools you need and why, can only be answered when you know what job you want to do. As you have seen, a good variety of languages are available for the TRS-80 Model 4. Whether for fun or for work, hopefully both, you should be able to do as much programming as you like. There are many other programming tools available in addition to the language programs themselves. They are designed either to give you short-cuts in programming or to speed up your program once you have written it.

Prosoft sells two programs designed to make BASIC

programs run faster on the TRS-80 Model 4 computer. *Trashman* is available for $39, and *Faster* costs $29. These programs are stored on floppy disks and have to be transferred to the disk that contains the BASIC program you are running. They will have little effect on a short program. However, on a long program you will notice that your program runs faster when either or both of these programs has been added to yours.

Software of the Future, Inc. sells a product called *The PRODUCER* that helps you organize and design programs written in BASIC. It shortcuts the actual programming process. By shortcut we mean you will be able to use one instruction to accomplish what would otherwise take a series of instructions. This program is more useful for the professional programmer than for people just getting started. Programs like *The PRODUCER* are difficult to understand if you are not already experienced in BASIC or some other language. If you are an experienced programmer looking for some specialized tools to add to your programming tool kit, *The PRODUCER* could be of value to you. It sells for $149.95.

Remember, you need not learn to program the computer at all to use its power. But programming is a pastime many people find both fascinating and fulfilling. With the Model 4, you have a wide range of programming languages from which to choose.

CHAPTER TEN

Peripherals

This chapter could have been called ways to spend your money. When we talk about peripherals, we are simply talking about the extra pieces of hardware you can buy for your computer to get it to do different jobs. Remember when you last looked at new cars? The first price the car salesperson quoted you was just for the bare-bones car. Then the salesperson started telling you all the things that went along with it. Each item made the car a little nicer, and each one had a price tag.

When it comes to peripherals, the TRS-80 Model 4 computer is a good buy. With some computers, buying the basic computer is a little like buying just the frame and drive train of a new car. Maybe you could start it up and listen to it purr, but there wouldn't be much else you could do with it. Some computers with low price tags have been stripped down to the bare essentials, and you have to spend one or two times as much on peripherals as you did on the computer to get it to do anything. That isn't true with the Model 4. Even the $999 cassette version will do lots of work with no more than a $60 cassette recorder.

Computer peripherals can be put roughly into seven groups:

- Input devices
- Memory
- Output devices
- Devices for both input and output
- Mass storage devices
- Interfaces

The TRS-80 Model 4 comes with more built-in peripherals than the average computer. With the basic system you get a keyboard, which is the most commonly used input device; the central processing unit; some memory; and a built-in monitor, which is the most commonly used output device. You can also buy models with one or two disk drives housed inside the same case that holds the keyboard and monitor. A serial interface can also be added inside the case. Even with all those peripherals, you still have a computer that fits in one case that can be picked up and carried around. It is not really portable; carrying it for more than a few hundred feet is quite an effort, especially if it has the disk drives (they weigh almost as much as the rest of the computer).

There are some disadvantages to having lots of parts all together in one case. You give up some flexibility. You have some limitations you would not have with a component system in which the monitor, keyboard, disk drives, and CPU chassis can be moved about independently and placed where you want them. Another disadvantage is that if one part breaks down, your whole computer is out of order until that one part gets fixed. On the other hand, component systems with many peripherals tend to look messy with all those cables running everywhere, and reliability can be a problem because of loose or poorly wired cables.

You can do quite a bit with a standard Model 4 with few peripherals. You can do even more with a fully-loaded machine with many specialized peripherals. A person who purchased one of each peripheral and accessory available for the Radio Shack computer would probably spend over $250,000. Most of us can't get that involved with the Model 4 and will want to shop carefully for accessories. The remainder of this chapter will help you do that.

INPUT DEVICES

Before we can do much with a computer, we have to be able to get information into it. The keyboard is the most familiar input device. For many purposes it is also the most efficient device for getting information into the computer. When you are doing word processing or writing computer programs, the keyboard is efficient. For other purposes, like drawing pictures on the computer screen, the keyboard becomes tedious to use.

A variety of other input devices with special features are good for doing certain jobs, such as creating computer graphics. You can create some graphics with the standard keyboard but complex graphics are awkward. As a result computer companies have developed a variety of peripherals that make graphics work quicker, easier, and better. The graphics tablet was described in Chapter Two. It is a very good input device for creating graphics.

Joysticks

A joystick is the standard input device for video games. They usually have buttons that can be used to fire rockets

or do other things. Video games and other applications that call for a convenient way of moving the cursor (or your laser cannon) around on the screen are likely candidates for joysticks. Joysticks come in lots of sizes, colors and shapes, and they vary widely in price and special features. Good quality joysticks can be bought from HW Electronics for $39.95 each.

Light Pens

A light pen is a pen-like pointer connected to the computer. By touching the light pen to the computer screen, you can give the computer information. Light pens are used in a variety of ways. One common use is to indicate your choice on a multiple choice test or questionnaire. You could also use the light pen to move the cursor around on the screen. Some programs even let you *draw* electronically on the screen by moving the light pen around.

In order to get the light pen to do these things, you have to have a program that will tell the computer how to do it. You will either have to write the program yourself or buy a software package. Light pens are not as common as joysticks, but are worth keeping an eye on in the future.

