$16.95

PERSONAL COMPUTING WITH THE UCSD P-SYSTEM™

Mark Overgaard
Stan Stringfellow

p-SYSTEM DETAILS FOR YOUR COMPUTER

General Information

______________	Personal computer type
_____	Major p-System version number

Storage volume characteristics

Size	: Device description
_____	: ______________
_____	: ______________
_____	: ______________
_____	: ______________

__________	#4: storage device
__________	#5: storage device
__________	RAM disk volume name
__________	Universal Medium accessibility
______________	Utility to format disks
_____	Need to Z(ero after formatting?

Special Keys for General p-System Use

_____	[ret]	Terminate response to a prompt
_____	[bs]	Move cursor back and erase character
_____	[delete line]	Delete entire line
_____	[break]	Interrupt current program
_____	[stop/start]	Stop or start console screen output
_____	[flush]	Discard output to console screen
_____	[esc]	Cancel current activity
_____	[eof]	End of file from CONSOLE:

Special Keys for Screen-oriented Editor Use

_____	[tab]	Move cursor to next tab stop
_____	[up]	Move cursor up one line
_____	[down]	Move cursor down one line
_____	[right]	Move cursor right one position
_____	[left]	Move cursor left one position
_____	[exch-ins]	Insert blank character in X(change
_____	[exch-del]	Delete character in X(change
_____	[etx]	Complete an activity and accept

Other Notes

____

____

____

____

Ronald J. Duchow
8-15-84

PERSONAL COMPUTING WITH THE UCSD P-SYSTEM™

MARK OVERGAARD
STAN STRINGFELLOW

SofTech Microsystems
San Diego, California

PRENTICE-HALL, INC.,
Englewood Cliffs, New Jersey 07632

Library of Congress Cataloging in Publication Data

Overgaard, Mark (date)
Personal computing with UCSD p-System.

Bibliography: p.
Includes index.
1. UCSD p-system (Computer system) 2. Microcomputers—Programming. I. Stringfellow, Stan (date)
II. Title.
QA76.6.0925 1983 001.64 83-569
ISBN 0-13-658070-X

Editorial/production supervision: Nancy Milnamow
Cover design: Ray Lundgren
Manufacturing buyer: Gordon Osbourne

UCSD p-System Personal Computing Series

10 9 8 7 6 5 4 3 2 1

ISBN 0-13-658096-3
ISBN 0-13-658070-X {PBK}

Prentice-Hall International, Inc., *London*
Prentice-Hall of Australia Pty. Limited, *Sydney*
Editora Prentice-Hall do Brazil, Ltda., *Rio de Janeiro*
Prentice-Hall of Canada, Inc., *Toronto*
Prentice-Hall of India Private Limited, *New Delhi*
Prentice-Hall of Japan, Inc., *Tokyo*
Prentice-Hall of Southeast Asia Pte. Ltd., *Singapore*
Whitehall Books Limited, *Wellington, New Zealand*

CONTENTS

PREFACE

Personal computing is making use of a small computer to assist you in your work or entertain you. This book is an introduction to the UCSD p-System, a software environment that can be used on most kinds of personal computers.

The p-System includes a set of fundamental tools for using your computer. It also allows you to use a host of specialized tools—called **application programs**—that address specific needs. You can use these programs to help you run a company, to write a book (as we did!), or even to entertain yourself with an imaginary journey through a strange land. You can also develop your own application programs, either as serious tools or simply as interesting and educational exercises.

We have paid particular attention to three types of p-System uses: a) using application programs that others have developed, b) editing and printing text (such as memos), and c) developing your own programs.

In the area of developing programs, it is not our objective to teach you programming or the details of any of the p-System programming languages. These topics are left to the excellent programming texts that are available. Instead, we address a topic that most of those books do not cover: the specific details of entering a program into the computer and preparing it for use.

In Part 1 of the book, called "Getting Started," we show you enough of the capabilities of the p-System for you to do useful work in any of these three areas of interest. This part is organized so that you need to read only the chapter or chapters that are relevant to your interests. For instance, if you simply want to use available application programs then you need to read just one chapter in Part 1.

All the chapters in Part 1 use a "hands-on" approach. They are intended to be read while you are sitting in front of your personal computer. These chapters provide a step-by-step introduction to the p-System's facilities in each of the three areas.

Part 2, called "Getting Interested," provides descriptions of all the basic p-System facilities, organized so that you can read them systematically or reference them occasionally. In this part, each chapter discusses a major component of the p-System, such as the text editor or the file manager. There is some repetition of the material presented in Part 1, because Part 2 is intended to be self-contained.

"Getting Serious," Part 3, provides a "larger view" of the p-System. One chapter describes aspects of the p-System's design that may influence how you use the system in the long term. A second chapter introduces the wide range of additional tools and program building blocks that are available for the p-System. We don't teach you how to use these facilities; we just want you to know about them and how they might be useful to you.

We hope that these three Parts provide a useful mix of step-by-step tutorial guidance, easily-understood reference material, and valuable background information.

ACKNOWLEDGEMENTS

We are pleased to be able to thank a number of people who assisted us in various ways in the preparation of this book.

Al Irvine encouraged us in this project from the beginning, made it possible for us to pursue it, and was understanding when (particularly toward the end) it consumed every spare moment, plus some moments not so spare.

Bob Fenichel and Erik Smith, the authors of the Sprinter II text formatting program with which we prepared the master copy of this book, were zealous in their dedication to the quality of their tool and in their help with our special needs.

Texas Instruments, Inc., through Presley Smith and Oscar Hughes, kindly provided professional renditions of the sketches we did for the figures in this book.

Cindi Gunderson and her students at National University used an early version of the book in a Pascal programming course, and provided valuable feedback to us.

Numerous friends and colleagues provided useful comments on all or parts of the manuscript: Elaine Bear, Winsor Brown, Randy Clark, Beverly Graves, Steve Koehler, Trevor Lawrence, and Linda Wildflower. Though we weren't able to adopt all their suggestions, we know that our book is much better for their involvement.

We gratefully acknowledge each of these contributions and hope that the final result is as pleasing for these contributors as it is for us. (For many of them, and for other important people in our lives, the long-awaited completion of this project is reward enough!)

INTRODUCTION

1 THE PERSONAL COMPUTING PHENOMENON

The first electronic computers were "personal" in the sense that they served one person at a time just like today's personal computers. Those early computers were impersonal in the sense that they required huge amounts of floor space, power, and air conditioning. By comparison, today's personal computer can sit on a desk in an ordinary office or travel to Afghanistan as an aid to a traveling reporter. And yet these tiny packages of electronics are more powerful than their giant predecessors!

Those early machines were also very difficult to use. Today's personal computers, in contrast, can be used by almost anyone.

Even with the drawbacks of these early computers, it is still a big surprise to learn that back in the early 1950's the *total* market for computers in the United States was projected as less than one hundred machines. Today, the industry rallying cry is: "A personal computer on every desk!"

One of the reasons why these small computers are popular is that they are very versatile. A reporter did, in fact, take his computer to Afghanistan (during a war!) and used it in preparing and editing his story. Personal computers were used to write this book. Farmers in Nebraska use personal computers to manage their dairy herds. Mental health professionals use small computers to help their clients develop an appreciation for their "biorhythms."

Two principal factors account in large part for the dramatic difference in the way computers are used today, compared to three decades ago. The first factor is stunning advances in the physical technologies used. The circuits that used to fill rooms have been shrunk to patterns on pieces of silicon the size of your fingernail. At the same time, these circuits have become much more powerful.

The fundamental operations performed by today's computers are not nearly as different from those of their predecessors as you might expect, given the enormous differences in physical construction. Today's computers still use operations such as adding two numbers together, moving a number from one place to another, or comparing two numbers.

Why then are today's computers accessible to millions while the early machines could only be used by the scientific elite? The explanation is the dramatic differences in the **software** built from those fundamental operations. Software turns an assembly of wires and tiny silicon chips into a useful tool that can help you make plans for a new business or control a model train.

Another name for software is **programs.** Computer programs are detailed directions for a computer that guide it in the performance of some task. **Application programs** are those programs which address specific needs such as keeping track of the accounts of a business. These programs are ultimately composed of the simple primitive operations mentioned above (like adding two numbers together). But they combine tens of thousands of these instructions to achieve great internal complexity and power. The challenge in developing one of these programs is in harnessing this power in such a way that everyday use is pleasant and productive, even for people who are not computer experts.

There are two principal ways in which you can use your computer. This book is intended for people with either of these two kinds of interests in personal computer software. First, you can use programs that others have developed. These programs may provide entertainment (such as a video action game), or they may serve a serious business purpose (like getting out a payroll). To use existing application programs, you usually don't need much technical background. Mostly, you need knowledge of the application area in which you want computer assistance.

Second, you can develop your own programs. Developing programs takes considerably more technical skill than using programs that others have written. Program development is still much easier, however, on today's personal computers than it was "back in the old days."

This book does not have much to say about personal computer hardware, since relatively little hardware knowledge is needed for productive personal computing. Instead, we concentrate on software. To provide a foundation for that discussion, however, it is necessary to briefly sketch the hardware components of a personal computer.

2 COMPONENTS OF A PERSONAL COMPUTER

A typical personal computer (an IBM Personal Computer) is pictured in Figure 1. Even if your computer is not the same as the one pictured, its major components are probably similar.

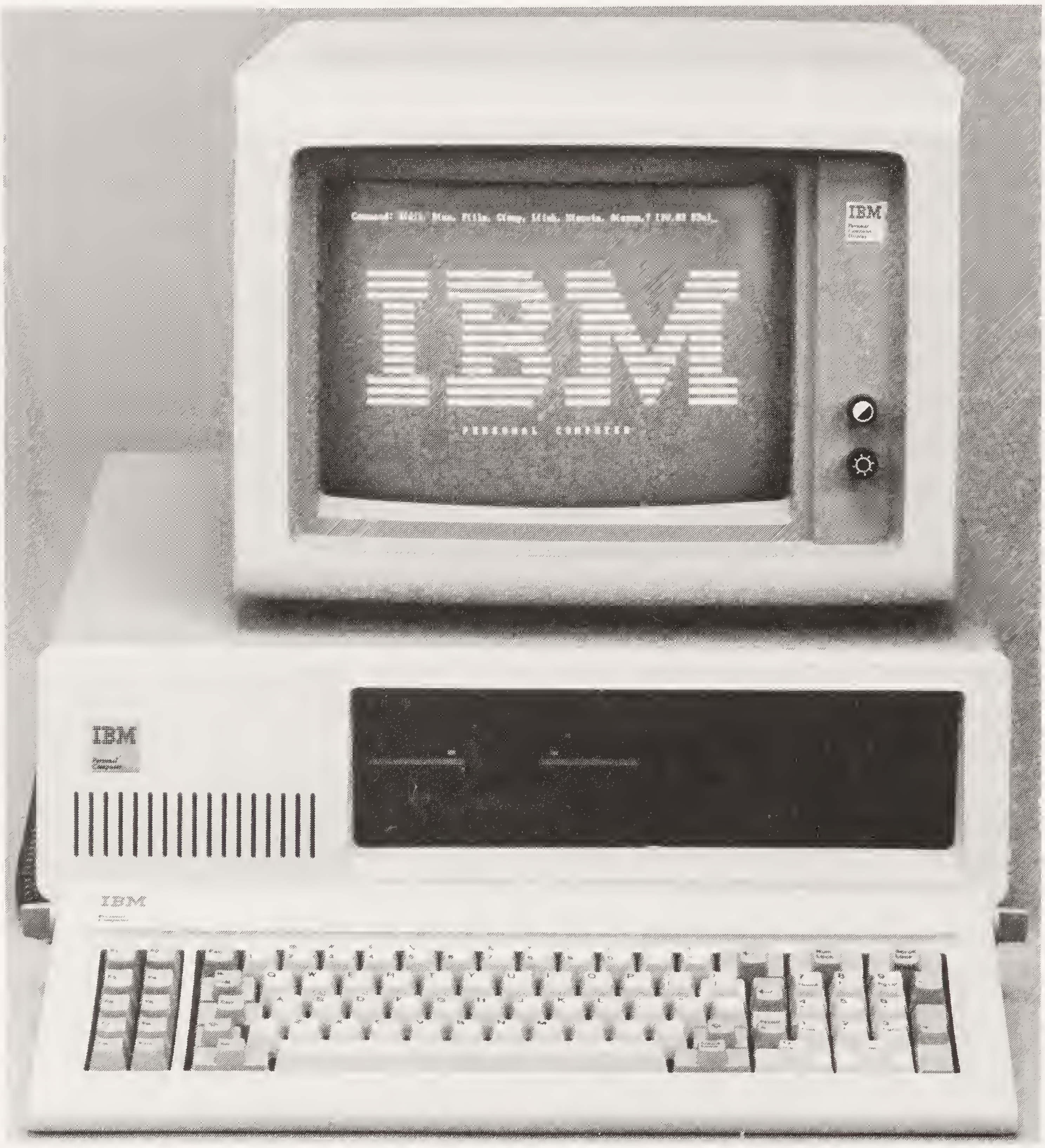


Figure 1

The first thing to notice is the keyboard, which is similar to that of an ordinary typewriter. The alphabetic keys ("A" through "Z") are laid out just like on a typewriter. A large variety of special keys are available (only some of which have corresponding versions on a typewriter).

Another necessary component of a personal computer is the **display**, which looks like a television screen (and may even be one!). The display is capable of showing characters and in some cases graphic pictures.

Underneath the display of this computer (and out of sight inside the unit) are its principal electronic components, including the **microprocessor**, which directs its operation, and the **main memory**, where computer instructions and data are stored when they are being actively used. On the right side of the unit is the main power switch.

This particular kind of computer also has room in the base unit for two **disk drives.** When a **diskette** (or **disk**) is inserted in one of these drives, the computer can store information on it and retrieve information from it. This information is stored (relatively) permanently, even when the diskette is not in use.

Another important (though optional) part of a personal computer is a **printer**, which can be used to make permanent printed copies of textual (and possibly graphic) information stored in the computer.

Some computers have all of these components packaged together. Others allow you to mix and match functional components just as you can with a component stereo system. For instance, the display and keyboard may be packaged separately from the rest of the computer and called the **terminal.**

Your personal computing can be very productive even if you know very little about the inner workings of the electronic and mechanical parts of your personal computer. You do need, however, to know something about how diskettes work so that you can handle them properly. When diskettes are well cared for, they can last through years of frequent use. When they are mistreated, however, valuable data and instructions stored on them can be lost.

A diskette is pictured in Figure 2. There are several kinds of diskettes, primarily distinguished by their sizes. A particular computer usually uses only one of these sizes. The most popular sizes are 8 inch, 5-1/4 inch, and 3-1/2 inch.

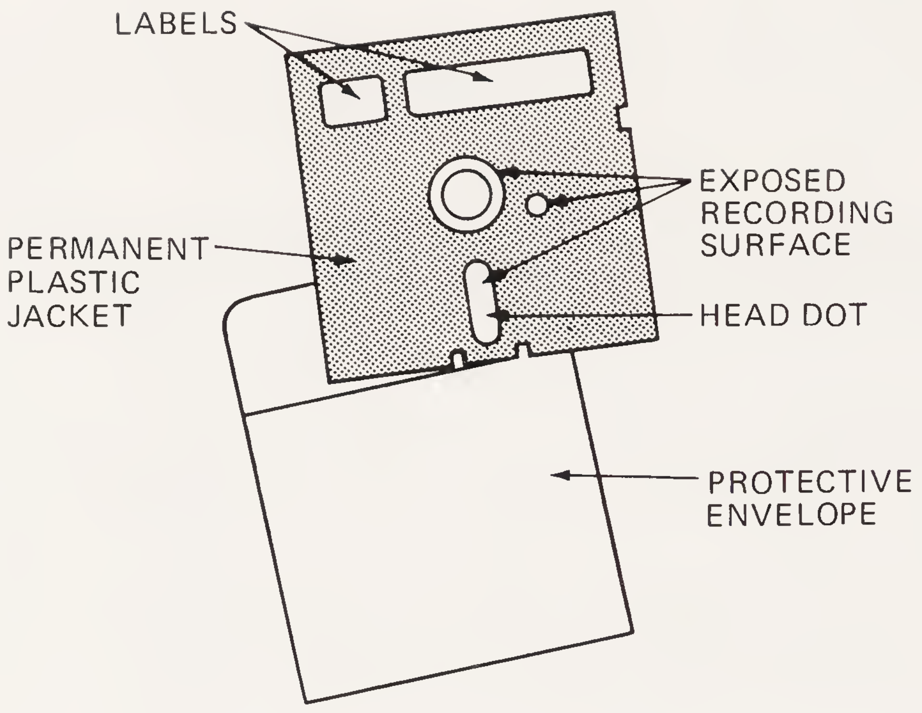


Figure 2

All of these types of diskettes work in fundamentally the same way. Their essential component is a circular piece of magnetic material similar to recording tape. This material is flexible and rather delicate, so it is protected by a square plastic jacket. When the diskette is in use, the recording material spins inside the jacket. A read/write head comes in contact with the diskette through a "head slot" in the protective jacket. This allows a computer to play (read) or record (write) computer information on the diskette just as a tape recorder plays or records music.

You should keep a diskette inside the protective envelope when not in use, so that dust (and your fingers!) do not come in contact with the magnetic material through the head slot. Also, you should treat diskettes in a friendly fashion—no folding, spindling, or mutilating! Writing on the label with a ball-point pen or laying heavy objects on the diskette can also be damaging.

Some personal computers use another kind of disk—called a **hard disk**—usually in addition to diskettes (which are also known as "floppy" or "flexible" disks). As the name suggests, the principal distinguishing feature of a hard disk is that the recording surface is rigid rather than flexible. Hard disks usually have many times the storage capacity of a diskette (along with substantially greater access speed). Often the hard disks are not **removable.** That is, there is no way to take the disk out of the drive and put in another disk with different information on it.

Hard disks are not treated differently by the p-System than flexible disks. If you use a hard disk on your computer, however, you may have to adapt some of your procedures. For instance, you may use different methods for keeping **back up** copies of your important information. Since hard disk handling procedures can vary widely among brands of computers and brands of hard disks, we have chosen not to cover them in this book. We concentrate, instead, on the flexible disk environment.

On some personal computers, you can use part of the main memory area to simulate a disk. (Because RAM—for "Random Access Memory"—is a popular name for main memory, a disk simulated in main memory is often called a **RAM disk.**) The main advantage of a RAM disk is that it is extremely fast, since access to it occurs at electronic speeds, rather than mechanical speeds. One disadvantage of a RAM disk is that the information on it is generally lost when the personal computer is turned off. (Mechanical disks, on the other hand, can store information indefinitely.) We don't deal in detail with RAM disks in this book, but we do mention them in a few places where their differences might be a source of confusion for you.

One principal use of disks (whether flexible, rigid, or RAM) is for storage of the software that makes your personal computer a truly useful tool. The next section discusses this software in general, and the p-System in particular.

3 PLACING THE p-SYSTEM IN CONTEXT

A personal computer system can be viewed as an inverted triangle like that in Figure 3. The widest part of the triangle represents the application programs that meet specific needs of personal computer users like yourself. Since there are so many users, each with a different collection of needs, an astonishing quantity and variety of application programs have been developed.