Memory

The Model 4 comes with 64K of RAM, enough for most applications. You can add another 64K of memory for less than $150. Model III owners were able to add memory to that machine by buying chips from companies such as B.T. Enterprises and plugging them into the empty sockets on the main circuit board. As long as you use high-quality memory chips and exercise reasonable care when adding the chips, there are few problems. Companies may also offer memory expansion kits for the

Model 4. Generally, memory from non-Radio Shack suppliers costs a half to a quarter of what it does from Radio Shack.

Solid State Disk Emulators

Disk drives are used to store information for later use. They are fast and reliable, but programs that require disk drive access can be slowed down by the operation of the disk system. One way of sidestepping this problem is to set aside some of the computer's memory and let the computer think that part of memory is really a superfast disk drive. The Radio Shack Model 4 has provisions for doing just that when you have 128K of RAM. There are also external disk emulators that plug into the computer. The intent of these devices is to provide semi-permanent storage of large quantities of information. One such device, called the *Interstellar Drive*, will store up to one megabyte of information that can be called up by the computer when you tell it to. This peripheral is sold by PION, Inc., and costs $1,095, which suggests that you only buy this type of addition to your computer if you really need it.

Output Devices

Monitors

The standard output device is a video screen. With many computers, you have two choices on this item. You can either use your TV set, or you can buy a specially built monitor. With the TRS-80 Model 4, you get a monitor built into the computer. For most uses, the built-in monitor that comes with the Model 4 is just fine. Like everything else, in some special cases you might want to add to your Model 4 monitor.

One problem with the Model 4 monitor is that, due to

the way it is built, when words or pictures are changed on the screen, you see a strobing or flickering effect. This is not a problem most of the time, but if you are using the computer for more than three or four hours at one time, your eyes can become very tired. Many computer screens use a special type of phospor to coat the back of the screen. Instead of a white on black image, you get a green on black or an orange on black image. Flicker is caused by using inexpensive television tube phospor, which glows only briefly when the electron beam hits it. That is a desirable feature in a tube that will be used in a television, since the images on the screen change rapidly. You don't want the image of the picture from a second ago still on the screen after another appears. Two other types of phospor, green and amber, glow longer when an electron beam hits them. They cut down on the amount of flicker and are much more gentle on your eyes. With a green or amber screen, you can work many hours in front of your computer without the eye strain of a black and white screen.

The standard screen can be replaced by a green or orange screen. The Langley-St. Clair Instrumentation Systems, Inc., can send you a replacement kit for $79. This company actually has a variety of colors and models to choose from, with the price ranging as high as $139. The kit comes with a good set of instructions that make it an easy task to upgrade your monitor. We installed an amber tube in our Model III computer and were very pleased with it. The screen is easier to read and easy on the eyes. The company now has green, amber, red, and blue versions of their screen for Radio Shack computers. You can even get their replacement tubes with a nonglare finish, an option we recommend if your computer will be in a room with bright lights or if a sunny window is behind it.

The other common complaint about the Model 4 computer is that it has no color. A color display is not absolutely necessary for professional and business applications but can be very useful in recreational and educational computers. We aren't aware of a color video kit for the Model 4, but there were several for the Model III, for from $200 to $400. For that price you can buy an excellent color computer like the Commodore 64. We think that may make more sense for most people. Buying a computer with built-in color graphics capability will let you take advantage of all the programs written for the computer. If you buy a kit that adds color to the Model 4, few companies will have software specifically for that accessory because only a few Model 4 owners are likely to have that color kit.

Printers

One of the first things many computer owners like to add to their basic computer is a printer. A printer lets you edit and correct programs from *hard copy* instead of from the video screen. A printer is essential if you plan to do word processing, and many business applications call for one.

At least 200 models of printers will work fine with the Model 4 computer. The computer comes with a standard parallel printer interface. You can use most printers with this computer simply by buying a cable that connects the two devices. At least eighty-five percent of the printers for small computers are available in a parallel interface version. Some are also available with serial interfaces, the same type of interface used by modems. But we have used several serial printers on our Model III and suggest that you buy a parallel printer if you can. Radio Shack's software assumes you will be using a parallel printer. If

you happen to have one with a serial interface, it can be difficult (sometimes impossible) to get the program to carry on civil communication with the serial printer.

With so many printer models available, we won't try to evaluate each one. Instead we will discuss the major features to look for, describe the two major families of printers, and provide some shopping suggestions.

There are four qualities you should consider when you look for a printer:

- Quality of print
- Speed
- Cost
- Special capabilities such as graphics and plotting

Many printer models available today cost less than $700. In that category you can find a printer that produces very high quality print (like the Smith Corona TP-1), a printer that is very fast (like the Epson FX-80, Okidata 80, and Gemini 10), and printers capable of printing graphics as well as standard characters (Epson FX-80, Okidata 80). You can't get a fast printer (eighty or more characters a second) that prints as well as an office typewriter for $700 or less. The Smith Corona TP-1 mentioned above has beautiful print, as good as an IBM Selectric typewriter, but it does its work at a very slow 12.5 characters per second. In order to get both speed and high quality, you will have to spend closer to $2000 or $3000. If you buy a very inexpensive printer (less than $300), don't expect much in the way of print quality. Most of the printers in that price range produce readable but mediocre print. Printers in the $500 to $800 range often have good print quality, though not as good as an office typewriter.

A few years ago many of the under-$1000 printers used a thermal printing process that required special pa-

per. Thermal printers were disagreeable little cusses and often refused to work just when you needed them most. Today most of the popular models are impact printers. Impact printers work just like a typewriter. The image of a letter is created by a metal or plastic object striking against a ribbon, which is pushed against the paper. The impact leaves an image of a character on the paper. There are two main types of impact printers: *dot matrix* and *daisy wheel*.