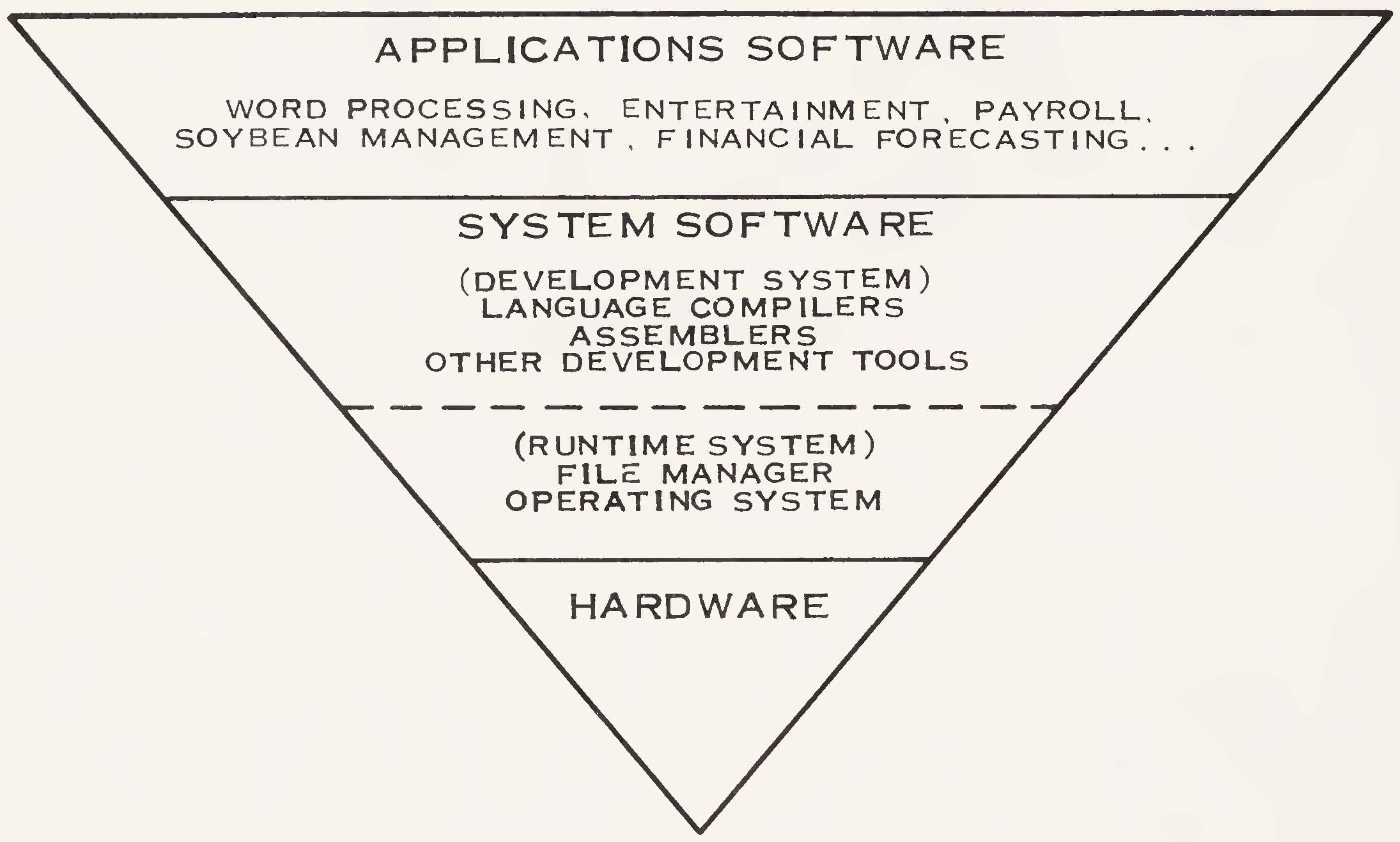


Figure 3

One reason why application developers are so prolific is that they can depend on **system software** to handle the fundamental interactions with the hardware, and to provide the tools necessary for building application programs.

The p-System is one of the most widely used types of system software for personal computers. It has several major components. The most fundamental one is the **operating system**, which is basically in charge of the personal computer hardware (subject to your direction, of course). One important thing you can do with the operating system is start and stop programs. Even after these programs are started, however, the operating system is crucial to their continued operation. It handles the details of reading information from disks and writing information to them. It also manages the other peripherals on your personal computer, including the keyboard, display, and printer.

In the p-System, there are other system software components such as a file manager that allows you to check and rearrange stored information ("files") on disks, and text editors, with which you can create, read, or modify stored textual information.

If you are interested in developing your own programs, the p-System includes a variety of facilities to assist you. Most important are the computer language translators, which take the programs you write and convert them to the coded form that the computer understands. In Chapter 3, you will use one of these translators to write some short programs. There are also various other program development tools. We leave further discussion of them to Chapter 8.

Figure 3 shows two categories of system software: **runtime** software and **development** software. As the names suggest, the first category is the software needed to run existing programs, while the second category of software is the tools you can use to build your own programs. When the p-System is packaged in a runtime configuration, the operating system and (sometimes) the file manager are included. Some runtime configurations include a text editor, as well. The development configuration includes the runtime components, along with a host of program development and other tools.

At the base of the structure in Figure 3 is the personal computer hardware. A hallmark of the p-System is its ability to run on almost all kinds of personal computers. We have paid specific attention to two of those in this book. In Chapter 7, we describe how this **portability** is achieved.

4 THE BACKGROUND OF THE p-SYSTEM

Development of the UCSD p-System was begun at the University of California, San Diego (UCSD) in late 1974. This early work was directed by Professor Kenneth Bowles. The principal objective was to provide programming tools for a large introductory course in computer science.

The course had previously used the central campus computer and the Algol programming language, but Bowles thought that small computers handling one student at a time could provide a more responsive learning experience. Furthermore, it seemed that the language Pascal was more suited to teaching novice programmers than Algol (a predecessor to Pascal). Finally, Pascal appeared to be suitable as the implementation language for building the necessary software tools.

Two principal objectives guided the early evolution of what was initially known as the **UCSD Pascal System:**

- o The System had to be easy for first-time computer users to learn. It also had to be usable by experienced programmers (such as those modifying or enhancing the System, itself).
- o The software had to run on small, inexpensive computers comparable in capability to many personal computers in use today. (For instance, those computers had about 56,000 bytes of main memory and about 500,000 bytes of diskette storage.) This objective was quite a challenge, since no one at the time had succeeded in installing the Pascal language on machines that small.

The UCSD Pascal System was initially intended for use inside the University, but as word of the software spread, copies were distributed to other campuses and to people in industry starting in the summer of 1977. Then in May, 1978, an article describing the System appeared in Byte magazine. The surprising result: the University received over a thousand inquiries about the software from all over the world!

It was soon clear that this level of demand could not be met by the small University project, and a search began for ways in which support for the growing community of UCSD Pascal users could be moved off-campus. This search ended in June, 1979, when the University awarded full responsibility for support and continued evolution of the UCSD Pascal System to SofTech Microsystems (SMS).

At the same time, the University reached agreements with Apple Computer and Western Digital Corporation which allowed those companies to market the UCSD Pascal System on their computers. Apple's version, dubbed Apple Pascal, is now widely used on Apple II and Apple III computers. (If you're interested, Appendix D provides some further details on the various versions of the p-System.)

One of the first moves of SMS was to add the programming language FORTRAN as an alternative to UCSD Pascal, originally the only programming language available in the p-System. When the time came to name this new product, several unappealing possibilities were considered:

o UCSD Pascal FORTRAN?

o UCSD Pascal System FORTRAN?

o FORTRAN for the UCSD Pascal System?

All these names sounded rather like "vanilla chocolate ice cream." Clearly the name "UCSD Pascal System" was not very compatible with the addition of FORTRAN to the product line. That's when the name of the main product was changed to the **UCSD p-System.**

The burning question, of course, is "What does the 'p' in 'p-System' stand for?" No one knows for sure, but there has been plenty of speculation. One pair of enthusiastic users wrote an article about the p-System that they called "P for Perfect?".

One possibility is that the "p" stands for "Pascal," since even today, it is the principal language supported by the p-System. Another possibility is that the "p" stands for "personal," since the p-System is a relatively friendly software environment to work in. Better yet, the "p" may stand for "portable," since the p-System is widely regarded as the most portable system software for microcomputers.

The best solution is not to worry about that "p." If for some reason you can't do that, the ultimate solution is to make the "p" silent when you say "p-System." p-Sychologists have been doing that for years!

Before discussing the p-System itself, we close this introduction with some recommendations on how you might proceed through the rest of this book.

5 HOW TO USE THIS BOOK

Here are the three parts of this book:

- o Getting Started: A "Hands-on" Tutorial
- o Getting Interested: A Systematic Reference
- o Getting Serious: A Larger View

If you are new to personal computing, Part 1 is designed for you. In it, we assume that you are sitting in front of your personal computer and are able to follow along and participate as we provide a tour through the p-System. We strongly recommend that you don't try to skip randomly around in Part 1, because you could easily stumble into a part of the p-System that you aren't prepared to deal with. You wouldn't do any harm to the p-System or to your computer, but you might get confused or frustrated.

We have organized this "Getting Started" part so that you only need to read the chapter or chapters that deal with the kind of use you want to make of the p-System. If you simply want to use available application programs, you can stop after Chapter 1. If you also want to use the text editor (say, for some simple word processing), go on through Chapter 2. Finally, if you want to develop your own programs, you should work through all three chapters.

To follow along in Part 1, you need a computer and a p-System that runs on it. The computer needs a display and a keyboard of some sort and at least two disk drives.

The p-System can be used with one-drive computers, but the second drive results in so much more convenience that we have assumed in this book that you have it. You can use a printer, also, but that is not required.

Part 2 ("Getting Interested") is organized for easy reference, though you may want to read straight through it. In fact, if you are already an experienced computer user, you may want to skim through Part 1, and concentrate on Part 2, which contains most of the information presented in Part 1, but with a more systematic organization. What's missing in Part 2 is the step-by-step directions intended to keep a first-time computer user on the right track.

Part 2 concentrates on the basic facilities of the p-System. For sophisticated work with the System, you still need to use the standard reference manuals that come with it.

Part 3 can be read at your leisure, but we recommend that you take time for it as soon as you can. It should improve your understanding of the p-System and how it can be useful to you in the long term.

There are several versions of the p-System in wide use. These tend to be similar in the overall way you use them, but different in details. This book is oriented toward Version IV of the p-System and emphasizes the most recent release of that version, which is called IV.1. If you're using some other version of the p-System than either of these two, you can get general help from this book, but you should be prepared for the possibility that the keystroke by keystroke descriptions in Part 1 may not be exactly applicable on your computer. Similarly, the p-System facilities discussed in the other two Parts may not all be available on your system.

If you're using Version IV.0, you should know that Appendix D, "Differences Among p-System Versions," provides a chapter by chapter list of the portions of this book that are affected by the differences between the IV.0 and IV.1 versions. Before you begin reading in a chapter, you should check that appendix.

One of the big challenges in writing this book was finding a way to deal with the inevitable differences that exist between implementations of the p-System on different types of personal computers. A major thrust of the p-System is to minimize those differences, but they still exist. This can be a source of confusion, particularly if you are a beginner following the step-by-step instructions of Part 1.

We have addressed this problem by providing appendices that describe the specifics of the p-System on several of the popular types of personal computers: the IBM Personal Computer, the Texas Instruments Professional Computer, and two Osborne computers—the Osborne 1 and the Executive. If you have one of these computers, you will be in good shape. If you have some other kind of computer, Appendix H provides general guidance on the kind of computer-specific information you need, and where it might be found in the p-System documentation provided by your supplier.

Even for the two computers that we specifically cover, these appendices are no substitute for the p-System manuals provided with the software. We just provide enough computer-specific information to get you going.

We have provided a place on the front inside cover of this book for you to record the most important details about the p-System on your computer. We suggest that, early in Chapter 1, you "fill in the blanks" there. Once you get that information recorded, the differences among personal computer types should cause you few problems as you proceed through the rest of this book.

We've also put the back inside cover to good use. On one side, a quick index to the major facilities of the p-System is provided. On the other side, the p-System's "File Conventions" are summarized. (Chapter 1 discusses what "files" and "file conventions" are.)

Just in case you try to do an operation with the p-System that is not allowed, you will be happy to know that, in Appendix A, we have listed the error messages that can be produced by several of the major components of the p-System, along with brief diagnoses of what might be wrong in each case, and possible recovery actions.

In Appendix B, we provide similar advice on general errors that can occur while you're running an application program.

Our overall goal has been to make your introduction to the p-System, and your continued use of it, as pleasant and productive as possible. We welcome you to the world of personal computing with the UCSD p-System.

MANAGING FILES AND RUNNING PROGRAMS 1

1.1 INTRODUCTION

This chapter shows you how to begin using p-System programs that others have developed. If your principal interest is in developing your own programs, this chapter gives you the necessary foundation.

Hundreds of p-System programs are offered commercially, covering a very broad range of application areas. Here is a small sample, just to give you some notion of the breadth of the possibilities:

o One application area that is well covered is known in the trade as "GLAPAR," which stands for General Ledger, Accounts Payable, and Accounts Receivable. These fundamental areas of accounting are often the first aspects of a small business to benefit from computer assistance. Almost any business has needs in this area, and a variety of p-System programs address these needs.

- There are also industry-specific application packages in such diverse areas as corn and soybean crop management and resort rental properties handling.
- Various management productivity aids are available, including several electronic spreadsheet simulators, project planning tools, and tax planning systems.
- There is even entertainment software based on the p-System, such as "Wizardry," an adventure and fantasy game. This game simulates the adventures of a group of explorers (including men, dwarfs, "mages" and "berserkers") in a dangerous land.

How can you find out about p-System programs that address specific needs that you have? One way is to acquire the *UCSD p-System Applications Catalog*, which is published periodically by SofTech Microsystems, and lists commercially offered p-System applications. For each of several hundred applications, a brief description, price range, and ordering information are provided.

Another source of application leads (and lots of other p-System information as well) is the UCSD p-System User's Society (USUS—pronounced "Use Us"). This group publishes a periodic newsletter. This newsletter includes a *Vendor Catalog* that lists vendors of p-System applications and other p-System-related products.

Chapter 9 provides details on how to get both of these useful publications. You can get the newsletter by becoming a member of USUS. If you do that, you'll be able to take advantage of other USUS services as well, such as a low-cost library of contributed software, bi-annual meetings, and various special interest groups.

Once you've located some application programs that look useful, you need to know how to acquire them. Application software that runs in the p-System is very likely to be usable on your computer, but you still need to be careful in making acquisitions. The last sections of this chapter discuss this topic. Of particular interest is the Universal Medium, a way of distributing p-System applications that makes them available for most kinds of personal computers that use 5-1/4 inch diskettes.

What do you need to know about the p-System to use these tools? It depends on the program.

For example, you often need facilities for making "back up" copies of information created by an application program on disk. Sometimes these facilities are built into the application program, but often the program depends on general p-System tools to meet this need. If every application you use provides these housekeeping functions, then you have little immediate need to know the material presented in this chapter. In most cases, however, this chapter will be useful, and perhaps even crucial, to your productive personal computing with the p-System.

Before we get into specific details on p-System facilities, some background on the concepts of programs and files is necessary.

Files in the p-System environment are collections of (usually related) information. They are similar to the everyday file folders that are used to keep information organized in an office. In the office, files are stored in file drawers. When p-System files are stored, disks play the role of file drawers. Each p-System file has a name. Two files on the same disk cannot have the same name. You can think of diskettes as small file drawers that you can remove and replace as you want to use the files on them with the p-System.

Most application programs use files, either to store information for later reference or to reference previously stored information. Some programs, such as the "Wizardry" adventure game mentioned above, have no need for file storage, since each use of this program is a self-contained experience. However, this type of program is the exception.

Files on p-System disks are permanently stored (at least as long as you don't damage the disks or explicitly discard the files). The more personal computing you do with the p-System, the more you will come to depend on your stored files, and the more careful you will need to be in preserving them.

What are programs? The noun "program" usually refers to a detailed schedule of events and participants in an activity (say, a graduation ceremony, or a picnic). In the computer context, program has a similar meaning, except that a program for a computer must be very detailed and explicit, since computers have none of the judgement and common sense that we take for granted in human beings. In fact, one of the research frontiers in computer science is the creation of programs that would allow a computer-controlled robot to navigate among the rooms of a house without demolishing the furniture!

Programs are stored as files on p-System disks. A program file contains the coded computer instructions that direct the operation of a computer when that program is in control. Many programs contain thousands (or even tens of thousands!) of coded instructions.

When a computer follows the instructions of a program, it is said to **execute** the program. The same word can be used when you start up a program: You "execute" it. "Running" a program means the same thing.

Now it's time for you to see files and programs in action by using the p-System yourself. If you already have a p-System that is ready to run on your computer, your next step is to start using it. To do that, skip the following section and go on to the section called "Starting Up the p-System."

If you don't already have a p-System that runs on your computer, read the following section to learn what's involved in acquiring a p-System.

1.2 ACQUIRING AND INSTALLING A p-SYSTEM

We mentioned in the introductory chapter that one of the hallmarks of the p-System is its ability to run on most kinds of personal computers. For each type of computer on which the p-System runs, there is a portion of the system that is specific to that computer. This computer-specific portion of the p-System caters to the particular type of microprocessor used in the computer, and to the details of the input/output devices that are attached. In order to run the p-System on your computer, you need a p-System with the right computer-specific portions installed. (Chapter 7 provides additional details on these computer-specific p-System components.)

One attractive source of a p-System for your computer is the vendor that provided your hardware. If that vendor or other local dealers can't provide a p-System for your use, you can acquire the *UCSD p-System Implementations Catalog* from SofTech Microsystems. This catalog (which is updated periodically) lists the known vendors of p-Systems that have been adapted to particular computers. The USUS *Vendor Catalog* (mentioned above) is another source of this kind of information. See Chapter 9 for details.

If no one provides a pre-configured p-System for your type of computer, you may be able to acquire an **Adaptable System** from SofTech Microsystems and do the installation yourself. Be forewarned, however, that this installation process is likely to involve sophisticated low-level programming (probably several weeks of it, at least). You probably shouldn't attempt the job unless you are an experienced programmer and have detailed knowledge of the internal operation of your computer.

Even if you can acquire a p-System that runs on your computer, there may still be one (relatively simple) configuration step that you have to handle. On some computers, the terminal component (made up of the screen and keyboard) is not integrated with the rest of the computer. On this kind of computer, different types of terminals can be connected, each with its own peculiar conventions about communication with your computer. If your computer is like this, you may need to adapt the p-System to your terminal. This adaptation can probably be done in a few hours. You may need to do a small amount of Pascal programming.

If you need to do any adaptation work in order to install the p-System on your computer, we recommend that you read over a good part of this chapter (at least through section 1.7) before you begin the adaptation. Even though you can't see the p-System operating during this dry run, you should still get a very useful introduction to the use of the p-System. That introduction should make your adaptation project easier.

1.3 STARTING UP THE p-SYSTEM

Once you have an appropriate p-System, you need to load it into your computer so you can use it. The process is really quite simple, though the details vary with computer types. Usually you start with the main power switch for your computer in the off position. Then you insert the diskette containing the p-System into the primary disk drive and turn the main power switch on. (On some computers, it's important that you turn on the main power **before** inserting a disk in a disk drive, since the disk could be damaged otherwise.)

The start up process is also called **bootstrapping**, by analogy with the phrase "pulling yourself up by your bootstraps."

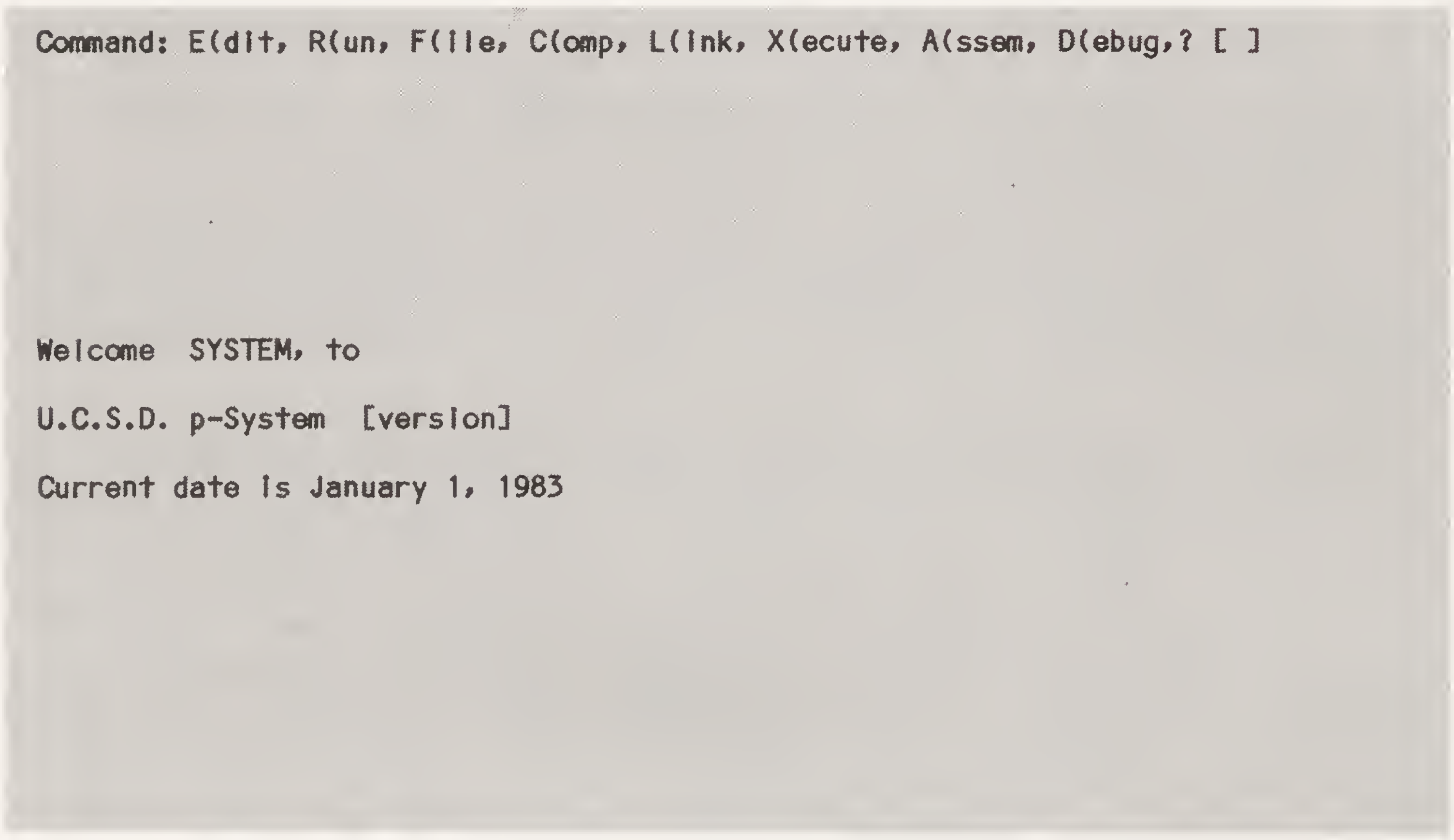
One of the first concepts you'll need as you begin to use the p-System is the notion of **special keys** on your keyboard. These keys are called "special" because they do not represent standard letters, numbers, or symbols. Instead, they have special meanings, such as "erase the last character typed." For instance, the special key [[bs]] (pronounced "backspace") allows you to erase and correct typing errors. Throughout this book, we use the double bracket symbols "[[]]" to enclose the names of special keys.

Now you need to start up the p-System on your own computer so that you can follow along as we explore the capabilities of the p-System. The details of that start-up process depend on what kind of computer you have. The way in which you type p-System special keys also depends on the kind of computer you have. Therefore we address both of these topics in the computer-specific appendices to this book that were mentioned earlier.

Locate the appendix that deals with your computer and read the introduction and the first section: "Starting Up the p-System for the First Time." If you have:

- o an IBM Personal Computer, read Appendix E.
- o a TI Professional Computer, read Appendix F.
- o an Osborne computer, read Appendix G.
- o any other kind of computer, read Appendix H.

After you follow the instructions in the appropriate appendix, you should have filled in your inside cover (describing the details of the p-System on your computer), your p-System should be running, and your display screen should look something like this:


```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug,? [ ]




Welcome  SYSTEM, to

U.C.S.D. p-System  [version]

Current date is January 1, 1983
```

What if the top line of your screen shows only part of the top line in the screen image above? Don't panic! The likely reason is that your computer's display is not set up to show the entire width of an 80-character line. If this appears to be your situation, check the documentation for your p-System (or the appropriate computer-specific appendix to this book). It is possible, for instance, that all 80 columns of the screen above are stored in your computer, and that there are special keys you can type to choose which portion of the 80 columns you want to see.

In the remainder of this book, we assume that you have an 80-column screen. All sample screen images have this width. It should be easy for you to follow along, even if the lines on your screen are not as wide as those shown here.

One other note: on some computers, the greeting lines (starting with "Welcome") shown in the sample above are replaced by some other kind of welcome message, such as a company logo. The display in Figure 1 (in the introductory chapter) shows an example of such a logo. In Chapter 4, we describe how this is accomplished via a special file on your disk called SYSTEM.STARTUP, and how you can modify your disk so that the standard p-System greeting lines appear, instead of the logo.

1.4 INTERACTING WITH THE p-SYSTEM

In the center of the screen on the previous page are three "greeting" lines that the p-System displays when it has just been started. We discuss this greeting in detail later in this book. For now, let's concentrate on the line at the top of your screen. It is called a **menu** because it shows you the p-System actions that you may select.

The p-System makes wide use of this menu concept. The main reason for this approach is to make the System easy to use. These menus help you use the system, especially those parts of the system that you don't use very often.

Menus in the p-System are usually displayed on the top line of your console screen. They list a set of **activities** that are available to you. Each menu has a name (like "appetizers" or "desserts"), that appears as its first word. Succeeding words indicate the activities that can be selected from that menu.

If you look at the screen, you can see the Command menu. This is the main menu of the p-System, and the activities listed here are the major ones available. You can select an activity from a menu by typing the first letter of the activity name. The "(" after the first letter tells you that you only need to type that first letter. Even though a capital letter is shown (for example, "E" for "E(dit"), lower case letters can also be used to select menu items.

The first part of this book (through Chapter 3) is designed for you to "follow along" on a step-by-step basis. Underlining emphasizes characters or keys that you are expected to type immediately on your personal computer keyboard. Even though you can use either capital letters or lower case letters to select from menus, we always show those selection keys as capital letters.

When a "?" appears on a menu, that is a sign that there are more activities in that menu than can be listed on the screen. You can see the rest by typing ?. (Remember that you should type underlined characters directly on your keyboard!) Here is the line you should see:

```
Command: H(alt, I(nitialize, M(onitor, U(ser restart [ ]
```

Notice that there is no question mark on this extension because there are no further activities in the Command menu.

The last item on a menu (generally enclosed in square brackets ("[ ]") is a **version number.** This number indicates which version of a p-System component you're using. A typical version number on the Command menu might be "IV.12A". If you have this legend on your command line, the major version of your p-System is IV.1, and you have variation "2A" of that.

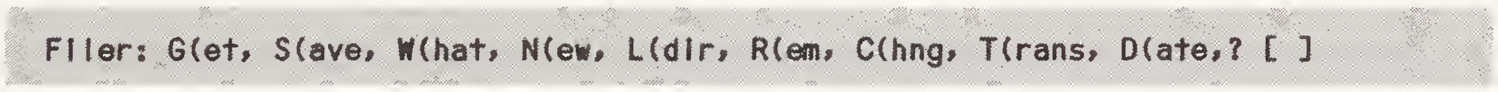
In this book, we have deleted the version numbers from the menus we show, so as not to confuse you. Most of the directions we provide in this book should work for any

Version IV p-System. The exceptions to this general rule are spelled out in Appendix D, "Differences Among p-System Versions." If you're using Version IV.0, you should be checking that appendix at the beginning of each chapter to find out what to expect.

The sequence of menu portions that you see each time you type "?" may be different from that shown above. If so, your p-System has been configured for some other screen width than 80 columns. The p-System always shows as many activity names as it can within the defined screen width. If there are more activities to show, the "?" appears to remind you.

It is not necessary for an activity to be visible on the menu in order for you to use it. You can select any of the activities of a menu, no matter which part of it is visible.

To prove that, select the F(ile activity from the Command menu by typing F. This activity allows you to do housekeeping operations involving the files on your diskettes and a variety of other useful tasks. After some disk activity, a new menu ("Filer") appears:



```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
```

One of the activities that can be selected from this menu is Q(uit. Try typing Q. You should shortly see the Command menu again. You have now left the F(ile housekeeping activity altogether.

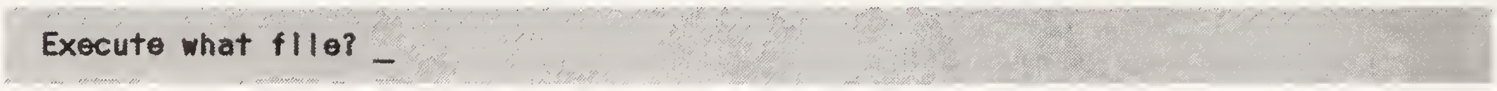
When you typed "Q", just now, you probably waited until you could see, by the presence of the Filer menu, that the p-System was waiting for your next selection. Many p-System implementations have a capability called **type ahead**, which allows you to type characters into the p-System even if it is still working on responding to earlier characters you typed. Thus, for instance, you could type "F" and "Q" in quick succession. After the Filer menu was displayed as a result of the "F", the p-System would immediately process the "Q", and leave the Filer.

If you don't have type ahead on your p-System, you must wait to type each key until the p-System has responded to your previous typing. If you don't wait, some of your input may be lost. If this happens, you (and the p-System!) may get confused.

Just so you know where you stand on type ahead, we suggest the following simple experiment. Type F Q in quick succession. If the p-System briefly enters the Filer and returns to the Command menu immediately, you probably have type ahead support. If the p-System stays in the Filer (as if you hadn't typed "Q", for Q(uit), then you probably don't have type ahead.

You're probably not very concerned, right now, about typing many menu selections in quick succession. You may happen to do so by chance, however, and then wonder why the p-System ignored some of the keys you typed. We did this small experiment here to prepare you for that possibility. Even if this experiment indicates you have the type ahead capability, it's usually not a good idea to get too many characters ahead of the p-System's responses, since you may make mistakes that might be difficult to recover from. Furthermore, all p-Systems have some limit on how far ahead you can get in your typing.

Now we return to consideration of the Command menu. Another activity there is X(ecute, which allows you to execute programs. Type X:



```
Execute what file? _
```

You haven't seen this kind of question from the p-System before. Previously, you were given a menu of possible activities from which you could make a choice by typing a single letter. Now you are being asked to answer a question. You are expected to enter the name of the program you want to X(ecute. This kind of question is called a **data entry prompt**, or simply **prompt**. Your response to a prompt tells the computer what you want it to do.

We are not prepared yet to actually execute a program, but we take this opportunity to experiment with data entry prompts and show you how they work.

Here is the procedure for responding to a data entry prompt:

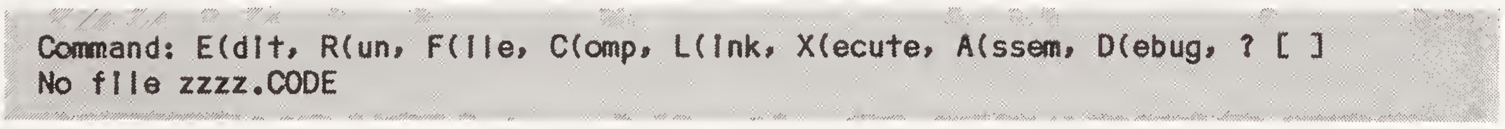
o Type in the sequence of characters that make up your response.

o If you make a mistake, use the ⟦bs⟧ key to erase the incorrect characters; then type the characters you want.

o When you're satisfied with the response you've typed, press the ⟦ret⟧ key to signal the p-System that your response is ready for processing.

If you don't remember how to type ⟦bs⟧ and ⟦ret⟧, the notes you put in the front inside cover (earlier in this chapter) should help. When you know where those keys are, try typing an x. It is displayed on the screen after the "?", and the **cursor** moves over to the next character position. The cursor is a marker that indicates where the next character that you type is put on the screen. Physically, its appearance varies among brands of computers and brands of displays. (For instance, it may be a solid block or an underline that flashes.) On your computer, the cursor looks like the character position right after the "x" you just typed! Now type two more x characters, followed by three ⟦bs⟧ keys. All the characters you typed are now gone.

Now type zzzz followed by a ⟦ret⟧. It is conventional in the p-System for the name of a program file to have ".CODE" on the end of it, so the p-System automatically adds that pattern to the name you entered and tries to find that file. That search is unsuccessful, as the p-System succinctly reports:



```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug, ? [ ]
No file zzzz.CODE
```

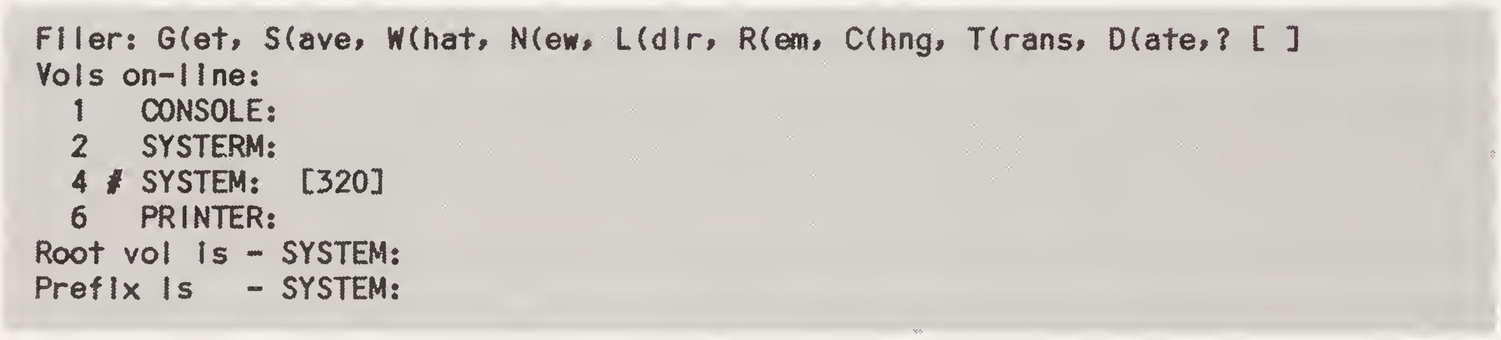
Notice that the Command menu has returned.

What if you mistakenly select an activity that involves a data entry prompt? It is usually safe to provide an **empty** entry by simply typing ⟦ret⟧. Try this with the X(ecute activity. After typing X to invoke X(ecute, type an immediate ⟦ret⟧ to the data entry prompt. The p-System simply returns to the Command menu.

It's time to begin exploring what can be accomplished in the F(ile activity. Type F to recall the Filer menu. The activity we want to try out is V(olumes (abbreviated "V(ols" on the menu). As you can see, there is no such activity visible on the Filer menu. When you check the menu extension with "?", however, you should see the V(olumes activity listed.

1.5 p-SYSTEM VOLUMES

Invoke V(olumes in the Filer menu with a V. After a short pause, your screen should look something like this:


```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
Vols on-line:
  1   CONSOLE:
  2   SYSTERM:
  4 # SYSTEM:  [320]
  6   PRINTER:
Root vol is - SYSTEM:
Prefix is   - SYSTEM:
```

You are back in the Filer menu, but there is new information on the screen: a list of **on-line volumes.** What is an on-line volume? For that matter, what is a volume?

One meaning of **volume,** is "a p-System diskette." In the display above, the volume named SYSTEM: is the disk from which the p-System was loaded—the **system disk.** On your display, the name on that line (after the "4 #") may not be SYSTEM, but it is still the name of **your** system disk.

(Another name for system volume is **root volume.** The second-to-last line on the screen identifies the current system volume. It is probably the volume that is loaded in drive #4:. On some systems that have lots of main memory and RAM disk support, the system volume may be the RAM disk.)

An **on-line volume** is one that is accessible to the p-System. Try opening the cover door of the drive containing your system diskette. Then invoke the V(olumes activity again. The new list of on-line volumes has no entry for your system diskette because the System cannot read a diskette when the drive door is open. Each time you select the V(olumes activity, the p-System does an inventory of the accessible volumes and displays a list of those it finds.

Now remove your system diskette from the drive and put it into another drive. (Be sure you close the drive cover after you put the disk in.) If you try the V(olumes activity again, the name of your disk should return to the list. This time, however, the number just to the left of it is different. If your computer has two disk drives, that number is probably 5. Now return your system disk to its original drive in preparation for the next operation.

Each p-System volume has a number associated with it in addition to a name. This is a **device number.** In the on-line volumes list, the device number is listed just before the corresponding volume name. Device numbers 4 and 5 represent the first two disk drives available with a p-System.

There are two categories of p-System volumes. Diskettes are in one category: **storage volumes.** Each storage volume (such as SYSTEM: in the list above) is identified in an on-line volumes list with a "#" and a number in brackets (320 in this case). This number indicates the total size of the volume in **blocks.** Each block holds 512 characters. (The fact that storage volumes are made up of blocks leads to the use of "blocked volume" as a synonym for "storage volume." The "blocked volume" terminology is still used in many p-System documents and programs.)

The key characteristic of storage volumes is that they can store information on a long-term basis. Each storage volume has its own private name, which is part of the stored information it contains. It is this private name that shows up on the on-line volumes list.

The second category of volumes is **communication volumes.** These volumes have no storage capability, but simply serve as channels for information. We deal further with communication volumes in a later section. For now, we concentrate on storage volumes. Sometimes we skip the "storage" and just use "volumes," or get very concrete and use "diskettes."

1.6 DIRECTORIES AND FILES

Information on a p-System volume is divided into **files**, and a **directory** keeps track of the name of each file, the date on which it was created, and various other housekeeping information, including the file's size and location on the volume.

The L(ist directory activity (abbreviated "L(dir" on the Filer menu) can be used to find out what files are on a particular volume.

Invoke the L(ist directory activity now by typing L. You are immediately asked to enter the name of the volume for which you want a directory listing. Ordinarily you enter a volume name *(including a colon)* in response to this prompt. You can look at the **default volume,** however, by simply entering : [[ret]].

```
List directory of what volume? : [[ret]]
```

The current default volume is your system disk. This will always be the case, unless you explicitly select a different default volume (by using one of the Filer activities described in Chapter 6, for instance). A **directory listing** is produced as a response to your request. It is shown on the next page.

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
SYSTEM:
SYSTEM.PASCAL    125 13-Jun-82
SYSTEM.FILER      37 13-Jun-82
SYSTEM.MISCINFO    1 30-May-82
SYSTEM.INTERP     28  8-Apr-82
SYSTEM.EDITOR     47  1-Apr-82
SYSTEM.LIBRARY    29  5-Jul-82
6/6 files<listed/in-dir>, 273 blocks used, 47 unused, 47 in largest
```

In this example directory listing, the name of the system disk is SYSTEM:. Your system volume name may be something else, and other details of your display may be different from those shown.

A directory listing shows, for each file on the volume, its name, its size (in 512-character **blocks**), and the calendar date on which the file was created or last modified.

Look at the top line of your display. If it contains the phrase "Type space to continue", then the number of files on the volume is greater than the number of lines available on your screen. In this case, you can press ⟦space⟧ (several times, if necessary) until you don't get the "Type space to continue" message as the top line.

Whenever the p-System lists the directory of a volume containing a large number of files, it displays a full screen of files at a time. For each batch, you are prompted to "type space" to continue to the next batch. If you aren't interested in any more batches, you can type ⟦esc⟧ to cancel the listing process.

1.7 RUNNING PROGRAMS

Now that you have had a basic exposure to the concept of files, it's time to try running programs. If you're in the Filer menu, use the Q(uit activity to return to the Command menu.

You have already run one program during the exercises of this chapter—the Filer. The Filer is stored in the file

SYSTEM.FILER, and the p-System provides a shorthand way to invoke it: you just type F in the Command menu.

For most programs, however, the invocation process is slightly more complicated. The main reason is that there are so many possible programs you might want to use that it is impossible to assign a single letter code in the Command menu for each one. Instead, the Command menu provides an X(ecute activity which allows you to enter the name of any program that you want to use.

It is easy to get confused between the X(ecute activity and the R(un activity, since we often use **running** as a synonym for **executing** when dealing with programs. (See, for example, the title of this section!)

In the p-System Command menu, however, there is a subtle but important distinction between these two activities. R(un is only used when you're developing new programs. R(un is described in Chapter 3; you shouldn't need it until then. (If you don't ever do program development with the p-System, you may never use R(un!)

Go ahead and invoke the X(ecute activity now. As you may recall from the early part of this chapter, the X(ecute activity is intended to be used with program files that have names that end in ".CODE". In fact, X(ecute is so sure that you will be invoking code files, that it adds ".CODE" to any name you provide in response to the data entry prompt.

What happens if you try to execute a file that doesn't have ".CODE" at the end of its name? The following screens show you what happens. Go ahead and try it, yourself.