Dot Matrix Printers. These printers produce the type of print many people recognize as being printed by a computer. Each letter is formed by a series of dots. The quality of the print varies but is getting better all the time. Some of the newest versions have such a tight pattern of dots that the letters look almost as if they were printed with a typewriter. Since these printers are impact printers, they do not require special paper. The advantages of these printers are that they are cheap and quite fast. The major disadvantage is the quality of print. Since the print does not look like typewriter print, they are not considered *letter quality* printers. The print quality is getting so good now that some people are beginning to use them for writing letters and preparing reports. However, inexpensive dot matrix printers still have a long way to go before their output is considered acceptable in an office environment. The drafts of this book were created on an IDS Prism 80, a dot matrix printer that has two print qualities. It will print in its *draft-quality* mode at 200 characters a second. A higher-quality mode called *correspondence quality* slows it down to 130 characters a second. The Prism 80 costs around $1400. Another dot matrix printer with very high quality output is manufactured by Toshiba but costs around $2000. If you want both speed and quality, plan on spending at least $1200 to $2000 for a printer.

If your primary use is for printing out computer pro-

grams and doing graphics, any of at least fifty dot matrix printers that cost less than $800 should do the job. If you are willing to put up with readable but not great print quality, you can get a printer like the Gemini 10 for under $500. We used a ProWriter dot matrix printer as a backup on this book. It retails for $495 and is available from several discount mail-order companies for just over $400. Radio Shack stores carry a wide range of dot matrix printers with prices starting at about $400 (not a printer to write home about). Their more expensive models are competitive both in price and quality of output. Radio Shack has a habit of putting their printers on sale, which can also save you money. If you plan to use the computer for business correspondence or other word processing, you may want to consider a daisy wheel printer.

Daisy Wheel Printers. This type will print fully-formed letters and characters as clear and crisp as those made by a typewriter (some say better than a typewriter). Each character created by a daisy wheel printer is one solid image instead of a pattern of dots. The daisy wheel printer gets its name from the print element, which looks like a daisy with long petals coming out from a central wheel. There is a letter, number, or character at the end of each petal. The daisy wheel spins around at a very high speed, and when the correct letter is properly positioned, a small hammer strikes it against a ribbon and makes an imprint on the paper.

Until recently, these printers were very expensive ($2000 to $4000). Now they have begun to drop in price and are becoming competitive with the dot matrix printers. The Smith Corona TP-1 is available in many cities for around $550, and several Japanese companies have daisy wheel printers for less than $800. Low-cost daisy wheel printers are very slow, however. Those in the $1000 to $1400 range are a bit faster, usually twenty-five to

thirty-five characters per second. Top-of-the-line models, like the Diablo 630 and models from Qume and NEC, print at speeds from forty to sixty characters per second but cost between $2000 and $3000.

Radio Shack has two models of daisy wheel printers, for $1495 and $1995. Both are made by Ricoh, the Japanese company known best for its 35mm cameras and office copiers. Two of the authors of this book have used a Radio Shack daisy wheel and were very pleased with it. The other had so much trouble with one, he swears never to buy or use another. Poor service and a tendency to break print wheels were the main problems. Print wheels, by the way, are expensive for Radio Shack daisy wheel printers. A wheel for a Diablo printer generally costs $6 to $9. A wheel for a Radio Shack model is $30. Ribbons are also more expensive for Radio Shack printers.

Some Other Considerations. If you would like to use your printer for printing graphics, you will want to buy a dot matrix model since the daisy wheel models cannot be used for that purpose. Many of the specialized graphics programs for the Radio Shack computers will work only with the most popular printers from Epson, C.Itoh, and Okidata.

If you will be using the printer to print long documents (that is, over six pages), you may want to consider seriously buying a *tractor feed* for your printer, if one is not included in the price of the machine. We have never used a printer with regular friction feed that could keep the paper straight when you wanted to print many pages continuously. A tractor feed moves paper through the printer with little teeth that fit into holes in the side of continuous form paper. The sides of the paper are perforated so you can tear off the strip with the holes and end up with a standard sheet of paper.

Finally, most printers can handle paper that is nine

inches wide, but some programs, particularly accounting software, expect you to be able to use paper that is thirteen inches or more in width. You may want to buy a printer that can handle wider paper if you will be using the computer for business accounting.

Spoolers

Computers can send thousands of characters a second, but most printers operate at between 20 and 200 characters per second. That may mean you sit in front of your very fast computer and wait for your slow printer to finish its work so you can continue with yours. Some printers have *buffers* that accept characters as fast as the computer can send them, then the buffer sends characters to the printing mechanism at a slower speed. Printers with buffers generally don't have more than 2000 characters of capacity, however, while one of the chapters in this book has 25,000 to 45,000 characters. If you find yourself waiting on your printer quite often, there is a way of avoiding that. Printer spoolers are devices that accept data from the computer at a very high rate, as many as 40,000 characters in a few seconds. You are then free to continue working on the computer while the spooler sends the material to the printer at a much slower rate. Its main function is simply to free the computer so you can keep on working while your printer works.

A very good printer spooler is the Microfazer from Quadram Corporation. This spooler is both pretty and functional. The cheapest model has a little over 8000 characters of storage (too little for most applications), but you can get it in versions all the way up to over half a million characters! That's plenty. This model also has a copy option that lets you push a button and get another printed copy of the document if you wish. Prices for the

Microfazer start at $169 for the 8K model. A 64K version is $299. A spooler like the Microfazer can also solve your interface problems, because it is available in models that accept parallel input and send serial output to the printer. You could use your serial printer on the Model 4's parallel interface with this device and get spooling as a bonus. Another very popular printer spooler is MicroSpooler available from Consolink Corp. The MicroSpooler sells for $199 for a 16K model and can be expanded to 64K capacity.

Speech Synthesizers

When a computer is equipped with a speech synthesizer, it can convert printed words into spoken words. Keep in mind that this means words spoken by the computer, and the computer has a strange accent. The quality of speech is getting better but still sounds like something from a science fiction robot. Speech synthesis is useful in several different ways. Educational software can give instructions and feedback verbally instead of by printing information on the screen. Children too young to read can use the computer without continuous adult guidance. Visually handicapped individuals can use computers that respond verbally instead of visually, and programs that require you to look at input data (like an inventory analysis program) can give you verbal feedback so you don't have to look at the screen. A computer that *talks* as well as displays information visually is also intriguing and interesting. Your Model 4 won't turn into R2D2 or C3P0, but voice synthesis makes it more like a human.

Street Electronics Corp. sells a good quality speech synthesizer called the *Echo GP Speech Synthesizer* for $299. This is a self-contained box that plugs into the bottom of the Model 4 computer. Another company, Al-

pha Products, sells a less expensive voice synthesizer. The VS100 is available in versions for the Model I, III, and 4, and the Color Computer for $70. The price includes demonstration software and a program that lets you control the synthesizer with instructions in BASIC.

Mass Storage

One of the most urgent needs any personal computer user has is a method of storing large amounts of information outside the computer, so you won't lose all the data in the computer's memory when it is turned off. It is not very practical to spend hours writing a program or doing word processing and then have to start all over the next morning after you turned off your computer. The family of peripherals that handle this problem are called mass storage systems.

Cassette Recorders

Nearly all the first personal computers used cassette recorders for mass storage. They are still quite popular although many computer owners are going to other systems. The cassette recorder has three serious limitations as a mass storage device:

- It is slow. Compared to the speed at which you can type information, the cassette recorder is fast. Compared to disk storage systems, it is very slow. It works fine for some uses, but after waiting five to ten minutes for a program to load or save onto cassette tape, you will start wishing you had a better system.
- It does not have random access. When you have more than one program on a tape, and you want the computer to find and load a certain program, you either

have to find the right place on the tape yourself, or start the tape at the beginning and let it run until the right program comes along.

- Poor reliability. Some dedicated tape users will argue differently, but cassette tape is notoriously unreliable as a storage system. If the slowness of the cassette system doesn't make you covet a disk system, the first time you lose three hours worth of work when you thought you had it all stored on tape will.

Despite the disadvantages of the cassette tape system, there is one major advantage. It is called PRICE! Radio Shack markets its own cassette recorder called the *CCR-81 Computer Cassette Recorder*. This recorder works well with Radio Shacks computers. It has some good features and sells for $59.95. A variety of other recorders will work, and they can be bought for less if you want to shop around. Our experience has taught us that if you are going to use a cassette system, it is a good idea to go with the one made for your computer.

Disk Drive Systems

A floppy disk is a small, usually 5-¼ inch, disk that looks sort of like a 45 RPM phonograph record. It is very thin and can bend easily—this is where it gets the name floppy. Computers can store data magnetically on floppy disks and read that data back into their memories using a disk drive. The biggest advantage of the disk system is that it saves information from the computer and loads it back into the computer many times faster than a cassette. Programs can be found very quickly by the computer, because it doesn't have to spend a lot of time searching as it does with cassette. The disk system is also many times more reliable than the cassette system. Most

of the time when something is lost on disk, it is because of an error made by the user, not the computer. Finally, disk systems can store large amounts of data on each disk.

Disk drives add quite a bit to the cost of a Model 4 but we think they are worth the price for many people. And if you have one, two would be better. In addition to the extra capacity a second drive gives you, you can completely automate the process of backing up disks. You *back up* a disk when you copy the data from one disk to another. With two drives, you can put the disk to be copied in one drive and a blank one in the other. Then you give the computer the backup commands and stand back while it does the job. With one disk drive you must swap the two disks in and out of the drive four or five times to make a backup.

After the Model III computer had been on the market for about a year, several third-party suppliers began offering disk drive kits for it. Companies like VR Data and Percom sold thousands of disk kits to owners of cassette Model IIIs. When Radio Shack was charging just under $1000 for the first disk drive and the circuit boards needed to make it work, you could buy well-designed disk drive kits for $650. That $650 would get you two drives instead of one! In many cities you could get the $650 kit installed for less than $40. We can't be absolutely sure that kits for the Model 4 will be available at prices that save you that much money, but several third-party suppliers say they are busily designing kits for the Model 4. Radio Shack has bundled its disk drive kits with the 24-by-80 column display, however. That may make it more difficult for other companies to design and market a kit that converts a cassette Model 4 with a 16-by-64 display into a disk model with a 24-by-80 display.