```
Execute what file? system.filer [ret]
```

```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug,? [ ]
Illegal file name system.filer.CODE
```

After the suffix is added, the file name is 17 characters long. The p-System limits file names to 15 characters in length. Therefore the file name is illegal.

In a later section of this chapter, we show you how to create a file that does end with the usual suffix (".CODE"). In order to execute the file SYSTEM.FILER right now, however, we need some way to disable the automatic addition of the suffix. Try invoking X(ecute again, and putting a period after SYSTEM.FILER:

```
Execute what file? system.filer. [ret]
```

Success! The Filer is invoked and displays its familiar menu. When you need to execute a program file that doesn't end with the .CODE suffix, you can respond to the X(ecute prompt with the file name, followed by a period. You may never need this fact again, but it sure was handy here.

Why did the p-System look on your system volume for the SYSTEM.FILER file? Because it is the default volume. The ":" response you used earlier with the L(ist directory activity referred to the default volume as well. In both cases, the default volume was the system volume.

You can also enter an explicit volume name in connection with a file name. Q(uit the Filer and invoke X(ecute again. This time, put the name of your system volume in front of the program file name. (Your system volume's name was listed at the top of the directory listing you produced in the previous section. Return to the Filer and refresh your memory, if necessary.) Here's how your screen might look:

```
Execute what file? system:system.filer. [ret]
```

As soon as the Filer menu appears, Q(uit to return to the Command menu.

The default volume is also known as the **prefix** volume, since the p-System puts its name in front of a file name to make a complete file specification. Thus, even when you entered simply SYSTEM.FILER above, the p-System acted as though you had explicitly designated the system volume.

You can find out what the current default volume is by invoking the V(olumes activity and looking for the "Prefix=" line on the resulting display. Look back to the on-line volumes list at the beginning of Section 1.5, for an example.

A volume can also be designated by the number of the device in which it is mounted. In the on-line volumes list you did earlier, your system disk appeared as device #4. Therefore the following response to the X(ecute prompt is equivalent to the two you just tried:

```
Execute what file? #4:system.filer. [ret]
```

To summarize, when responding to a prompt that requests a file name (in X(ecute or other activities) you can:

o indicate the volume by entering the number of the device in which the volume is mounted (e.g., #4:SYSTEM.FILER.), or

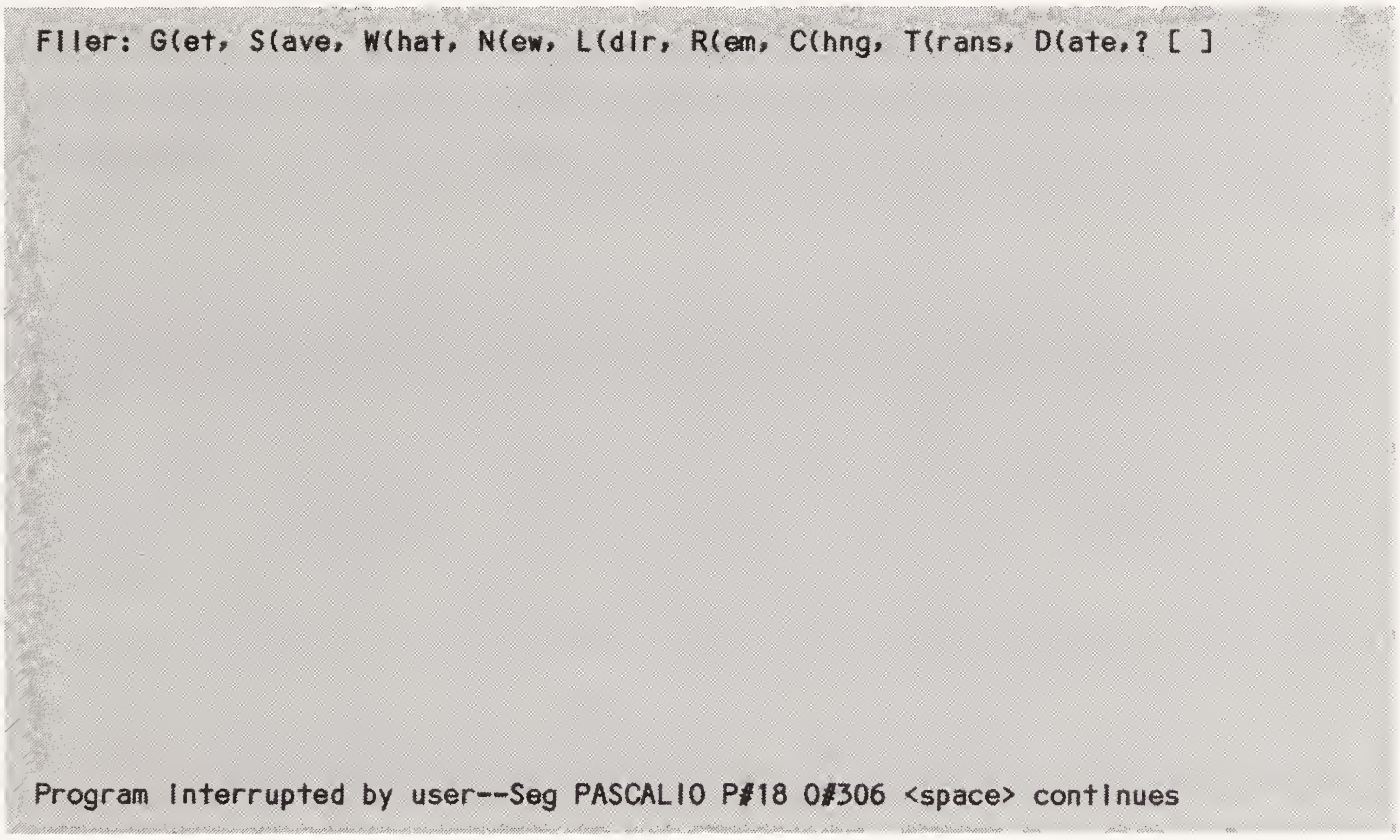
o enter the name of the volume name explicitly (e.g., SYSTEM:SYSTEM.FILER.), or finally,

o omit the volume designation altogether, as long as you intend to refer to the default volume.

Now that you know how to invoke programs, you also need to know how to stop them. Most of the time, of course, you should simply use the orderly exit procedure that is built into the program (for example, the Q(uit activity in the Filer menu). Sometimes, however, you simply must leave a program without going through the normal exit procedure. One reason, for instance, is if a program is clearly out of control (yes, sometimes that happens!).

The [break] key addresses this need. To experiment with it, use any of the ways you know to enter the Filer and then hit [break]. (Check the inside front cover if you don't remember how to produce [break].) On some kinds of computers, you need to type a character (say, [space]) after hitting [break] to make sure that the [break] is accepted by the p-System.

When the [break] takes effect, the bell on your computer sounds, and a message appears on the bottom line of your screen:



```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
```

```
Program interrupted by user--Seg PASCALIO P#18 O#306 <space> continues
```

This is called an **execution error message.** It means that something has caused the p-System to halt the program that was executing. In this case, the cause was your typing the [break] key, but other causes that really are errors are also possible.

The first portion of the error message identifies the error ("Program interrupted by user", in this case). On some systems, due to main memory limitations, the textual error message (such as "Program interrupted by user") does not appear. Instead, an error number ("8", in this case) is shown. If this happens on your computer, you can check Appendix B, "Execution Errors," to get the textual message.

Appendix B also provides possible reasons and recovery actions for each of the various types of execution errors.

The error message also provides **error coordinates** that indicate where the program was executing when it was interrupted. If you're running a program developed by someone else, you probably can't do much with those error coordinates. You should, however, note them down, if you want the supplier of the program to help you diagnose what went wrong.

After the error coordinates, the error line indicates how to go on. Type [[space]] to do that. After some disk activity the Command menu returns, along with a notice that the p-System has reinitialized itself (since the unexpected interruption may have left it in an unhealthy state):

```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug,? [ ]
System re-initialized
```

You should now know enough about running programs in the p-System to get started on productive personal computing. As for the other topic of this chapter (managing files), there are additional aspects to cover.

1.8 BACKING UP YOUR p-SYSTEM DISKETTES

The next section introduces the first of many Filer activities that can modify disks, not just examine them. The use of these activities increases the risk that you might unintentionally damage your p-System disks. Replacing your copy of the p-System would certainly be inconvenient, and possibly expensive, as well. Therefore, take time right now to make an extra (back up) copy of your p-System disk or disks (if you haven't already done so).

The details of making back up copies are somewhat machine-dependent. Therefore you will deal with this task during your next visit to the appendices.

One of the operations that you may use during the back up process is **disk formatting.** Formatting a disk involves having the system write some necessary control and address information on the disk surface, and is (on most computer types) a necessary step before a new diskette can be used with any software.

Formatting is done by a utility program. The details of how you run that program are usually different on each kind of personal computer. (For some computers, you don't need to do the formatting operation at all, because you can get disks that are already formatted.)

In addition to making a copy of your p-System diskettes in this trip to the appendices, you also need to make an empty volume for later use. (An "empty" volume contains no files.) The Z(ero activity in the Filer menu is used to make empty volumes.

Even though different kinds of personal computers support different disk capacities, we request that you make your empty volume 100 blocks in size and give it the name MYVOL:. This uniformity makes it easier for us to be specific in the descriptions below.

You should turn now to the appropriate computer-specific appendix and follow the directions in the section "Making Back Ups and MYVOL:."

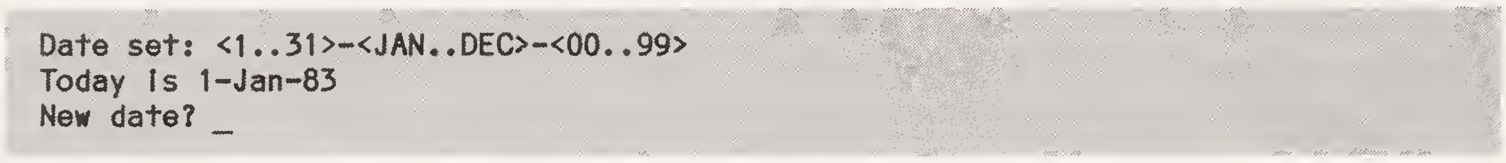
1.9 CHANGING THE CALENDAR DATE

Having just returned from a trip to the appendices, you should now have an extra copy of your main p-System diskette, and one other diskette containing an empty p-System volume. You should be using the new copy of the p-System diskette that you just made.

One of the first things to do whenever you begin a session with the p-System is update the calendar date maintained by the System. During the first session with the p-System on a particular day, use the D(ate activity in the Filer menu to tell the system the correct date. Enter that activity now. (You may need to enter the Filer, first.)

Keeping the date current is important because whenever you create or modify a file, the current date is stored with the file name in the volume directory. As you begin to do more work with the p-System, the dates associated with files will become very important to you. They can tell you, for instance, whether a data file stored on a diskette is the current version of that file, or one that is out-of-date.

Here is the prompt produced by the D(ate activity:



```
Date set: <1..31>-<JAN..DEC>-<00..99>
Today is 1-Jan-83
New date? _
```

This activity does two things. First, it tells you the p-System's notion of the current calendar date. Second, this activity allows you to enter a new date if you want to.

The line "New date?" is a data entry prompt. If you don't want to change the date, you can simply press [[ret]]. The p-System returns to the Filer menu.

If you do want to change the date, read the line that starts "Date set". The date format is day, month, year, with two "-" separators:

- o The day should be in the range 1 to 31,
- o a three character abbreviation for the month should be used, and
- o a two-digit year is expected.

Try entering the current date in the indicated format. If the structure of your entry is acceptable, the p-System reports the new date as shown on the next page. If the System cannot interpret your entry, it reconfirms the old date.

```
Today is 1-Jan-83
New date? 2-jan-83 [ret]
The date is 2-Jan-83
```

When you establish a new date, it is recorded on the system disk, and remains there until you change the date again. Until that time, whenever you start up the p-System with the same system disk, the same date is used.

There is a handy short cut that should simplify your use of the D(ate activity. The p-System allows you to enter just the day (if only that has changed) or just the day and month. Try it! First change just the day, and then try the day and month. After your experimentation, be sure to re-establish the correct date.

1.10 MOVING FILES AROUND

Now you're ready to start using the empty volume that you made during your last excursion to the appendices. Your first use of the new volume involves the T(ransfer activity, which is the Filer's principal tool for moving files around.

This section describes only a few of the capabilities of T(ransfer. Additional aspects are discussed later in this chapter and in Chapter 6.

Insert the MYVOL: disk in drive 5. Then invoke the L(ist directory activity and look at the directory of MYVOL: (that is, type L MYVOL: [ret]). After you type the "L", the L(ist directory prompt appears. When you respond to that prompt, your screen should look like this:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
MYVOL:
0/0 files<listed/in-dir>, 6 blocks used, 94 unused, 94 in largest
```

Six blocks of the volume are already occupied by the directory, even though there are no files on the volume.

Now invoke the T(ransfer activity. You are immediately asked what file you want to transfer:

```
Transfer what file? _
```

You are going to copy the file SYSTEM.FILER from your system disk to MYVOL:. Type SYSTEM.FILER ⟦ret⟧. The Filer responds with another data entry prompt, requesting that you specify where you want SYSTEM.FILER to be put:

```
Transfer what file? SYSTEM.FILER ⟦ret⟧
To where? _
```

When you type MYVOL:FILER.CODE ⟦ret⟧, some disk activity occurs; then the Filer reports:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
To where? MYVOL:FILER.CODE ⟦ret⟧
SYSTEM:SYSTEM.FILER    -->  MYVOL:FILER.CODE
```

What you've done is put a copy of SYSTEM.FILER on MYVOL:, with a new name: FILER.CODE.

When you choose a name for a new file, be sure it has fifteen or fewer characters. For program files, the suffix ".CODE" should generally be present, leaving ten characters for you to choose. It's simplest if you stick to alphabetic letters (A to Z) and digits (0 to 9) in the file names you create. Chapter 4 defines legal file names in greater detail and indicates the special characters that are also valid. This information is summarized on the back inside cover of this book.

Let's check the directory of MYVOL: to see how that has changed. Type L MYVOL: ⟦ret⟧:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
MYVOL:
FILER.CODE        37 13-Jun-82
1/1 files<listed/in-dir>, 43 blocks used, 57 unused, 57 in largest
```

If you compare the new FILER.CODE entry in the directory with the SYSTEM.FILER entry in the directory of your system volume, you should find that both the size and the date on the new file match those on the old file. T(ransferring a file doesn't change its date (since the contents are unchanged).

What if you want to move a file to a different volume, and retain the original file name? You could, of course, type the same name twice, but the p-System makes life easier for you by providing a special symbol that you can use in place of an explicit destination file name when you simply want to reuse the old name on the new file. The screen below shows you how to do such an operation, which results in a file SYSTEM.FILER on MYVOL:

```
Transfer what file? SYSTEM.FILER [ret]
To where? MYVOL: $ [ret]
SYSTEM.FILER   ---->   MYVOL:SYSTEM.FILER
```

When you use "$" in place of a destination file name in the T(ransfer activity, the Filer uses the source file name for the new file. (Note that you must still specify the destination **volume.**)

What happens if you choose a destination file name that conflicts with a file already on the destination volume? Since there cannot be two files on a volume with the same name, the Filer asks you to settle the matter. For example:

```
Transfer what file? SYSTEM.FILER [ret]
To where? MYVOL: $ [ret]
Remove old MYVOL:SYSTEM.FILER? _
```

If you answer "Y" for "Yes," the old version of the destination file (SYSTEM.FILER in this case) is removed, and a new copy of the file is transferred to MYVOL:. Answer "No," and the T(ransfer operation is canceled. You can try doing the example T(ransfer shown above if you'd like.

This kind of Yes/No question is like a menu in that a single character response is expected, and no ⟦ret⟧ is necessary. In this menu, however, the options are implicit!

There is one last experiment in this "What can go wrong with T(ransfer" sequence. Try transferring SYSTEM.FILER from your system volume again, but this time use NEWFILER.CODE as the destination file name. The two screens below show what happens.

```
Transfer what file? SYSTEM.FILER ⟦ret⟧
To where? MYVOL:NEWFILER.CODE ⟦ret⟧
```

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
No room on vol
```

The Filer indicates that there is no room to store a third copy of the Filer program on MYVOL:. Let's check the directory of MYVOL: to see why that is. Type L MYVOL: ⟦ret⟧; this screen should appear:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
MYVOL:
FILER.CODE        37 13-Jun-82
SYSTEM.FILER      37 13-Jun-82
2/2 files<listed/in-dir>, 80 blocks used, 20 unused, 20 in largest
```

The summary line at the end of the directory listing tells the story. Of the 100 blocks in the volume, only 20 are unused; that's certainly not enough room for a 37 block copy of SYSTEM.FILER.

If you get this "No room on vol" message, you can often make room on the destination volume by removing any unnecessary files (an operation which is explained in a later section).

1.11 TEXT FILES AND COMMUNICATION VOLUMES

So far we've only dealt with files that contain programs—the **code files** whose names usually end in ".CODE". These files contain encoded computer instructions and are not directly readable by ordinary mortals. There is another variety of files called **text files** that contain readable characters. Not surprisingly, the names of these files generally end in ".TEXT".

To experiment with a text file, you must create your own. There are many ways to create a text file; here is one that should prove useful in its own right.

Invoke the L(ist directory activity (by typing L) and respond to its prompt as follows:

```
List dir of what volume? MYVOL: , MYVOL:DIRECTORY.TEXT [ret]
```

After some disk activity, the System returns to the Filer menu, as usual, but instead of the usual directory listing on the screen, the phrase "Writing." appears. The reason is that this expanded version of the L(ist directory request has caused a textual version of the directory of the volume MYVOL: to be stored in the file MYVOL: DIRECTORY.TEXT.

Invoke L(ist directory again, but this time request a conventional display of the directory of MYVOL:. The result should look like this:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
MYVOL:
FILER.CODE        37 13-Jun-82
SYSTEM.FILER      37 13-Jun-82
DIRECTORY.TEXT     4  2-Jan-83
3/3 files<listed/in-dir>, 84 blocks used, 16 unused, 16 in largest
```

A text file has indeed appeared there. That file contains the directory listing that would ordinarily have appeared on your screen just a few moments ago. Note that the date shown for DIRECTORY.TEXT is the current date that you set earlier in this chapter.

You can look at the contents of DIRECTORY.TEXT using the T(ransfer activity:

```
Transfer what file? MYVOL:DIRECTORY.TEXT [ret]
To where? CONSOLE: [ret]
```

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
MYVOL:
FILER.CODE       37  13-Jun-82
SYSTEM.FILER     37  13-Jun-82
2/2 files<listed/in-dir>, 80 blocks used, 20 unused, 20 in largest
MYVOL:DIRECTORY.TEXT ----> CONSOLE:
```

For this T(ransfer operation, the destination was the console screen rather than a file on a diskette. Just as with previous T(ransfers, the p-System reported the source and destination of the operation after it was completed. This accounts for the last line of text on the screen.

It may surprise you that the file DIRECTORY.TEXT doesn't appear on this list. The reason is that when the directory listing contained in DIRECTORY.TEXT was made, there was no DIRECTORY.TEXT file! Once the DIRECTORY.TEXT file has been created by the p-System, the fact that it represents a directory listing is entirely forgotten. To the p-System, the file is simply a collection of characters. Therefore, there is no attempt to update the text file when the **real** directory on MYVOL: is updated to include the new file.

This was your first use of the communication volume CONSOLE:. You can use the V(olumes activity to see the other communication volumes available. (They don't have the "#" marks.)

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
Vols on-line:
  1   CONSOLE:
  2   SYSTERM:
  4 # SYSTEM:  [320]
  5 # MYVOL:   [100]
  6   PRINTER:
Root vol is - SYSTEM:
Prefix is   - SYSTEM:
```

One of the standard p-System communication volumes is PRINTER:. If that is listed on your screen, you probably have a printer device attached to your computer. If PRINTER: doesn't appear in your V(olumes list, it may be because you don't have a printer, or possibly because it is not turned on and readied for operation. On some computers, PRINTER: may appear on the list even though the printer is not ready to print. Check your printer for readiness.

If you do have a printer, and it is ready to be used, T(ransfer the file MYVOL:DIRECTORY.TEXT to the volume PRINTER:.

Your printer should produce a printed copy of the directory listing you saw earlier. If the Filer waits before printing anything, it may be because your printer isn't ready to print—check the manual for your printer if necessary. If you can't get the printer to work, and the p-System continues to wait, you may have to restart the entire p-System and not try to use the printer again until you know how to make it work.

It is often quite useful to have a printed list of the files on a diskette. As you accumulate a larger collection of diskettes, it gets harder to remember what is on each one. A printed directory listing, tucked into the diskette envelope, can be very helpful. Is there a more direct way to produce a printed directory listing? Yes, there is: you could type <u>L</u> <u>MYVOL:</u> <u>,</u> <u>PRINTER:</u> [ret].

Just as with storage volumes, you can use the device number style of referencing communication volumes. CONSOLE: is equivalent to #1:, while PRINTER: is equivalent to #6:. If you like, try transferring DIRECTORY.TEXT to #1:, instead of to CONSOLE:.

Which is the better approach, using the name of a volume or the corresponding device number? In the case of communication volumes, it is simply a matter of convenience. Some people feel more comfortable with the name, since it is more meaningful. Others are more concerned about the number of keystrokes they use!

In the case of storage volumes, there is an important difference between these two approaches. When you use the device number style of volume reference, you refer to **whatever volume is installed in that device.** This may or may not be the one you intended. If you use the volume name, however, this potential source of confusion and mistakes is eliminated.

You should use the name style of volume reference (at least initially).

Now that you've seen several ways to create new files on a volume, it's time to find out how to remove them.

1.12 REMOVING FILES FROM A VOLUME

Just as with the files in an ordinary file drawer, files on a diskette volume occasionally need to be discarded. A particular file may contain obsolete information or may have been created by mistake. Whatever the motivation, it is important to keep in mind that removing a file from a storage volume has one important difference from taking a file folder out of a file drawer and throwing it in the wastebasket:

> **It's very hard to take the diskette file out of the wastebasket again if you change your mind!**

So, be cautious in your "housecleaning" on a diskette.

Invoke the R(emove activity (on the Filer menu) now. Respond to the resulting prompt as follows:

```
Remove what file? MYVOL:SYSTEM.FILER [ret]
MYVOL:SYSTEM.FILER              --> removed
Update directory? _
```

Now you have one last chance to change your mind. If you type "N" (for "No") to this question, the removal operation is canceled. If you type "Y", you indicate your approval for the removal and the file SYSTEM.FILER is no more. Type Y.

The p-System generally asks for verification when you request an operation where a mistake could have serious consequences. This is one of the ways that the System is designed to help you avoid costly mistakes.

Notice that you are back in the Filer menu. Check the directory of MYVOL: to see if SYSTEM.FILER has indeed disappeared. This is the directory listing you should get:

```
MYVOL:
FILER.CODE         37 13-Jun-82
DIRECTORY.TEXT      4  2-Jan-83
2/2 files<listed/in-dir>, 47 blocks used, 53 unused, 37 in largest
```

SYSTEM.FILER is indeed gone.

What if you try to delete a file that isn't there? Try <u>R</u> <u>MYVOL:SYSTEM.FILER</u> <u>[[ret]]</u> again:

```
MYVOL:SYSTEM.FILER - File not found <source>
```

The aspects of the T(ransfer and R(emove activities that you've seen so far are sufficient to do most things you'll need to do. However, if you should need to transfer or remove many files at once, the methods you know could get a bit tedious. The next section introduces some short-cuts for such multi-file operations.

1.13 MULTI-FILE SHORT CUTS

When you want to remove many files from a volume, it is rather inconvenient to have to repeatedly type "R", followed by the name of one of the files and [[ret]]. It's easy to forget the names of the files you want to discard, so you may have to get a printed copy of the directory of the volume, or you may have to invoke the L(ist directory activity frequently to refresh your memory.

There is a better way! To try it, type <u>R</u> <u>MYVOL:</u> <u>?</u> <u>[[ret]]</u>. You are telling the p-System that you want to remove files from the volume MYVOL:, but that you don't want to go through the tedious process of naming each file you want to delete. Instead, you are requesting the system to ask you, for each file on the volume, whether you want to remove that file. The Filer responds:

```
Remove what file? MYVOL: ? [ret]
Remove MYVOL:DIRECTORY.TEXT? _
```

Now the Filer is waiting for another of those yes or no answers. Type Y. After repeating this question for FILER.CODE, the Filer gives you the familiar chance to change your mind:

```
Remove what file? MYVOL: ? [ret]
Remove MYVOL:DIRECTORY.TEXT? Y
Remove MYVOL:FILER.CODE? N
Update directory? _
```

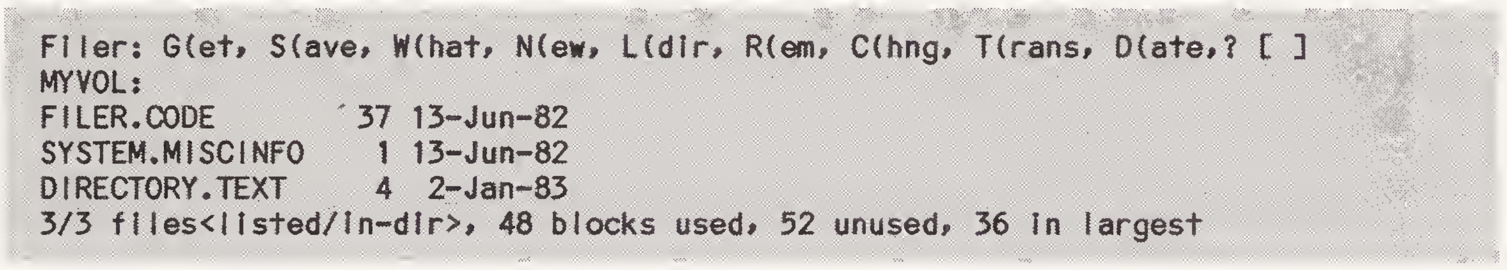
If there are many files on a volume, the system asks you specifically about the removal of each of them, before asking the "Update directory?" question. If you answer "Y" to this question, all the files selected individually for removal disappear from the volume. Since there is really no need to delete the DIRECTORY.TEXT file, answer N.

This kind of multi-file capability is available in the T(ransfer activity also. It is very useful for making back up copies of an important group of files. Just as with the R(emove activity, you are asked about the transfer of each file on a designated volume. Try this example:

```
Transfer what file? ? [ret]
To where? MYVOL: $ [ret]
```

This response indicates that some of the files from the default (system) volume are to be transferred to MYVOL:. Just as with the single file T(ransfer you did earlier in the chapter, the special "$" symbol means "don't change the names of the source files when they are transferred to the destination volume."

You are now asked about the T(ransfer of each file on the system volume. For the purposes of this exercise, you should probably answer "Yes" only for the SYSTEM.MISCINFO file, since there isn't much room on MYVOL: and SYSTEM.MISCINFO is very small. Here is the final directory listing of MYVOL:



```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
MYVOL:
FILER.CODE         37 13-Jun-82
SYSTEM.MISCINFO     1 13-Jun-82
DIRECTORY.TEXT      4  2-Jan-83
3/3 files<listed/in-dir>, 48 blocks used, 52 unused, 36 in largest
```

The capability of the p-System to support multi-file operations is much more general than described here. One property of these multi-file operations that is particularly useful is the ability to use the special key [[esc]] to cancel a series of questions about specific files. The full story is told in Chapter 6.

The next topic is some further discussion of the structure of files and volumes.

1.14 DEALING WITH CROWDED VOLUMES

Have you ever tried adding a file folder to a drawer that is almost full already? Usually you have to compress the existing files together so that the new one will fit. This wouldn't be necessary if it were practical to take the sheets of paper in the new file folder and slip them in wherever they would fit. Unfortunately, that would make it rather difficult to find the information from that folder when needed.

A similar situation occurs in storage volumes maintained by the UCSD p-System. The information in a p-System file must be kept together, too. As a volume is used, and files are added and removed, they can get spread around on the volume with unused space between them. Sometimes there is not enough space available in one place to store a new file on a volume.

The L(ist directory activity indicates, in the summary line of its output, how much total space is unused on the volume and the size of the largest single area. Here is the status of your MYVOL: diskette:

```
MYVOL:
FILER.CODE        37 13-Jun-82
SYSTEM.MISCINFO    1 13-Jun-82
DIRECTORY.TEXT     4  2-Jan-83
3/3 files<listed/in-dir>, 48 blocks used, 52 unused, 36 in largest
```

In this case, the size of the largest file that can be placed on MYVOL: is 36 blocks. An attempt to add a larger file (such as SYSTEM.FILER) to MYVOL: would result in a "No room on vol" message just like you saw earlier.

The total unused space, however, is 52 blocks, which is plenty of room for another copy of the SYSTEM.FILER file.

How can you gather the various unused areas on a volume into a single large area? The Filer activity K(runch is designed to do exactly that. When invoked, it first asks you to designate the volume you want to K(runch. You respond by designating a volume.

Don't **ever** stop the p-System, remove a disk, or turn off your computer during a K(runch operation. You might interrupt the operation at an inappropriate time and lose one or more files from your disk. If by accident you do interrupt a K(runch operation, refer to Chapter 6, where the topic of recovering a damaged volume is dealt with in considerable detail.

Let's try crunching MYVOL:. Select K(runch, and respond to the resulting prompt as follows:

```
Crunch what vol ? MYVOL: [ret]
From the end of the disk, block 100? _
```

A "Y" answer causes the Filer to gather all the open space to the end of the disk. During your early use of the p-System, you should always use this answer. If you get curious about the implications of a "No," check the description of K(runch in Chapter 6.

The Filer gathers the open space by moving files so that they are adjacent. As each file is moved, that action is reported to the screen. A final message indicates completion of the K(runch activity:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
Moving forward DIRECTORY.TEXT
MYVOL: crunched
```

A L(ist directory shows that the K(runch achieved the intended purpose. All the unused space is collected in one area:

```
MYVOL:
FILER.CODE        37 13-Jun-82
SYSTEM.MISCINFO    1 13-Jun-82
DIRECTORY.TEXT     4  2-Jan-83
3/3 files<listed/in-dir>, 48 blocks used, 52 unused, 52 in largest
```

What if there still isn't enough room on a volume even after K(runching? The obvious solution is to remove some files (making sure, of course, that you can do without them first!).

One drastic way of removing all the files on a volume is using the Z(ero activity. You're going to need (in the following chapters) a volume bigger than the artificially small 100 blocks that MYVOL: contains. At least 250 blocks are needed. Invoke the Z(ero activity and follow the prompt/response sequence on the next page. In the response where "250" is shown, you can enter the actual size of an appropriate storage volume on your computer if you know that size. It should be recorded on the inside front cover, along with other p-System details for your computer.

```
Zero dir of what vol? MYVOL: ⟦ret⟧
Destroy MYVOL: ? Y
Duplicate dir ? Y
Are there 100 blks on the disk ? (y/n) N
# blocks on the disk ? 250 ⟦ret⟧
New vol name ? MYVOL: ⟦ret⟧
MYVOL: correct ? Y
MYVOL: zeroed
```

This sequence has established an empty volume called MYVOL: with a size of 250 blocks (or whatever size you entered, above). We defer the detailed description of the Z(ero activity to Chapter 6.

There is one more preparation we need to make for following chapters. We need a text file on your new MYVOL:. A simple invocation of L(ist directory does the job:

```
List directory of what volume? : , MYVOL:DIRECTORY.TEXT ⟦ret⟧
Writing...
```

You now have a text file on MYVOL: containing the directory of the system volume.

Another Filer activity that is useful with crowded volumes is E(xtended directory list. It shows you where each of the unused areas on a volume is and also provides additional information about the files on the volume. We leave the details of this activity to Chapter 6.

1.15 DEALING WITH DAMAGED VOLUMES

One other housekeeping aspect of the use of disks needs to be mentioned here. Just as a phonograph record can become warped or scratched, it is possible for areas of a disk to become unusable for storing or retrieving information. This may result from a physical deformity, a speck of dust, or some other cause. Blocks on the disk that are not usable by the p-System are called **bad blocks.** If the p-System has trouble doing some operation, such as a T(ransfer, it may be due to bad blocks on a disk.

In Chapter 6, the B(ad block scan and X(amine activities of the Filer menu are described. These activities are useful in diagnosing and correcting the existence of bad blocks on a p-System volume.

Another way the p-System helps you recover from disk failures is the **duplicate directory** facility. When you Z(ero a disk, you can choose to have the p-System maintain an extra copy of your directory information on the disk. If one copy gets damaged, the other copy serves as a back up source of information about the files on your volume. When, in the previous section, you answered "Y" to the question "Duplicate dir?", you were establishing a duplicate directory on MYVOL:. In Chapter 6, we describe the p-System tools that are available to work with duplicate directories.

This concludes our discussion for this chapter about managing p-System files. We also have dealt with the running of programs. The last topic of this chapter is how to acquire the p-System programs you want to use.

1.16 ACQUIRING p-SYSTEM APPLICATION PROGRAMS

If you've ever browsed among the offerings of a personal computer software outlet, you may have noticed that each software package in the inventory is usually specifically intended for one brand (and often one particular model!) of personal computer. Even if a particular product is offered for more than one computer, there's usually a separate version for each computer variety.

There are two reasons for this. First, most personal computer software is not very **portable**. That is, it cannot handle the differences between the physical computer hardware used in different brands of computers. The result: software must be specifically tailored to a particular computer and once this tailoring is done, it won't run on other kinds of computers.

Second, there are incompatibilities between personal computer brands in the way information (including application programs) is recorded on diskettes. Even when two dissimilar computers both use the same size diskette (often the 5-1/4 inch size), there may still be differences in the details of information recording. The result: even when software portability is achieved, these mismatches in distribution media make it impossible for a single software package to be used on many different personal computers.

The p-System addresses both these problems (lack of software portability and distribution medium mismatches) to a greater degree than any other widely available software environment for personal computers.

First, p-System application programs can be completely portable to any personal computer that has the p-System installed.

Second, the distribution medium mismatches are addressed by the use of a standard diskette format that can be used by most personal computers that have 5-1/4 inch diskette drives.

The p-System's portability and this standard diskette format are combined to produce the **Universal Medium** for personal computer software distribution. When application software is recorded on a Universal Medium diskette, it can be used by owners of almost any kind of personal computer that uses 5-1/4 inch diskettes. (If you have only 8 inch or 3-1/2 inch diskettes on your computer, you can't take direct advantage of the Universal Medium.)

You may wonder why all this is important to you. After all, if you only have one kind of computer, why should it matter whether a software package can run on other computers? What if the only kind of computer you care about is yours?

One answer is that you should benefit if an application developer does not have to adapt an application specifically for your brand of computer, since the cost of development and distribution can be substantially reduced. This cost reduction should (we hope) be passed on to you in a lower price for the product, or perhaps in greater capabilities. Without the simplifications of the p-System's portability, the developer may choose not to make the product available at all for your computer!

In addition, there may be benefits of portability that haven't yet occurred to you. For one thing, you may want to replace your current computer by a different one eventually. Wouldn't it be pleasant to continue to use the same software on the new machine?

If you use a personal computer in your work, are there other people in your organization that also use personal computers, but of different kinds? The portability of the p-System offers the hope that productive sharing of software can occur (both for software that is developed by your organization and for software that is acquired from others).

But you can't begin to reap all these benefits unless you find application programs that meet your needs. You can start looking in the usual places like retail computer stores and personal computing magazines. If those sources don't turn up the application programs you need, check the the *UCSD p-System Applications Catalog* or the USUS *Vendor Catalog* mentioned in Chapter 1.

Once you have decided to acquire a particular application, you need to be aware that the p-System's portability is not completely automatic: application developers must still take care in their programs to make sure that portability is not compromised. Similar care is needed in documentation and packaging of an application if it is to realize the portability that is possible in the p-System.

You should tell the potential supplier of your application what kind of personal computer you use and something of its configuration (for instance, how much main memory it has). You should also mention the version of the p-System that you use. If the application depends on specific features of a particular version, it's important to know if you have that version. You should also check on the application's use of "real numbers." Section 1.18 discusses the issues in this area.

After this discussion about the hardware and software that you have, the conversation can turn to the application you want to acquire. In addition to the natural discussion about what the application can do for you, you may want to raise the following questions:

- o Is the software offered on the Universal Medium? If your computer can use the Medium, then a "yes" is good news indeed because you should be able to acquire the application and put it to immediate use.

  Even if you can't directly use Universal Medium applications, a "yes" on this question is good news, since this generally means that the developer has made sure that no dependencies on specific computers are built in to the product. The remaining problem is to get the application recorded on a medium that your computer can access.

- o Is the software specifically offered for your brand and model of computer? If the answer is "yes," the developer has probably tested the software directly on your kind of computer and made sure that any peculiarities of that computer are dealt with by the software and the documentation that accompanies it.

Let's say that the answers to these questions indicate that you can acquire the application you want on the Universal Medium. The next question is "Does your computer support the Universal Medium, and if so, how do you use it?"

1.17 USING THE UNIVERSAL MEDIUM

At the time of this writing, the Universal Medium is a relatively new concept. Some p-System vendors are already supporting it, but widespread standards (on how the Medium can and should be used) have not yet emerged. As a result, this section provides general guidelines, rather than specific "follow-along" directions.

The first requirement for accessing the Universal Medium with your computer is that you use 5-1/4 inch diskettes.

If you meet this first requirement, there are three possibilities. The convenience with which you can use the Universal Medium is determined by which of these three possibilities apply to you.

The first possibility is that the Universal Medium diskette format is already supported on your p-System installation as the standard format for diskettes, or perhaps one of the standard formats. If your computer is in this category, you're in luck! You can access Universal Medium diskettes just like you do the diskettes you already have. No special access mechanisms are necessary.

The second possibility is that you need to use an Adaptor program to access the Univeral Medium with your computer.

To use an Adaptor program, you invoke it with the X(ecute activity and then, under the program's direction, insert a Universal Medium diskette in one drive of your computer, and an empty disk suitable for routine use with your computer in a second drive. The Adaptor program then copies the information from the Universal diskette onto your diskette in your "native" format. As soon as this copying operation is complete, you can make use of the program on the native format diskette, just as you would any other program that you acquire.

The final possibility is that the standard Universal Medium format cannot be accessed at all from your computer, even with the aid of an Adaptor utility program. There is still hope, however, because the alternate side of a Universal Medium diskette is reserved for "foreign" formats that are fundamentally incompatible with the standard Universal side. The only problem is that there is room for only one foreign format. Therefore, the application supplier has to choose from among the possibilities. If the supplier chooses to put your format on the second side, you're in luck! If not, contact the supplier.

All of the computers that we treat specifically in this book can access the Universal Medium format as a native format. If you have some other computer, you may have already determined the kind of Universal Medium access you have, and recorded it on the inside front cover. Otherwise, consult your p-System documentation or your p-System supplier.

1.18 APPLICATIONS THAT USE REAL NUMBERS

There is one other issue you should discuss with the potential supplier of an application program. You should ask whether the program you're interested in uses **real numbers.** In computer jargon, real numbers are those that can have fractional parts, such as "4.531" or "6.92". In the same vein, an **integer number** cannot have a fractional part. Examples of integer numbers are "58" and "21237".

The simplest situation is if the program you want to use doesn't use real numbers. Then you don't need to worry about the issue at all.

If the program does use real numbers, then you need to be aware that the p-System can support two sizes of real numbers. However, only one size is supported by a particular p-System configuration. You have to make sure that the size assumed by the program you want to use is the same as the size for which your p-System is configured. Some p-System suppliers allow you to choose either size; other suppliers make the choice for you. The computer-specific appendices to this book (or comparable information from your p-System supplier) should tell you what freedom you have in this area.

The two sizes supported are known as "two-word" and "four-word." A p-System "word" has room to store two characters, or bytes. Real numbers either occupy two of these words, or four of them. The size difference determines how big the real numbers can be, and how precisely they can be represented. For instance, with the two-word format, a program usually can't distinguish numbers that have the first six or more digits in common. So the dollar figure $5,345,789.20 would be treated as essentially the same as the dollar figure $5,345,786.73. For some kinds of programs, this limitation poses no problems.

For other kinds of programs (in the accounting area, for instance) the four-word format is highly preferable, since as many as 15 digits can be distinguished. The basic question is whether your preference is for precision or compactness in the real numbers processed by your applications.

Some application suppliers provide programs in both sizes so you can make your own choices.

EDITING TEXT 2

2.1 INTRODUCTION

This chapter shows you how to use the p-System to manipulate text files like the DIRECTORY.TEXT file that you created in Chapter 1.

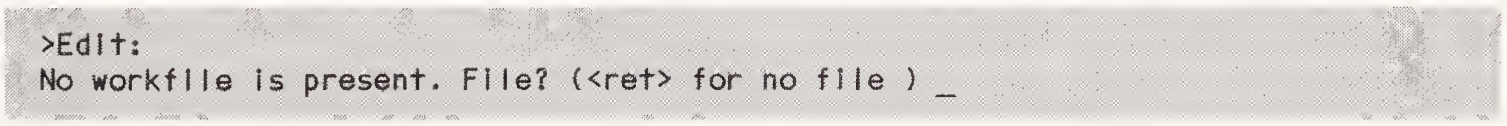
Of course the text that you deal with will be much more interesting and useful than the simple list of file names in DIRECTORY.TEXT. Business plans for a new company, human readable forms of computer programs, or even a PhD thesis, a letter to your Mom, or a book report, —all these can be stored as text files on p-System volumes.

Why should you work with these kinds of text using your computer and the p-System rather than manual methods involving pencil and paper or typewriter? If your interest is in developing p-System programs, you have no real alternative, since the p-System must be able to process your program, and it can't do that unless the program is stored in a file.

For other kinds of text, the main reason for using the p-System is convenience. The p-System includes an **Editor** program that allows you to create a text file and then later review and modify it very easily. When you are satisfied with the contents of the file, you can print it out on paper with just a few commands to the p-System. Alternatively, you can use a text formatter program to do the printing, just as we did with this book. If changes are needed, you can use the Editor again and then print the revised text. This approach is a big improvement over typing all that text again on a typewriter (especially since you're likely to produce a new set of typographic errors in the process)!

We've talked enough about the joys of text editing. It's time to do some! If you aren't already looking at the Command menu on your computer screen, do whatever you must, to get to that state. (If you need to start up the p-System again, refer back to the appropriate computer-specific appendix, or to your p-System documentation.)

To follow along in this chapter, you need to have the Screen-oriented Editor. To see if you have it, type E to invoke the E(dit activity from the Command menu. You're in luck (and you should go on to the next section), if your screen ends up looking like this:



```
>Edit:
No workfile is present. File? (<ret> for no file ) _
```

If, instead, your screen has the message "Cannot find SYSTEM.EDITOR", then you need to find the file containing the Editor and use the T(ransfer activity in the Filer to copy the editor file onto your MYVOL: volume. The section "Editor Set Up Details" in the appropriate computer-specific appendix provides some guidance. Once you have installed the Editor as SYSTEM.EDITOR on MYVOL:, invoke it by typing E in the Command menu. When you see the screen above, go on to the next section.

Some runtime configurations of the p-System don't have the Editor at all. If this is your situation, you can still read this chapter and see how useful the Editor would be if you had it!

2.2 LOOKING AT AN EXISTING TEXT FILE

Your first experience with the Editor involves a text file that already exists. (You guessed it: DIRECTORY.TEXT!) Later you will create a text file from scratch.

After the Editor program is started up, your screen should look like this:

```
>Edit:
No workfile is present. File? (<ret> for no file ) _
```

With the "File?" question, the Editor is requesting that you designate the file you want to work on. Since this is a data entry prompt, and since the file you're going to edit is DIRECTORY.TEXT, enter MYVOL:DIRECTORY [ret]. Only text files can be edited, so the ".TEXT" suffix is omitted.