Hard Disk Drives

The real Cadillac (or Mercedes Benz) of mass storage is the hard disk system. These are the most technically advanced mass storage peripherals available for small computers. Data is stored on a solid spinning disk sealed inside a case that protects it from contamination. Particles of dust, tobacco smoke, or a spilled cup of coffee cannot reach the stored information. Hard disk systems work much faster than even floppy disk drives, and their storage capacity is measured in terms of millions of characters. They are high-capacity, reliable, and, unfortunately, expensive systems. Most home users will not need the capacity of a hard disk drive. We still use floppy disk systems in our work, although some authors use hard disk drives. Hard disks are more common in businesses where large amounts of data are stored, retrieved, and modified on a daily or weekly basis. The primary disadvantage to these systems is price. They are at least five times as expensive as a floppy system.

For those who really need or just want the best, a variety of hard drive systems are available for the TRS-80 Model 4. Radio Shack's version stores over five million characters (five megabytes in computer jargon) of data and sells for $2,495. Apparat, Inc., sells a hard disk subsystem for $1,995.

Devices for Both Input and Output

The main peripheral in this group is the modem, which allows you to connect your computer with another computer by telephone. The modem connects to your computer, and the telephone connects to the modem. When another information source is connected to the other end

of the telephone line, you can send and receive information with your computer. The primary use of this type of system is in telecommunications, which is discussed in Chapter Six.

Other Peripherals

Most, but not all, the peripherals you are likely to use with the Model 4 have been discussed in this chapter. There are a number of special products such as home controller units, ham radio interfaces, printer switches (for people who use more than one printer), and interfaces that let you connect the Model 4 to laboratory instruments. Most of these are very specialized accessories, however. We hope many of the items you will be looking for have been discussed in this chapter.

This concludes *Things To Do With Your TRS-80® Model 4 Computer*. We hope you have enjoyed it and have learned some useful things. If you haven't bought a computer yet, you might want to read some of the other books in this series. Buying a computer can be either an enjoyable or a frustrating experience. How much you enjoy your computer may depend on how much you find out about it before you buy it.

Glossary

Alphanumeric: Information presented in both alphabetic and numeric form, for instance, a mailing list. The numbers 0–9 and the letters A–Z or any combination.

Applications software: Programs designed to perform specific tasks. Applications software can be games, educational programs, or business programs.

Arithmetic expression: A group of letters, numbers and/or symbols that tell the computer to perform an arithmetic function. For example:

2+2
2*2
A22
2/4
2/A
A*(2/B8)

Arithmetic operator: A symbol that tells the computer to perform an arithmetic operation. The operators include + addition; − subtraction; * multiplication; / division; and ^ raise to a power.

ASCII: A simple code system that converts symbols and numbers into numbers the computer can understand.

For instance, when you type a on the keyboard of your computer, the binary number 01100001 is sent to the computer's central processing unit (CPU). The CPU then displays the letter a on the screen.

Assembly language: A low-level programming language that is much faster than a high-level language such as BASIC. Assembly language programs are extremely difficult to write. Here are two lines from an assembly language program:

```
LDA
MOV C,A
```

BASIC: Beginner's All-purpose Symbolic Instruction Code. A high-level computer language designed for beginners. TRS-80 Model 4 BASIC is a dialect of BASIC designed especially for the TRS-80 Model 4 microcomputers. Here are three lines of a program written in BASIC:

```
10 PRINT "HELLO HOW ARE YOU?"
20 INPUT A$
30 GOSUB 500
```

Baud: A unit of information transfer. In microcomputers, a baud is one bit per second.

Baud rate: The rate at which information is transferred. For instance, 300 baud is a transfer rate of 300 bits per second. the TRS-80 Model 4 is an eight-bit computer. This means that each character, space or symbol requires eight bits. Therefore, a baud rate of 300 transfers only 37.5 characters per second. If you are sending a letter with each word approximately six characters long and you have one space between words, you can send about five words a second or 300 words a minute.

Binary number: A number system that uses only two digits, 0 and 1, to express all numeric values. See digital computer.

Bit: The basic unit of computer memory. It is short for binary digit and can have a value of either 1 or 0.

Black box: A piece of equipment that is viewed only in terms of its input and output.

Boot: The process of loading part or all of the disk operating system into the computer. This lets you load information from the disk or save information to the disk.

Break: To interrupt execution of a program. The TRS-80 Model 4 has a control key labeled BREAK. When you press the BREAK key, the program quits running. The computer tells you what line number it was on when the program was interrupted.

Buffer: A temporary storage place used to hold data for further processing.

Bug: A problem that causes the computer to perform incorrectly or not at all.

Bus: A set of connection lines between various components of the computer.

Byte: A group of eight bits usually treated as a unit. It takes one byte to store a unit of information. For instance the word *love* requires four bytes.

CAI: Computer-Aided Instruction or Computer-Assisted Instruction.

Canned software: One or more programs that are ready to run as is. The game Deadline is canned software.

Cartridge: A 2x3x3/4 inch plastic box that contains ROM software such as BASIC. The TRS-80 Model 4 does not use cartridge software.

Cassette: A small plastic cartridge that has magnetic tape inside on two reels. The tape is wound from one reel onto the other. Computer programs can be stored on a standard audio cassette.

Cassette drive: A standard tape recorder used to save (record) or load (retrieve) computer information.

Cathode ray tube: The picture tube of a television set or monitor. It is used to display computer output.

Central processing unit: This is the heart of the computer. It contains the circuits that control the execution of instructions.

Chip: A formed flake of silicon or other semiconductor material containing an integrated circuit.

Circuit: The complete path of an electric current. A computer circuit may have thousands of different elements, such as transistors, diodes, resistors, and so on.

Circuit board: A plastic board that has hundreds or even thousands of different circuits.

Clock: An electronic circuit in a computer that is the source of timing and synchronizing signals.

Code: A system of symbols and rules for representing, transmitting, and storing information.

Coding: Designing a computer program.

Command: An instruction that tells the computer to perform an operation immediately. The command *RUN*, for instance, tells the computer to begin immediately executing a program.

Compiler: A computer program that translates high-level language statements into machine language.

Computer-Aided Instruction: The process of teaching by computer. This is a system of individualized instruction that uses a computer program as the learning medium.

Console: The keyboard and other devices that make up the control unit of a computer.

Control key: Pushing the computer's control key in conjunction with another key causes the computer to perform special functions. For instance, the control key pressed in conjunction with *Y* causes the Model 4 to display large type.

Controller: A device that can be attached directly to the computer or to an external mechanical device so that images on the screen can be moved around. A joystick is a controller.

CPU: Central processing unit.

CRT: Cathode ray tube.

Cursor: The little flashing white square on the CRT that indicates where the next character will be displayed.

Daisy wheel printer: A printing machine whose print head has a number (usually 96) of radial arms or petals. Each petal has a type character on the end. Daisy wheel type is equal to or better than most typewriter type.

Data: All items of information a computer can process or generate—numbers, letters, symbols, facts, statements, and so on.

Database: The entire collection of data in a computer system that can be accessed at one time.

Database management system: A program that organizes data in a computer's data storage so that several, or all, programs can have access to virtually any item, and yet a particular item need be keyed into the computer system only once.

Data processing: The process of converting data into machine-readable form so the computer can work on it.

Data transmission rate: Baud rate.

Debug: To eliminate errors in a computer program or a computer.

Decimal number system: This is the number system you are familiar with, that is, 0–9.

Default: See default value.

Default value: An assigned quantity for a device or program that is set by the manufacturer. For instance, a printer may have a default value that tells it to

print everything in elite type. A default value in a program is usually the most common or safest answer. As another example, a word processing program may ask if you want to clear everything in memory. The safest answer is no, since it doesn't cause any harm if you hit the wrong key. In this example the program would have a default value of no.

Desktop computer: A complete computer system designed to fit on a desktop. The TRS-80 Model 4 is a desktop computer.

Device: Any piece of computer equipment.

Digital: A system that uses the numbers 0 and 1 to represent variables involved in calculation. This means that information can be represented by a series of offs (0) or ons (1). See bit.

Digital computer: A computer that uses a series of electronic offs and ons to represent information. These offs and ons are converted to (or from) binary numbers. The TRS-80 Model 4 is a digital computer.

Directory: A list of all the files on a diskette.

Disc: Disk

Disk: A piece of flat rotating circular mylar that is coated with magnetic material. It is used to store computer information. See also hard disk and diskette.

Diskette: A flexible disk that is 5¼ inches in diameter (about the size of a 45 RPM record). It is the most common mass storage device. The TRS-80 Model 4 uses diskettes as the primary means for mass storage.

Disk drive: An electromechanical device that stores on or recalls information from a disk. Two disk drives can be installed in the Model 4.

Disk file: An organized collection of data stored on a disk.

Disk operating system: An operating system that lets the computer use one or more disk drives. See operating system. The two most common disk operating systems for Radio Shack computers are TRS-DOS and LDOS.

Documentation: All of the available information about a particular computer, computer program, or set of programs; it would include instructions on how to turn on the computer, how to load programs, and so on. For computer programs, the documentation should include such information as what type of computer the program runs on, how much memory is needed and how to operate the program.

DOS: Disk Operating System

Dot matrix printer: A printer that forms characters as patterns of dots. The dots lie within a grid of definite dimensions, such as 5x7 dots.

Dual density: A technique of writing twice as much information on a diskette. The Model 4 uses dual density disks.

Edit: To make changes on the screen in data or a program.

Electronic mail: Personal or other messages generated on computer and transmitted to another computer at a different location. The computers are connected by phone lines.

Execute: To operate a computer program or part of a computer program. The process a computer goes through when it analyzes instructions and acts on them.

Expression: A combination of numbers, variables and operators that can be evaluated. The answer must be a single number or variable. For instance, $2+3=5$. It can't equal 7. Other expressions such as $A+B$, $A-3$, or A/B*38 must also have only one answer.

External memory: Mass storage.

Field: A unit of information that is part of a file. For instance, in the following mailing list file, NAME, ADDRESS, CITY, STATE and ZIP are all fields:

SAMPLE MAILING LIST
NAME_____
ADDRESS_____
CITY_____
STATE_____
ZIP_____

In the example above, both the information and title are part of a field. For instance, the field for Joe Jones is this: NAME Joe Jones.

File: An organized collection of related records. A payroll file has a complete payroll record for each employee.

Floppy disk: Diskette

Formatting: The process of electronically organizing a diskette so that information can be stored on it and retrieved from it.

Fortran: FORmula TRANslation. A high-level computer language used for mathematical or engineering applications. Here are three lines from a FORTRAN program:

```
40 FORMAT (E14.7)
X=A+B*C/D-E
WRITE (6, 50)X
```

Function key: A key that tells the computer to perform a special function. These functions are defined by the programmer. The Model 4 has three function keys.

Graphics: Pictures, line drawings, and special characters that can be displayed on the screen or produced by a printer. The Model 4 has limited graphics capability.

Hard copy: A copy of the computer's output printed on paper.

Hard disk: A mass storage device that uses a rotating rigid disk made of a hard plastic-like material. It has many times the storage capacity of a diskette.