Now the Editor goes to the MYVOL: diskette and gets the DIRECTORY.TEXT file (or whatever file you designate in response to the "File?" prompt). The file is copied from the disk into the Editor's **workspace** in main memory so that you can work with it. DIRECTORY.TEXT is still out on the disk; a copy of it is made in main memory. When the copying is done, a screen something like the following appears:

```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
SYSTEM:
SYSTEM.PASCAL     125 13-Jun-82
SYSTEM.FILER       37 13-Jun-82
SYSTEM.MISCINFO     1 30-May-82
SYSTEM.INTERP      28  8-Apr-82
SYSTEM.EDITOR      47  1-Apr-82
SYSTEM.LIBRARY     29  5-Jul-82
6/6 files<listed/in-dir>, 273 blocks used, 47 unused, 47 in largest
```

First notice the familiar menu structure on the top line of the screen. This is the Edit menu. Later, we explore the activities on this menu.

Also notice that the contents of the file DIRECTORY.TEXT are displayed on the screen below the menu. (The details shown on your screen reflect your system volume, and may differ from those shown above.)

This editor is called "screen-oriented" because it uses the display screen of your computer as a **window** into the workspace. When you want to look at or modify a portion of a workspace, you move the window so that you can see the portion of interest, and then use the activities on the prompt line to make changes (or whatever). Figure 2.1 shows this concept.

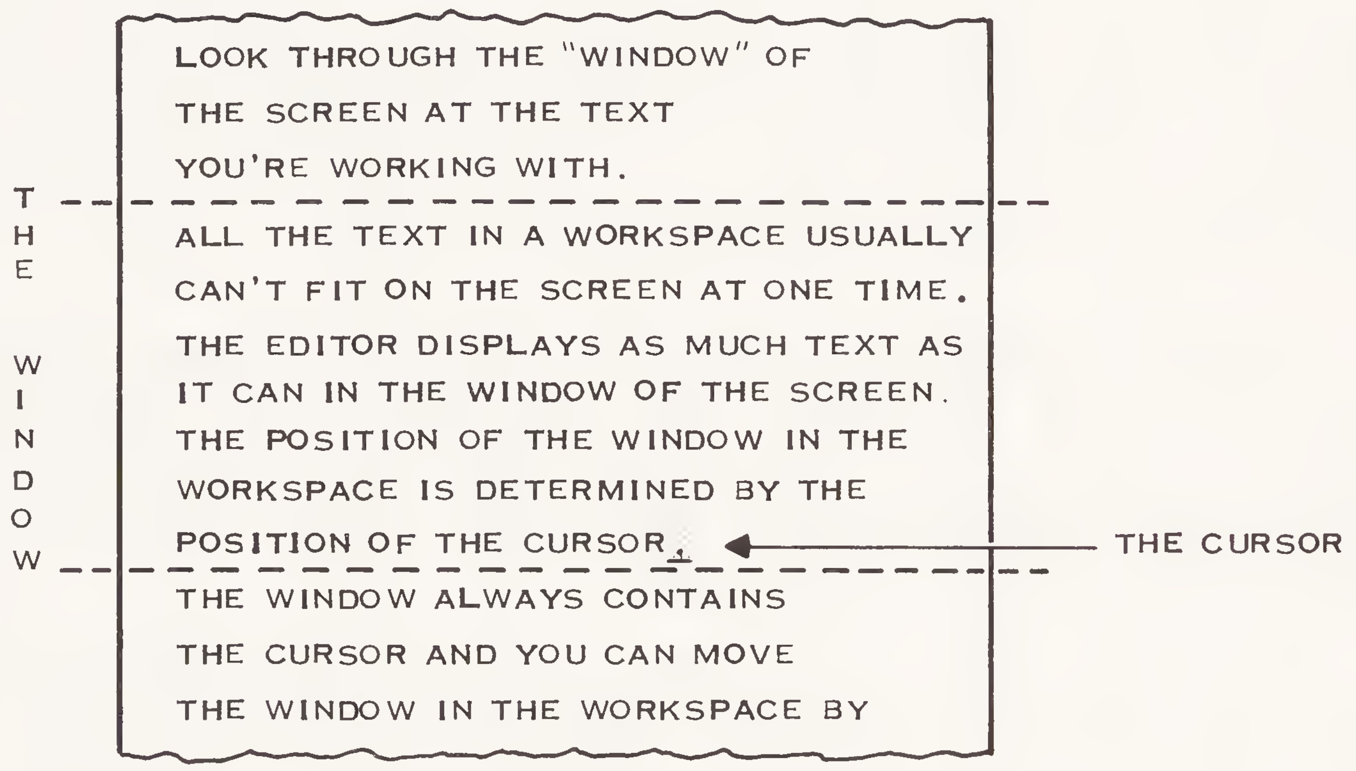

LOOK THROUGH THE "WINDOW" OF
THE SCREEN AT THE TEXT
YOU'RE WORKING WITH.
THE WINDOW
ALL THE TEXT IN A WORKSPACE USUALLY
CAN'T FIT ON THE SCREEN AT ONE TIME.
THE EDITOR DISPLAYS AS MUCH TEXT AS
IT CAN IN THE WINDOW OF THE SCREEN.
THE POSITION OF THE WINDOW IN THE
WORKSPACE IS DETERMINED BY THE
POSITION OF THE CURSOR.
THE CURSOR
THE WINDOW ALWAYS CONTAINS
THE CURSOR AND YOU CAN MOVE
THE WINDOW IN THE WORKSPACE BY

Figure 2.1

The window only highlights a general area of the workspace for attention. How can you point to a specific letter or word within the window? The answer involves the cursor, which we talked about earlier in connection with data entry prompts. You should see it right now on the first character of the line just below the menu on your screen. (A cursor is also shown in Figure 2.1.) You can think of the cursor as a pointer into the workspace you're editing. When you want to do some editing action, such as removing a word, your first step is to move the cursor to point to the word. As you move the cursor in the workspace, the Editor generally moves the window so that you can see the area where the cursor is pointing.

There are special keys which you can use to move the cursor. Some of these you've used already, but they have a slightly different function when used for cursor movement.

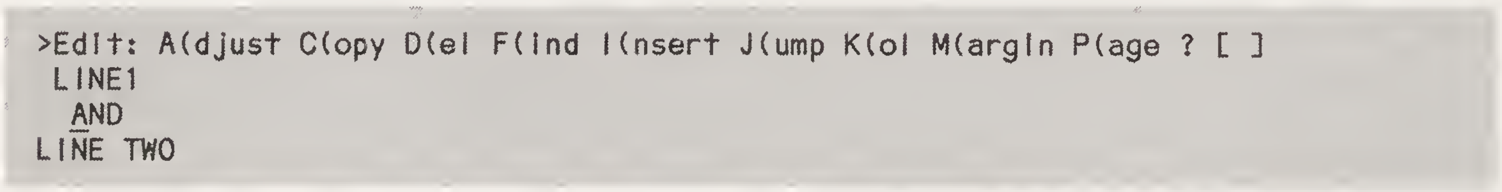
The ⟦space⟧ bar can be used to move horizontally on a line. Each ⟦space⟧ moves the cursor to the right by one position. If you space past the end of a line, the cursor moves to the beginning of the next line. Go ahead and ⟦space⟧ past the first line of the directory information in your workspace.

You can move the cursor to the left with ⟦bs⟧. Notice that when you use ⟦bs⟧ for this purpose, characters aren't erased as you backspace over them; only cursor movement occurs. What happens if you backspace through the beginning of a line? Try it! As you may have expected, you end up at the end of the previous line.

Another familiar key, ⟦ret⟧, moves the cursor towards the end of the workspace like ⟦space⟧, but by leaps of a line at a time, rather than small steps of a character at a time. Each time you type ⟦ret⟧, the cursor moves to the beginning of the following line.

The arrow keys, which you haven't used before in this book, also move the cursor. The ⟦left⟧ arrow key has the same effect on the cursor as described above for ⟦bs⟧. The ⟦right⟧ arrow key acts like the ⟦space⟧.

You can think of the characters in your workspace as beads on a string. Lines of text are separated from each other by line separator characters. These separators are also like beads on the string, but they are invisible on the screen. Consider, for instance, this simple workspace:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
 LINE1
  AND
LINE TWO
```

Figure 2.2 shows the characters of this workspace as "beads on a string." The normally invisible line separator characters are shown, and the position of the cursor is indicated by an upward pointing arrow designating the "A" in the second line. This corresponds to the position of the cursor in the workspace above.

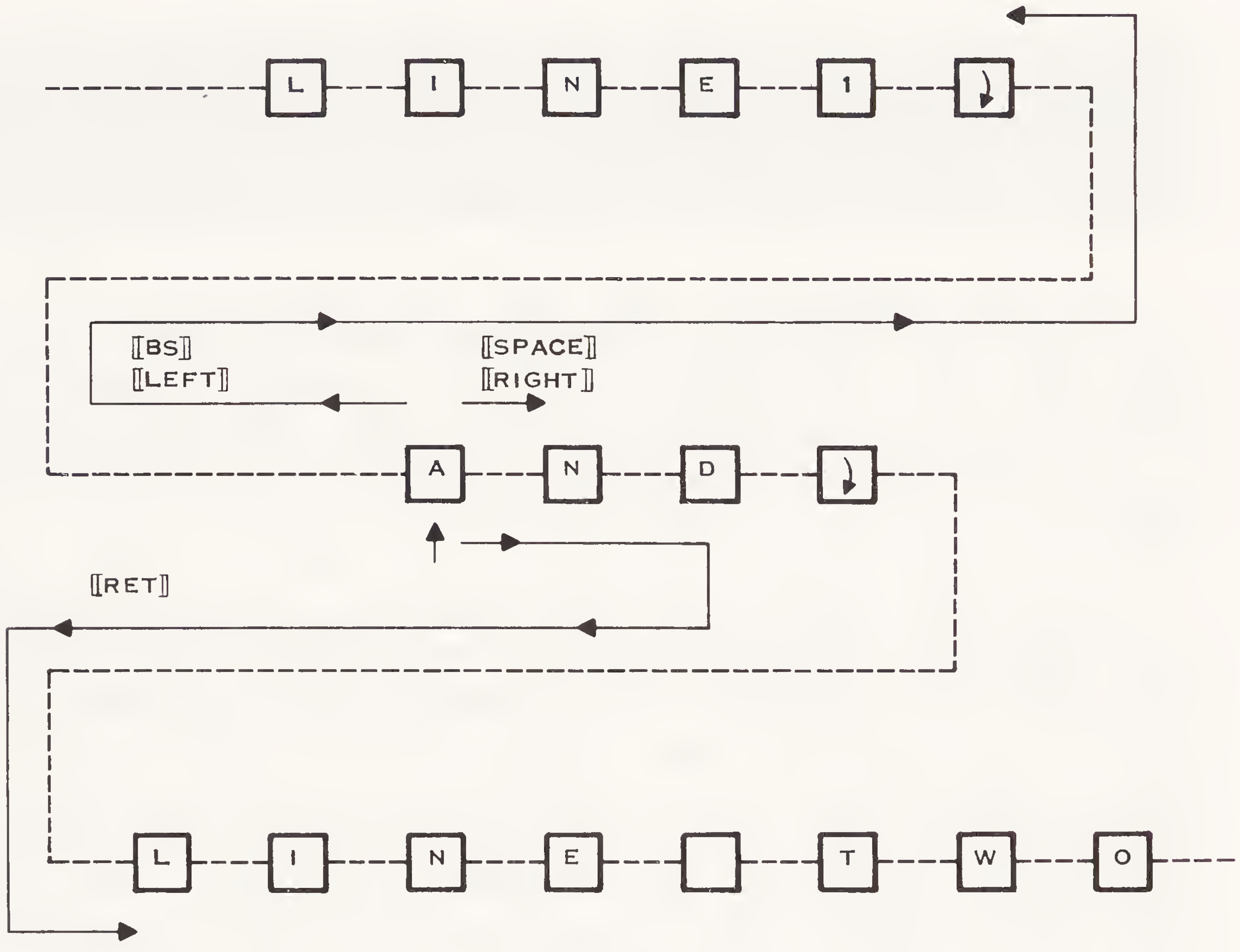


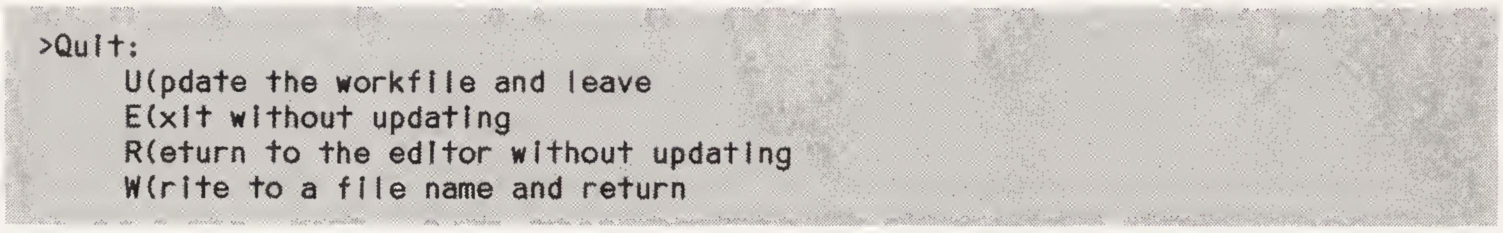
Figure 2.2

The cursor movements that would result from pressing any of five special keys ([[bs]], [[left]], [[space]], [[right]], [[ret]]) are shown.

The [[up]] and [[down]] arrow keys move the cursor, also, but they cause movement vertically, rather than along the imaginary string of Figure 2.2.

If you want to exercise your understanding of the cursor movement commands, try traversing a square on the screen using the cursor. It should be easy. Imagine how much more tedious the job would be if you couldn't use the vertical arrow keys.

You've probably seen enough of DIRECTORY.TEXT by now. You can leave the Editor by invoking the Q(uit activity. When you type Q, you should see the following screen:



```
>Quit:
     U(pdate the workfile and leave
     E(xit without updating
     R(eturn to the editor without updating
     W(rite to a file name and return
```

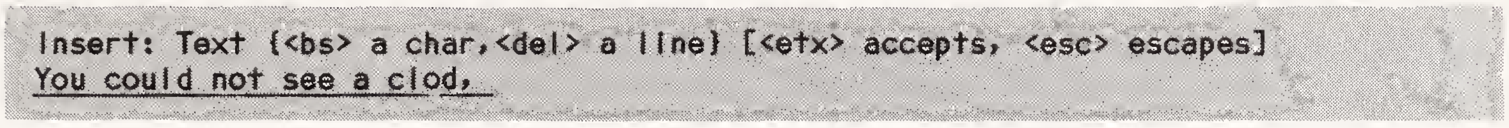
In this chapter we are only concerned with the last three of these options. The R(eturn activity is useful if you press "Q" by mistake. It puts you right back in the Editor as if you hadn't typed "Q" at all. Try typing R Q, to exercise the R(eturn item and get back to the Quit menu.

The E(xit activity is used when you haven't modified the workspace, implying that the file stored on disk does not need to be updated. For instance, you may have been simply inspecting the text. E(xit is also used if you have made modifications to the workspace but want to discard them and leave the file on disk (DIRECTORY.TEXT in this case) as it was before you entered the Editor. Go ahead and invoke E(xit. You should soon be out of the Editor and back in the Command menu. Since the next topic is the use of the Editor to create a new file, you should immediately reinvoke the E(dit activity.

2.3 CREATING A NEW TEXT FILE

This time when the prompt "No workfile present. File?" appears, you should simply press [[ret]], indicating that there is no existing file you want to edit, since you are going to build one yourself. Now the main edit menu appears, but the screen below it is empty. You're looking through the window of the screen at an empty workspace.

I(nsert is the activity that allows you to enter text. Type I You could not see a clod , and the screen should look like this:

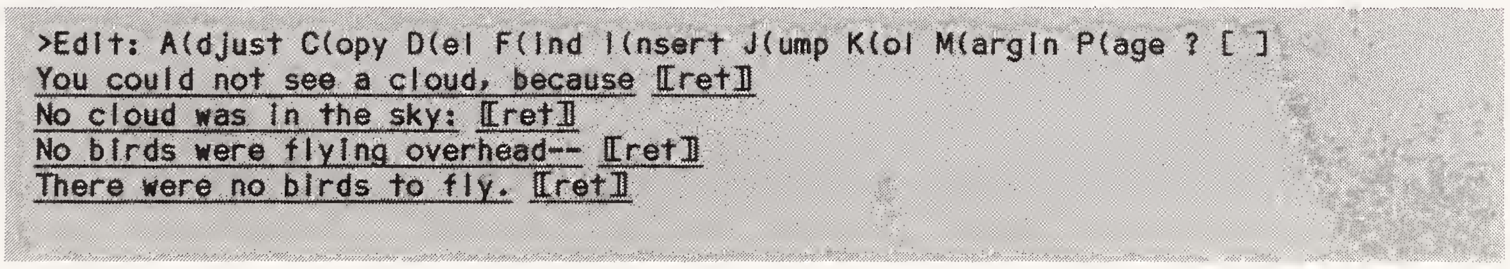


```
Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
You could not see a clod,
```

You are now inserting text. The cursor is immediately after the comma, indicating where the next character you type goes. What if you wanted "cloud", rather than "clod"? Just as with data entry prompts, you can use ⟦bs⟧ to correct errors. Type ⟦bs⟧ ⟦bs⟧ ud , and the error should be fixed.

The Insert prompt is somewhat different from other prompts you've seen. In this activity, you can type any arbitrary text that you want to add to the workspace—the word "text" in the prompt is intended to remind you of that. You can also use ⟦bs⟧ to delete a character you just typed—"<bs> a char" is intended to remind you of that. Furthermore, you can delete an entire line, but we leave the description of that possibility to Chapter 5. The last two special key possibilities in the prompt are discussed below.

Now enter the remainder of the following small excerpt from Lewis Carroll's poem "The Walrus and the Carpenter" in *Through the Looking Glass*. Use ⟦ret⟧ to end each line. Here is the screen after you press ⟦ret⟧ on the last line:



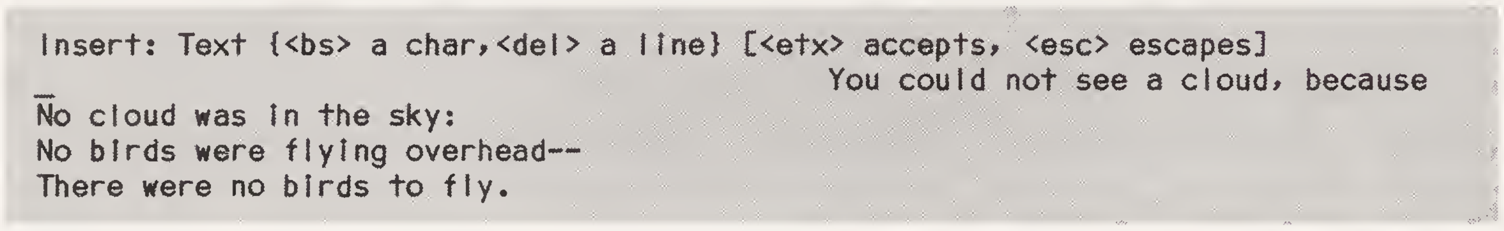
```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
You could not see a cloud, because ⟦ret⟧
No cloud was in the sky: ⟦ret⟧
No birds were flying overhead-- ⟦ret⟧
There were no birds to fly. ⟦ret⟧
```

Now you have two alternatives. First, you could conclude that this little bit of poetry was not what you wanted to insert at all. In this case, typing the ⟦esc⟧ key would discard the text you entered and you would be back in the Edit menu with an empty screen.

The second possibility is to complete the insertion by typing the ⟦etx⟧ key. (If you need to, check the inside front cover for the details on typing the ⟦etx⟧ and ⟦esc⟧

keys on your system.) Go ahead with ⟦etx⟧, and you return to the Edit menu.

Imagine you're Lewis Carroll for a moment. You're not quite happy with these four lines as they stand: they start out rather abruptly; another couple of lines at the beginning could help considerably. Move the cursor to the beginning of the first line (⟦up⟧⟦up⟧⟦up⟧⟦up⟧ should do it) and type I. The Editor doesn't know the size of the insertion you want to make, so it first opens up as much space as it can on the line where the cursor is:



```
Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
                                                  You could not see a cloud, because
No cloud was in the sky:
No birds were flying overhead--
There were no birds to fly.
```

You can now enter new material. One possible new line is "'The time has come', the Walrus said,". Enter that and see how it looks. Notice that the new line goes **before** the character on which the cursor appeared ("Y"). The cursor really points **between** characters. Since that is impossible to show accurately on most computer display screens, the character immediately after the real position of the cursor is highlighted. When an insertion is made in the workspace, the characters ("beads") after the cursor are moved down to make room for the inserted material. Figure 2.3 shows some character beads on a string, before, during, and after an insertion. For each case, the location of the visible cursor is shown by an arrow.

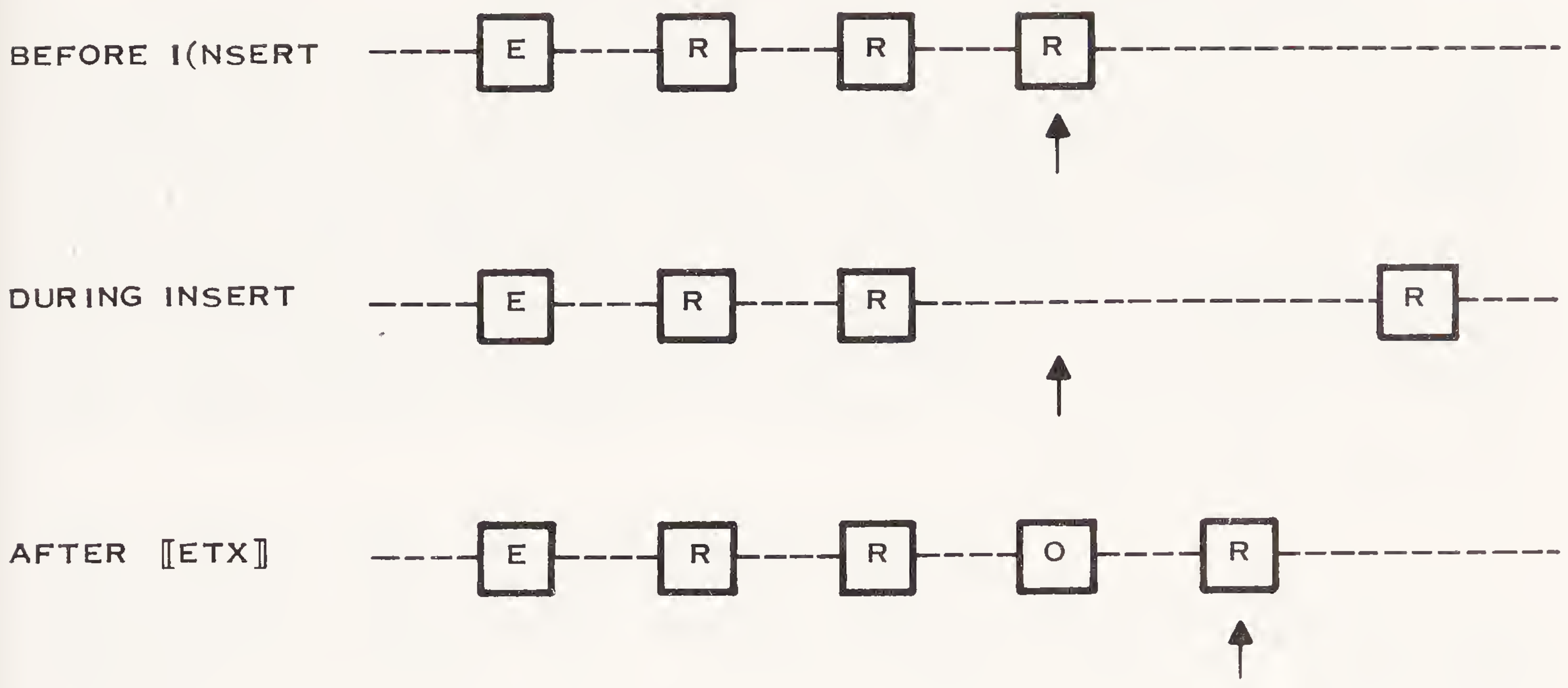
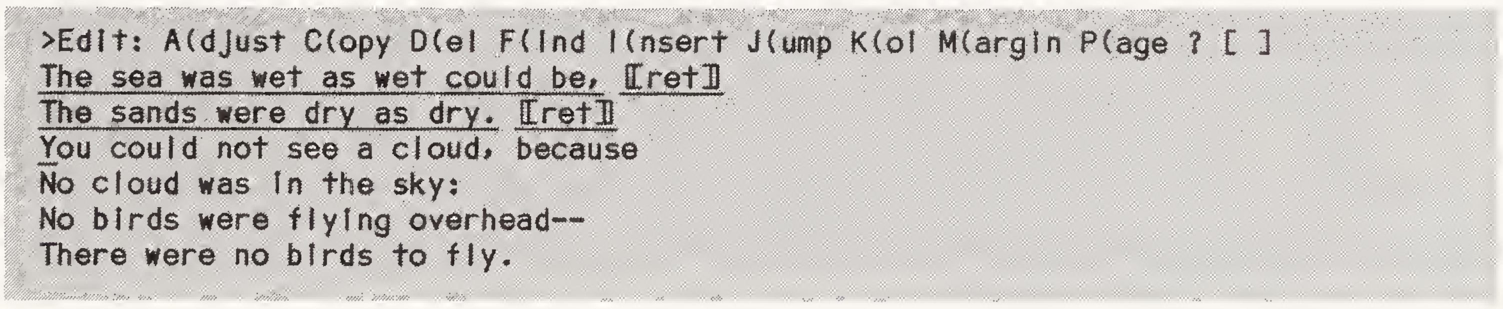


Figure 2.3

Even though you're not Lewis Carroll, it should be clear after you've entered this new line that it doesn't quite work. Here's your chance to use the ⟦esc⟧ key to discard an insertion. When you type ⟦esc⟧, the offending line vanishes, and you're back with the original four lines.

Maybe the best idea is to use the words that Lewis Carroll actually wrote. Type I to invoke I(nsert; then enter the two new lines that are shown at the top of this screen:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
The sea was wet as wet could be, ⟦ret⟧
The sands were dry as dry. ⟦ret⟧
You could not see a cloud, because
No cloud was in the sky:
No birds were flying overhead--
There were no birds to fly.
```

Now press ⟦etx⟧ to accept the insertion. The next section describes how you can save the results of your work so far.

2.4 SAVING THE WORKSPACE ON DISK

When Lewis Carroll wrote these lines in 1872, he wasn't using a personal computer and didn't have to worry about power failures or other technical catastrophes. You do. As a result, it is prudent to stop periodically during a long editing session and write a copy of your workspace from main memory onto a disk file. Usually you wouldn't do this after only six lines of input, but poetry is hard work, and it's time for a break.

To save a copy of your workspace on disk, invoke the Q(uit activity and its W(rite option. The screen should look like this:

```
>Quit:
Name of output file (<cr> to return)  ->_
```

When you enter a file name here, you can leave off the .TEXT suffix just as you did on entry to the Editor.

You need to choose a name for this file. How about "WALRUS"? To use that name on volume MYVOL:, respond as follows:

```
>Quit:
Name of output file (<cr> to return)  ->MYVOL:WALRUS [ret]
```

The Editor reports the results of the copy-to-disk operation, including the number of **bytes** ("characters") that were contained in your workspace. The Editor then queries you on the next step:

```
>Quit:
Writing..
Your file is 1003 bytes long.
Do you want to E(xit or R(eturn to the Editor?_
```

Type E to E(xit the Editor. We'll re-enter the Editor momentarily and copy "WALRUS" into the workspace again from disk.

Sometimes a Q(uit W(rite operation can go wrong. For instance, you might pick a file name that had too many characters or was illegal in some other way. Chapter 5 discusses (in the "Leaving the Editor" section) the possible problems and what you can do about them.

Now that you know how to **insert** text, the next step is learning how to **delete** text.

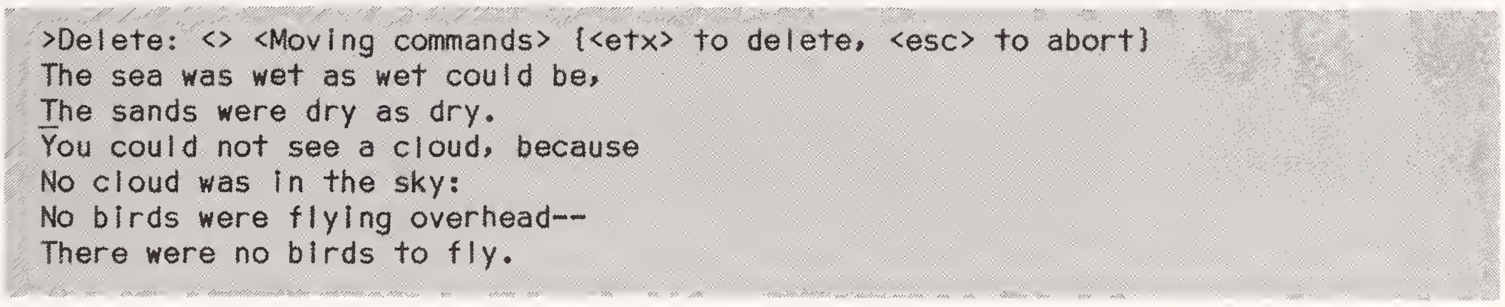
2.5 DELETING AND MOVING TEXT

One of the pleasures of using a personal computer to write poetry is that it's easy to experiment with various arrangements of the lines of a poem. Let's try some modifications to our "Walrus and the Carpenter" excerpt. Let's exchange the second and the fourth lines. That probably won't be an improvement from an aesthetic point of view, but it will be an enlightening exercise.

Enter the Editor and respond to the "File?" question with MYVOL:WALRUS ⟦ret⟧. After some disk activity, the immortal lines should reappear below the Edit menu.

There isn't a specific operation in the Editor for moving material from one place to another. What you do instead is delete text from one place and copy it in at the new location. A special facility called the **copy buffer** allows you to avoid retyping the text during this process.

Move the cursor to the beginning of the second line by typing ⟦ret⟧. Invoke the D(elete activity by typing D. The Delete menu appears:



```
>Delete: <> <Moving commands> {<etx> to delete, <esc> to abort}
The sea was wet as wet could be,
The sands were dry as dry.
You could not see a cloud, because
No cloud was in the sky:
No birds were flying overhead--
There were no birds to fly.
```

The position of the cursor when you enter Delete is called the **anchor.** The cursor moving keys, such as ⟦space⟧, ⟦bs⟧, ⟦ret⟧, and the arrow keys, are operational in

Delete. Whenever you cause the cursor to move away from the anchor, text disappears; if you move towards the anchor, that text reappears. This works on either side of the anchor. Figure 2.4 shows what happens.

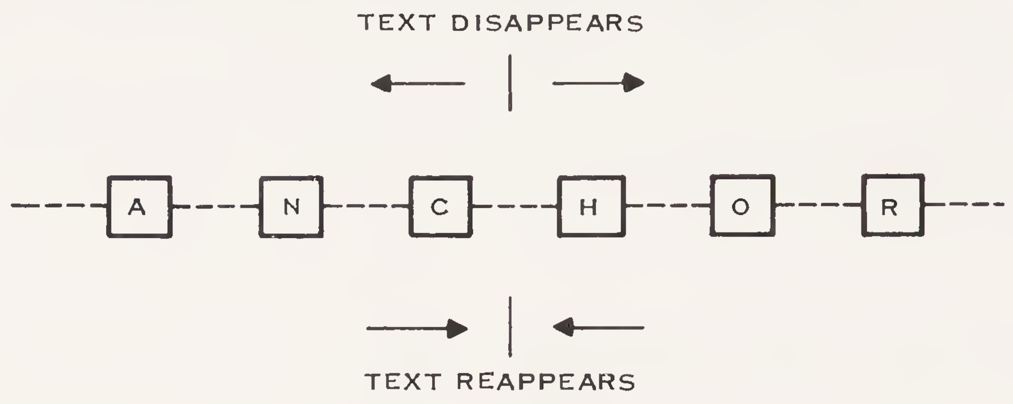


Figure 2.4

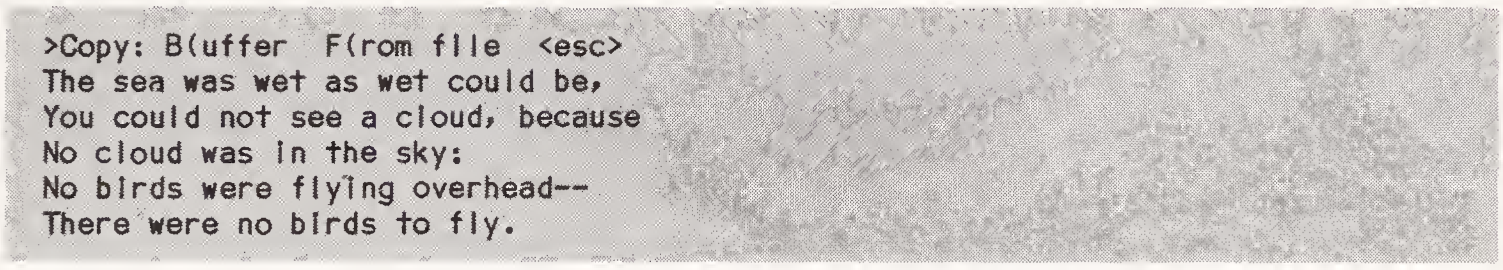
You can see this behavior in action by typing __[[space]]__ several times. Each [[space]] causes a character to disappear. Now try a few __[[bs]]__ keys; for each one, a character reappears until you reach the anchor. If you continue, characters start disappearing again.

Since what we really need to do is delete the entire "sands were dry" line, __[[space]]__ back to the anchor. You could now delete the characters of this line individually with [[space]], but it is simpler to use [[ret]] to do it in one step. Go ahead and do that.

At any point during Delete, you have the option to type [[esc]] and leave the workspace just as it was when you invoked D(elete. Alternatively, you can type [[etx]] and cause the deletion to take effect. Now that the line we wanted to get rid of has disappeared, it's time to type __[[etx]]__. The resulting screen shows that you have succeeded:

```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
The sea was wet as wet could be,
You could not see a cloud, because
No cloud was in the sky:
No birds were flying overhead--
There were no birds to fly.
```

There is still the matter of copying the deleted line into its new location. For that, we make use of the C(opy activity. The Editor has saved the line you deleted in its **copy buffer.** If you now move the cursor to the place you want the text to go, the C(opy activity allows you to place it there. Type [[down]] C; this screen should result:



```
>Copy: B(uffer  F(rom file  <esc>
The sea was wet as wet could be,
You could not see a cloud, because
No cloud was in the sky:
No birds were flying overhead--
There were no birds to fly.
```

The Copy menu shows two possible choices: "B" causes the contents of the buffer to be inserted where the cursor was on entrance to C(opy; "F" allows text to be copied in from another file. Type B. You did it! Now use the same approach to move the "No cloud was in the sky" line so that it becomes the second line of the poem. How does it feel to be an author? (Or at least an editor!)

Text is stored in the copy buffer when any of the following actions occur:

- o When you exit the Delete menu with [[etx]], the designated text disappears and is saved in the copy buffer. You just made use of this feature.
- o When you exit the Delete menu with [[esc]], the designated text is not deleted, but it is stored in the copy buffer, anyway. This facility can be used to make a duplicate copy of a section of text.
- o When you exit the Insert menu with [[etx]], the inserted text is stored in the copy buffer, and can be reinserted elsewhere in the workspace.

When you [[esc]] from Insert, the copy buffer is cleared. If you're using the copy buffer to move some text, be careful not to invoke I(nsert before you have placed the text in its new position.

We think Lewis Carroll would have enjoyed the concept of the copy buffer. We can see the sequel: *Alice's Adventures in the Copy Buffer.*

If you want to do any further experimentation with your workspace, do it now. When you're ready to go on to other material, there is one more thing you need to know about the Q(uit W(rite activity. When you invoke it this time, the screen is different from last time:

```
>Quit:
$ writes to MYVOL:WALRUS.TEXT
Enter output file name (<cr> returns) ->_
```

This time, the Editor knows that the workspace was copied from the file MYVOL:WALRUS.TEXT. The Editor now gives you a shorthand way to write the workspace out to that file. If you simply type $ ⟦ret⟧, you'll save eighteen letters of typing and the mistakes you might have made in the process. Go ahead and do that; then E(xit the Editor.

A Q(uit W(rite operation on a file replaces an existing version of that file by a new one containing the workspace. Therefore you should be sure, when you use Q(uit W(rite, that you really want to discard the previous version of the file.

In the next section we create a larger file and explore some other capabilities of the Editor that are very useful with larger files.

2.6 SHORT CUTS FOR TEXT CREATION

We are going to create text from scratch again, so enter the Editor (with E) and type ⟦ret⟧ to the "File?" question. Invoke the I(nsert activity and enter the text shown in this screen:

```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
99 bottles of beer on the wall, ⟦ret⟧
99 bottles of beer; ⟦ret⟧
If one of those bottles should happen to fall: ⟦ret⟧
There'd be 98 bottles of beer on the wall. ⟦ret⟧
⟦ret⟧
_
```

Be sure to do an extra ⟦ret⟧ on the last line to insert an empty line and an ⟦etx⟧ to accept the insertion.

As you probably know, there are many verses to this song—one hundred to be exact! Each one starts with one less bottle available. We are now going to test your text-entering stamina by adding the next ten or so verses to the one you've already entered.

Before you panic and/or rebel, we should tell you that it won't be as hard as it sounds. Using the conveniences of the Editor simplifies the task dramatically.

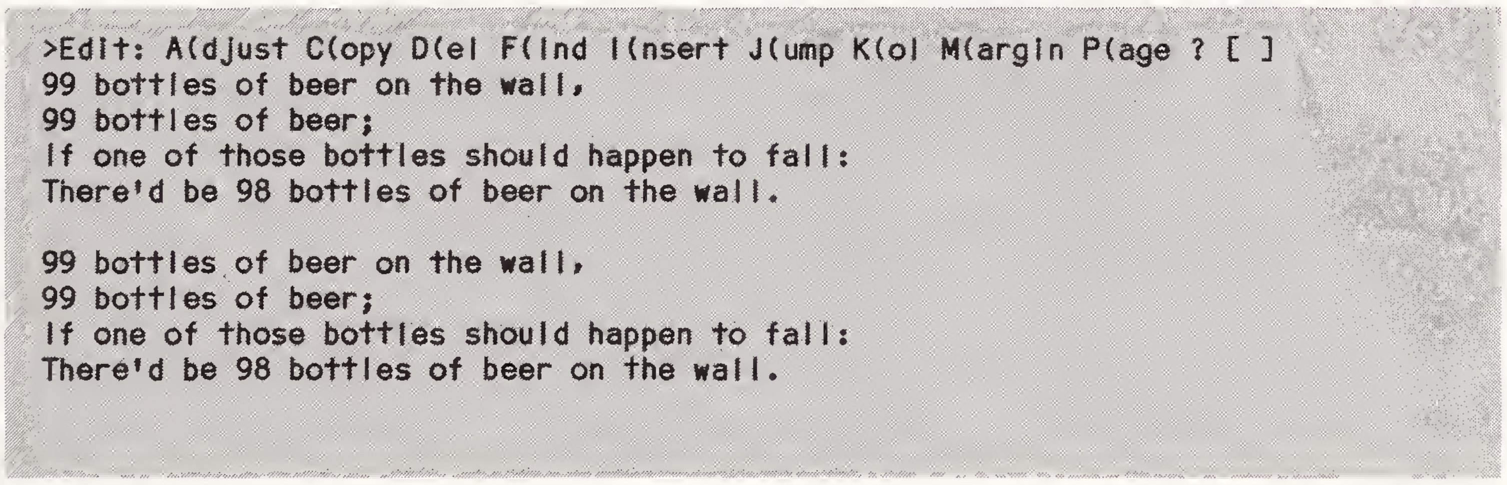
If you entered all the text above in a single invocation of the I(nsert activity, then those lines are stored away now in the copy buffer.

If you did more than one Insert or a Delete, those operations modified the copy buffer, so you need to go to the top line of the text, and type

D [ret][ret][ret][ret][ret][esc]

to set the copy buffer.

Type C B. The screen should look like this:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
99 bottles of beer on the wall,
99 bottles of beer;
If one of those bottles should happen to fall:
There'd be 98 bottles of beer on the wall.