Hardware: The various physical components of a computer system, such as the computer itself, the printer, keyboard and monitor.

High-level language: A computer language that uses simple English words to represent computer commands. For instance, the command PRINT "Hello" in BASIC tells the computer to print the word *Hello* on the screen.

Initialize: To set a program element or hardware device to an initial quantity (usually zero).

Input: To transfer data from the keyboard or a mass storage device into the computer's internal memory.

Input device: A device used to enter information into a computer. These are all input devices: keyboard, joystick, disk drive, cassette player.

Input-Output: The processing of entering data into a computer or taking it out.

Integrated circuit: A group of components that form a complete miniaturized electronic circuit. The circuit has a number of transistors plus associated circuits. These components are fabricated together on a single piece of semiconductor material.

Interactive: A computer system that responds immediately to user input.

Interface: A device that allows other devices to communicate with each other. A modem, for instance.

Inverse video: A process that shows dark text on a light background on your screen. Normally light text is shown on a dark background.

I/O: Input/Output

Jack: A plug socket on a computer.

Joystick controller: A two-inch by two-inch black box with a movable plastic stick on the top of it. It is used as an input device most often with computer games.

K: When used as a measure of computer memory, K is an abbreviation for kilobyte or kilobytes. It is also an abbreviation for kilo.

Kilo: A prefix meaning 1000. In computer jargon it is used as an abbreviation for 1,024.

Kilobyte: 1,024 bytes. Thus 4 kilobytes (abbreviated 4K) of memory is about 4,000 bytes of memory. It is exactly 4,096 bytes, but 4K is a convenient way to keep track of it. This means that if you have 4K of memory, you have space for 4,096 characters, spaces, numbers, and symbols in your computer.

Language: The means of communicating. The difference between computer language and human language is that a computer language allows humans to communicate with computers. The lowest level of language is machine language; the *pure* language of the computer. Machine language programs use 1s and 0s to represent the offs and ons in the computer. Machine language programs are the most difficult programs to write, but they do not have the speed and action limitations of higher level languages. Assembly language programs are also low-level languages, but they use simple mnemonic statements as commands. High-level languages, such as BASIC, FORTRAN and Logo, use English-like statements to tell the computer what to do. BASIC is the most common language because it is the simplest to use.

Load: The process of entering data or programs from an external device, such as a disk drive, into the com-

puter. For instance, if you load a program into the computer it is available for use.

Line number: A number that defines each line of programming in a high-level language. Each line of the program begins with a line number. The computer executes the program in line number order starting with the lowest number.

Logic: A systematized interconnection of devices in a computer circuit that causes it to perform certain functions.

Logical operator: A symbol that tells the computer to make a comparison. These operators include; > (greater than), < (less than), and = (equals).

Logo: A high-level computer language that is often used by children. An easy-to-learn language, Logo allows colorful, detailed graphics to be drawn on the screen. Sprite graphics and turtle graphics are terms associated with Logo. The Model 4 does not run Logo.

Loop: A series of programming instructions that repeat. The last instruction in the loop tells the computer to return to the first instruction. Intentional loops have some means of escape built into them. Unintentional loops, caused by programmer error, can only be stopped by pressing the break key or turning the computer off.

Low-level language: A computer language at the machine level (a pattern of pure binary coding.) It is neither simple nor obvious for a human being to read, understand, or use.

Machine language: The lowest-level language. It is a pattern of ones and zeros that the computer understands.

Mail merging: A program usually used with word processing that allows you to insert names and ad-

dresses into a group of documents. All you have to do is load the names and a sample of the document; everything else is automatic. For instance, suppose you want to send the same letter to 2000 people. Once you have created the mail list and the letter, the computer adds the name and address of the first person to an original copy of the letter. It can also address the person by name at several different places in the letter. It does the same thing for the second person on the list, the third, and so on.

Mainframe computer: A large, expensive computer generally used for data processing in large corporations and government installations. Originally, the term referred to the extensive array of large rack and panel cabinets that held thousands of vacuum tubes in the early computers.

Mass storage: The files of computer data that are stored on media other than the computer's memory. For example, diskettes and cassettes are mass storage devices.

Matrix printer: Dot matrix printer

Mega: A prefix meaning one million.

Memory: The internal hardware in the computer that stores information for further use. The Model 4 comes with 16K of memory, but this can be expanded to 64K.

Menu: A display shown on the screen that gives you a list of options. You select an option by typing a letter or number and pressing the return key.

Microcomputer: A fully operational computer that uses a microprocessor as its CPU. Microcomputers are a new kind of computer. Whereas minicomputers are small scale versions of large computers, microcomputers are an outgrowth of semiconductor technology. Consequently, some microcomputers have

features not found on either minicomputers or mainframe computers.

Microprocessor: A central processing unit contained on a single silicon chip.

Minidisk: Diskette

Minicomputer: A small computer based on large computer technology.

Mnemonic: A technique or symbol designed to aid the human memory. Its most common computer use is in assembly language programming. For instance, it is much easier to remember LDA (an assembly language term) than 004000 072.

Mnemonic code: A system of abbreviations designed to replace obscure, complex terms used in preparing assembly language programs.

Modeling: A partial simulation of real or possible situations.

Modem: A modulating and demodulating device that enables computers to communicate over telephone lines.

Monitor: A television or cathode ray tube used to display computer information. In common usage, a monitor usually refers to a special device used exclusively for computer output. It can display a line 80 characters long and has at least 24 lines of text.

Mylar: A type of plastic used in the manufacture of floppy disks.

Nano: One billionth

Nanosecond: One billionth of a second. Modern computers operate in nanoseconds.

Numeric data: Data that consists entirely of numbers.

Operating system: A set of computer programs devoted to the operation of the computer itself. The operating system must be present in the computer before applications programs can be loaded or run.

OS: Operating system.

Output: Information or data transferred from the internal memory of the computer to some external device.

Output device: A device used to take information out of a computer. CRTs, mass storage devices (such as disk drives), and printers are all output devices.

Packaged software: Canned software.

Parallel: The performance of two or more operations or functions simultaneously. For instance, a parallel port accepts all eight bits of a byte at one time. Some printers are connected to the computer by the parallel port.

Pascal: A powerful high-level computer language for business and general use. Named for French mathematician and philosopher Blaise Pascal (1623–1662). Here are three lines from a Pascal program:

```
BEGIN
READLN(I,HOURS)
IF I=1 THEN WORK:=SUN
```

PC: Personal computer.

Peripheral: Any device that connects to a computer. Printers, joysticks, and modems are peripherals.

Personal computer: Microcomputer.

PILOT: This is an easy-to-learn, high-level language designed for novice computer users. Primarily used for educational programs.

Pixel: A picture element that is one point on a screen. The size of the pixel depends on the computer graphics mode being used and the resolution capabilities of the screen.

Port: The location where Input/Output devices are connected to the computer. For example, a printer may be connected to computer with a cable at the parallel port. A modem may be connected at the serial port.

Power supply: A device, consisting of a transformer and

other components, that converts household current (115 or 230 volt) to the voltage used by a computer.

Powerful: As used with computers, powerful means that a computer, a device, or a program has a lot of features. Powerful is so *over used* in the computer industry that it really has no meaning.

PRINT: A command to the computer that tells it to display something on the screen or print it out on a printer.

Printer: A device for producing paper copies (hard copy) of the data output of a computer.

Program: An organized group of instructions that tells the computer what to do. The program must be in a language the computer understands.

Prompt: A symbol, usually a question mark, appearing on the screen that asks you to enter information.

QWERTY: An abbreviation used to indicate a standard typewriter-style keyboard. The first six letters in the third row of a standard keyboard are QWERTY.

RAM: Random Access Memory.

Random Access Memory: This is the read-write memory available for use in the computer. Through random access the computer can retrieve or send information instantly at any memory address. See memory.

Read: The act of taking data from a storage device, such as a diskette, and putting it in the computer's memory.

Read Only Memory: A random access memory device that contains permanently stored information. The contents of this memory are set during manufacture. A game cartridge is a Read Only Memory.

Read/Write memory: Computer memory that you can put data into or take data out of at any time.

Record: An organized block of data. For instance, the payroll information on one person.

Resolution: The number of points (or pixels) you can put

on a television screen (or monitor) both vertically and horizontally. High-resolution indicates a large number of pixels and, therefore, a sharper display.

Reverse video: Inverse video.

ROM: Read Only Memory.

SAVE: A command that tells the computer to store the contents of memory on some media, such as a diskette or cassette.

Screen: A CRT or television screen.

Semiconductor: A metal or other material (silicon, for example) with properties between those of conductors and insulators. Its electrical resistance can be changed by electricity, light, or heat.

Serial: A group of events that happen one at a time in sequence. For instance, a serial interface reads in a byte one bit at a time. Modems transmit data serially.

Silicon: A nonmetallic chemical element resembling carbon. It is used in the manufacture of transistors and solar cells.

Software: The programs and data used to control a computer. Software is available in many forms. You can type the program in yourself, or you can have it transmitted to you over the telephone. You can also get it on cassette, diskette, or cartridge.

System: All of the various hardware components that make the computer usable, such as the computer, printer, modem, keyboard, CRT, and disk drive or cassette player.

Text Editor: A computer program that allows you to change or modify the contents of memory. It can modify either data or programs.

Turtle graphics: A small, triangular shape that is displayed on the screen when the language Logo is used. The *turtle* shows the direction of lines for

graphics. For example, if the instruction is to move north, the turtle moves towards the top of the screen. Although the Model 4 does not run Logo, there are some short programs that will produce turtle graphics.

User-friendly: A computer system or software package that is easy for novice users to use and understand.

User's manual: A book or notebook that describes how to use a particular piece of equipment or software.

Variable: A quantity that can assume any of a given set of values. For instance, assume A is a variable whose value is 1. If you add 3 to it, its value becomes 4.

Video display: The screen of your monitor or TV.

Volatile memory: As used with computers, volatile means that the memory loses its contents when the computer is turned off. That is, any information in volatile memory is lost when the computer is turned off.

Window: A portion of the CRT display devoted to a specific purpose.

Word: A minimum storage element in computer memory and the smallest data element worked on by the CPU. Word sizes vary with the design of the computer, varying from eight bits to 12, 16, 32 or 64 bits.

Word processing: A special feature of a computer that allows you to manipulate text. See also word processor or text editor.

Word processor: A computer program that helps you manipulate text. You can write a document, insert or change words, paragraphs or pages, and then print the document letter-perfect.

Write: To store data on external media such as a disk or cassette. The expression *write to diskette* means that the information stored in the computer's memory is

sent to the diskette where it is stored.

Write protect: When new material is written to a diskette, any old material there is erased. Write protect is a method of fixing the disk so that it can't be written on.

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