99 bottles of beer on the wall,
99 bottles of beer;
If one of those bottles should happen to fall:
There'd be 98 bottles of beer on the wall.
```

Type the same two characters ("CB") three more times, and you have the first five verses (except for little details like the correct numbers in each).

The next step is to go back and get all the numbers right. (Don't worry, there are short-cuts for this task, as well.)

The first need is to get back to the beginning of the workspace. You could type [[bs]] a great many times. Alternatively, you could type [[up]] somewhat fewer times. Either approach would be rather awkward. In the next section, we describe some additional facilities in the Editor for moving the cursor around; these are particularly applicable (and necessary) when workspaces start to get large like this one.

2.7 MORE ON CURSOR MOVEMENT

One very useful cursor movement concept is **repeat factors.** A repeat factor is a number that you type before pressing a cursor movement key. If you type "5", and then [[ret]], the Editor acts as if you typed [[ret]] five separate times.

If you don't type an explicit repeat factor before a cursor movement key, the Editor only performs the cursor movement once. If you do type a number, it won't appear on the screen: you'll just see the results when the cursor makes a large leap rather than a small step. The repeat factor only applies to the very next activity or special key, and can have any value between 1 and 9,999.

Try it! Experiment with the [[up]] and [[down]] keys, using various repeat factors. Notice that no matter what repeat factor you use, you can't move down past the end of the workspace or up past the beginning.

There is a special repeat factor, "/", which means "as many as possible." When you type "/" [[ret]], the Editor moves the cursor all the way to the end of the workspace. Similarly, "/" [[up]] moves the cursor to the beginning of the workspace.

There are more direct ways to accomplish these movements: the J(ump activity allows you to leap directly to the beginning or end of the workspace with just two keystrokes. Invoke J(ump now, by typing J. This menu should appear on the top of your screen:

```
>JUMP: B(eginning E(nd M(arker <esc>
```

The purpose of the B(eginning and E(nd options should be clear by now. Try them out if you'd like. We postpone discussion of the M(arker option until Chapter 5.

One remaining cursor movement operation needs to be introduced in this chapter: the P(age activity, which moves the cursor by a distance that is approximately the size of the display screen. P(age is very handy for browsing through the workspace.

What if you want to P(age backwards in the workspace? Look at the first (leftmost) character on the menu line of the screen. It is the Editor's **direction indicator.** The ">", which should be there now, indicates that forward motion (towards the end of the workspace) is assumed by the Editor. To change to backward motion, press the <u><</u> key (left angle bracket, usually the shifted version of the comma key). You should see the direction indicator change to "<". If you invoke P(age next, the cursor leaps towards the beginning of your workspace. Try exercising P(age in both directions.

This direction indicator affects more than the P(age activity. If the direction is backwards, ⟦space⟧ acts like ⟦bs⟧, and ⟦ret⟧ moves to the end of the previous line, rather than the beginning of the next line. The arrow keys and ⟦bs⟧ are unaffected by the Editor's direction status.

You can change the Editor's direction indicator whenever you can use the cursor movement keys such as the arrows, ⟦space⟧ and ⟦bs⟧. You can also type the comma key or the minus key as a substitute for typing "<", and the period key or the plus key, instead of ">".

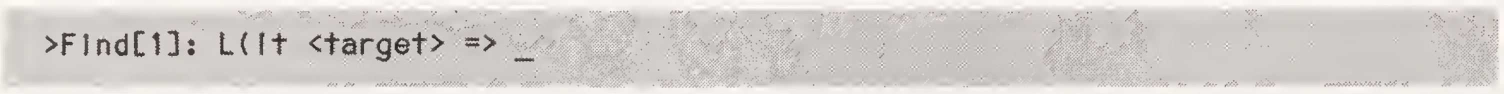
The period and comma are available in this context because on many keyboards, "<" is the shifted version of the comma, and ">" the shifted version of the period.

You now know many ways to move the cursor, including several equivalent approaches to each kind of cursor movement. Each user of the Editor develops a style of cursor movement in which some of these approaches are emphasized and others are virtually ignored. In the style we use in our own work, for instance, we rarely change the Editor's direction indicator, except in connection with the P(age activity.

Now back to the original problem: changing the numbers in each verse from "99" or "98" to the appropriate ones. You could, of course, use the cursor movement keys you have seen above to put the cursor on each "99", delete those two characters and insert a "98" (or a "97", or a "96"...), but there's got to be a better way!

2.8 FINDING AND REPLACING TEXT PATTERNS

One better way involves the F(ind activity on the Edit menu, which allows the Editor do the work of finding each occurence of "99". If the cursor isn't already at the beginning of the workspace, use J B to move the cursor there. Also make sure that the direction indicator is pointing forwards, ">". Then invoke F(ind, and the following prompt appears on the top line of your screen:



```
>Find[1]: L(it <target> => _
```

You are now expected to enter a **target** text pattern; that is, the one you wish to find. The pattern (or "string") should be bounded on each side by a **delimiter** character, such as "/". Any character that isn't a letter or number is fine, as long as the same one is used on both ends of the string and does not occur within the string. Here are some valid strings with delimiters around them:

/99/
/tropical "blend"/
"ways/means"
:"Hello!":

Normally, F(ind only discovers occurrences of the target that are "isolated words" (that is, character sequences surrounded on both sides by blanks or special characters). For instance, if the target is "the", the word "thereafter" is ignored by F(ind. The description of F(ind in Chapter 5 has details on finding "embedded" patterns of this sort.

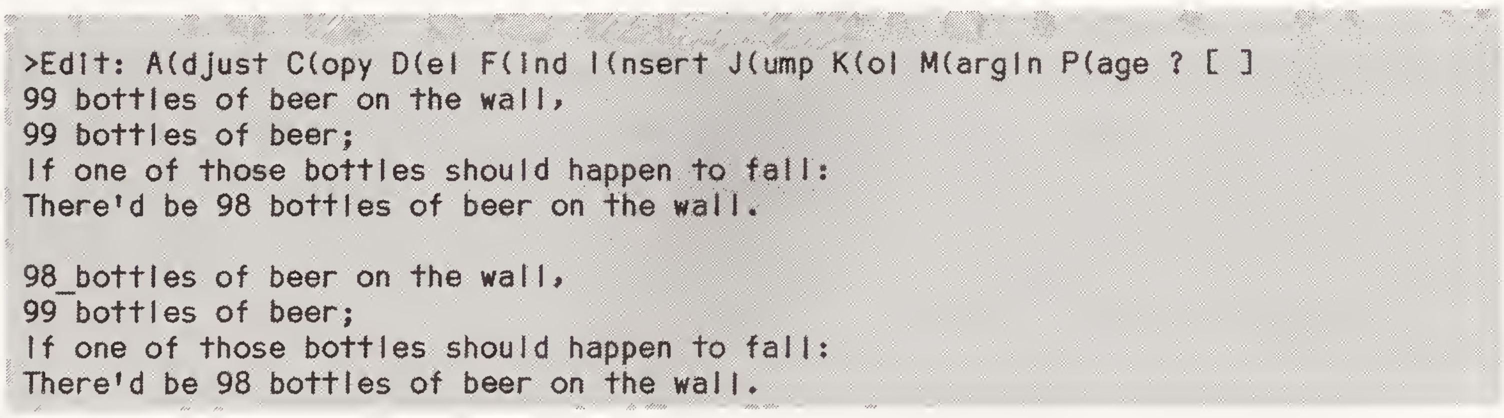
Type /99/; the cursor should leap to the end of the first "99" in the current direction (forwards). Since this instance of "99" is just fine as it stands, you need to go on. Fortunately there is a short-cut that saves you typing "99" again. When you search for the same string twice in a row (or more), you can type "F" to select F(ind, and then "S" (for "same"), instead of typing the string again. Even more conveniently, it turns out that repeat factors work for the F(ind activity just as they do for the simpler cursor movement operations. Remember the "[1]" in the Find menu? That was the repeat factor for that invocation of F(ind. (Recall that an absent repeat factor is assumed to be one.)

We can combine these two shorthand tricks and type 2FS to skip to the character after the third "99" in the workspace. (In that short-hand sequence, the "2" is a repeat factor, the "F" invokes F(ind, and the "S" indicates that "99" should be sought again.)

We want to change that "99" to a "98". The following sequence should do the job:

D [[bs]][[etx]]	Delete one character backwards.
I 8 [[etx]]	Insert an "8".

Here is the interesting part of the resulting screen:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
99 bottles of beer on the wall,
99 bottles of beer;
If one of those bottles should happen to fall:
There'd be 98 bottles of beer on the wall.

98_bottles of beer on the wall,
99 bottles of beer;
If one of those bottles should happen to fall:
There'd be 98 bottles of beer on the wall.
```

F(ind is certainly a handy activity for this job, but it would be preferable if you didn't have to do the explicit I(nsert and D(elete operations. And you don't if you use the R(eplace activity (abbreviated "R(plc" on the menu). With this activity, you can replace occurrences of one string of characters (called the target, just as in the F(ind activity) with another (called the **substitute**). When you use R(eplace, the Editor F(inds the first occurrence of the target string you specify and replaces it by the substitute string.

Invoke R(eplace now, by typing R; the following prompt appears:

```
>Replace[1]: L(it V(fy <targ> <sub> => _
```

Ignoring for this chapter the "L(it V(fy", this prompt is requesting that you specify the target and substitution strings. What you need to do is replace "99" by "98", so type /99/ /98/ and make sure the replacement is done.

To complete conversion of the second verse, type R /98//97/. Here is the interesting portion of the resulting workspace:

```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
99 bottles of beer on the wall,
99 bottles of beer;
If one of those bottles should happen to fall:
There'd be 98 bottles of beer on the wall.

98 bottles of beer on the wall,
98 bottles of beer;
If one of those bottles should happen to fall:
There'd be 97_bottles of beer on the wall.
```

It should be clear now that you could go on to do similar operations to correct the rest of the verses. Even though the use of R(eplace would simplify that job compared to doing it with I(nsert and D(elete, the task would still be somewhat tedious.

A further simplification can be achieved by using repeat factors with R(eplace. Just as with F(ind, the repeat factor is shown inside square brackets in the R(eplace menu. With R(eplace, the repeat factor determines how many instances of the target string are replaced by the substitute string. When the "infinite" repeat factor ("/") is used, the result is that **every** occurrence of the target string that is found in the current direction of cursor movement is replaced by the substitution string. (See section 2.7 for a discussion of the infinite repeat factor.) The following sequence uses repeat factors with R(eplace to complete the corrections on the first five verses of *99 Bottles of Beer*.

2 R /99//97/	Correct the two 99's in the third verse.
R /98//96/	Correct the 98 in the third verse.
2 R /99//96/	Correct the two 99's in the fourth verse.
R /98//95/	Correct the 98 in the fourth verse.
2 R /99//95/	Correct the two 99's in the fifth verse.
R /98//94/	Correct the 98 in the fifth verse.

At last you're done!

You certainly want to save this masterpiece on disk. Go ahead and do that now, using the Q(uit W(rite activity, and choosing some appropriate file name (say, "MYVOL:99BOTTLES"). Remember to complete the entry of the file name with [ret]. When the writing is done, type R to R(eturn to the Editor for one more experiment with this workspace.

The exercise below is intended to eliminate any confusion you may have about the difference between the effects of Q(uit E(xit and Q(uit W(rite. Here is the sequence:

J B	Move cursor to start of workspace.
/ R .beer..Coke.	Replace **all** "beer" by "Coke".
Q E	Q(uit E(xit.
E	Re-enter the Editor and get
MYVOL:	(from volume MYVOL:)
99BOTTLES [ret]	the file 99BOTTLES.TEXT. If you chose a different name in the Q(uit W(rite, above, use that name.

The screen you see in the Editor should have lots of "beer" and no "Coke" at all! The conclusion:

The work you do with a workspace in the Editor is not saved on disk, and is lost forever, if you use Q(uit E(xit to leave the Editor.

In the next section we use the creation of another small workspace to show you how the Editor helps you in entering text where the indentation structure is important (as in outlines, for example). To prepare for that exercise, leave the Editor now (via Q(uit E(xit, <u>Q</u> <u>E</u>).

2.9 ENTERING OUTLINE-STRUCTURED TEXT

The Editor is quite handy for working with text in which the indentation of a line shows its position in a structure. One example of such text is an outline. Another potential example is a computer program.

We are indebted to **The Official Preppy Handbook** for an example of an outline to work with in this and subsequent sections. The word "preppy" was made famous by Erich Segal's best-selling novel, **Love Story.** The least interesting definition of "preppy" is a young man in college who had his high school training in a private "prep school." Selections from the **Handbook's** Table of Contents are shown below:

```
THE RIGHTS OF BIRTHRIGHT: The Years at Home.
  Prep on All Fours: The Proper Pet.
  Regulating the Cash Flow: Well-to-Dos and Don'ts.
THE ROOT OF ALL PREP: The Years at School.
  Preparing to Prep: Picking the School for You.
    Boarding vs. Day
    Single-Sex vs. Coed
  Breaking the Rules: The Importance
    of Getting Kicked Out.
```

Enter the Editor with an empty workspace (by typing E ⟦ret⟧ from the Command menu). Then invoke I(nsert and type in the first line of the table of contents above. On the second line, type ⟦space⟧ twice at the beginning. When you finish that line and type ⟦ret⟧, notice that the Editor places the cursor under the "P" of the previous line.

This behavior is called **automatic indentation.** When you type spaces at the beginning of a new line, the Editor assumes that means you are establishing a new indentation level at the first non-space character you type. On your next line, the Editor automatically indents the cursor to that new indentation level.

After you enter the third line, the Editor initially aligns the cursor with the beginning of the previous line. The same principle you used above allows you to change the indentation in the other direction. If you type ⟦bs⟧ twice and then the "THE ROOT OF ALL PREP" line, another new indentation position is established. Go on in this way to do the entire selection. When you're done, type ⟦etx⟧ to confirm the insertion.

Remember, if you want to change the indentation on a line, you must type ⟦space⟧ or ⟦bs⟧ immediately after terminating the previous line with ⟦ret⟧.

This concludes our introduction to the aspects of the Editor that are useful for working with programs and with ordinary text like memos and books. If you are only interested in using the Editor to develop programs, you may skip the rest of this chapter and go right to Chapter 3. You may want to come back and read the rest of this chapter at some point. The last section "Printing Text Files," is likely to be of interest to you even if you use the p-System solely for programming.

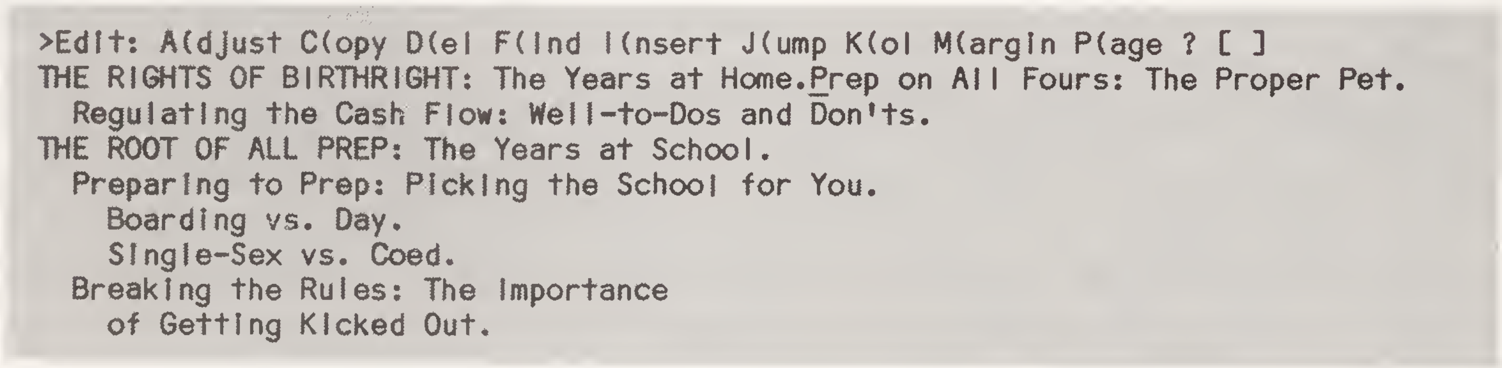
2.10 PARAGRAPH-ORIENTED TEXT

So far we have dealt with text that has lines as a natural structural unit. We've seen poems, song lyrics and outlines. There are many kinds of text, of course, where paragraphs are the natural unit of structure, and line boundaries are simply determined by the left and right margins that have been established. In this section we introduce you to the Editor activities which are useful for manipulation of text that is paragraph-oriented.

You have just entered portions of a Table of Contents into your workspace. Imagine now that each of those lines is a sentence in a paragraph and that you need to get them to look more like a paragraph than a set of independent lines. As an exercise, we're going to go ahead and fill this imagined need.

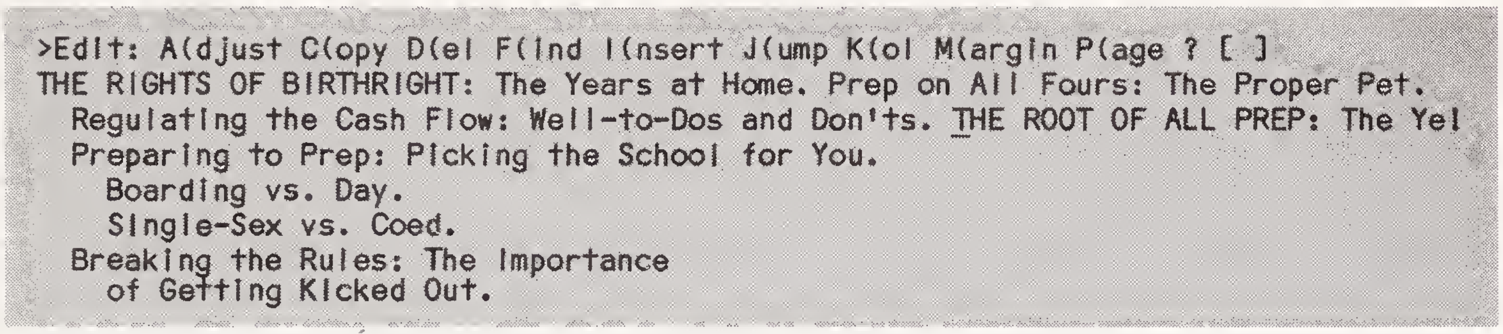
There are two ways to proceed: the easy way (using facilities built into the Editor for just this kind of task) and the hard way (using Editor facilities that you already know about). We spend a little time on the hard way, first. (If you haven't already typed ⟦etx⟧ to accept the insertion of the Table of Contents, do so at this point.)

The principal foundation of this more difficult approach is that two lines can be merged into one by deleting the invisible line separator that divides them. You can delete that character by moving the cursor to the end of a line (right after the last character), invoking D(elete, pressing ⟦space⟧ (to move one character), and closing with ⟦etx⟧. If you apply this process at the end of the first line of the outline, you should get this result:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
THE RIGHTS OF BIRTHRIGHT: The Years at Home.Prep on All Fours: The Proper Pet.
  Regulating the Cash Flow: Well-to-Dos and Don'ts.
THE ROOT OF ALL PREP: The Years at School.
  Preparing to Prep: Picking the School for You.
    Boarding vs. Day.
    Single-Sex vs. Coed.
  Breaking the Rules: The Importance
    of Getting Kicked Out.
```

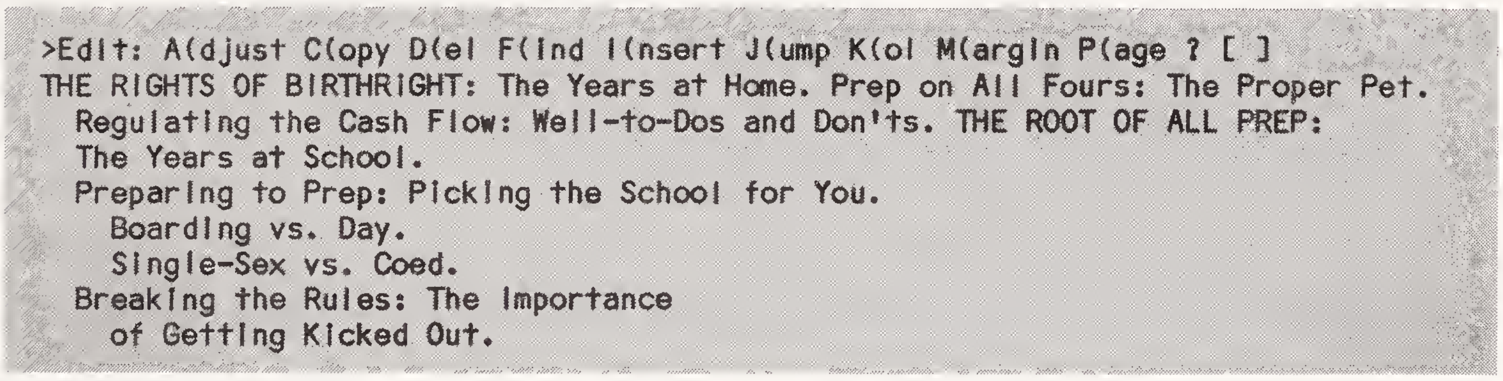
Since there is ordinarily some space between sentences, you need to insert a space character at the position of the cursor to complete the transformation. (Type I ⟦space⟧ ⟦etx⟧.) If you apply this same process to the next pair of lines, the following display results:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
THE RIGHTS OF BIRTHRIGHT: The Years at Home. Prep on All Fours: The Proper Pet.
  Regulating the Cash Flow: Well-to-Dos and Don'ts. THE ROOT OF ALL PREP: The Ye!
  Preparing to Prep: Picking the School for You.
    Boarding vs. Day.
    Single-Sex vs. Coed.
  Breaking the Rules: The Importance
    of Getting Kicked Out.
```

You probably have a "!" on the right-hand margin of your screen, just like that shown above. When the Editor cannot display a line completely, it substitutes a "!" for the last character that it can show (in our case the 80th). The location of the "!" on your screen depends on what line width your display can handle.

The entire line (without the "!") is still in the workspace. What we need to do now is break this over-sized line by inserting a line separator (just as we deleted one earlier). Move the cursor right to the "T" in "The". Typing 22 [[right]] should do it. Then type I [[ret]][[etx]] to complete the first few lines of your painful transformation of the line-oriented workspace to a paragraph orientation:

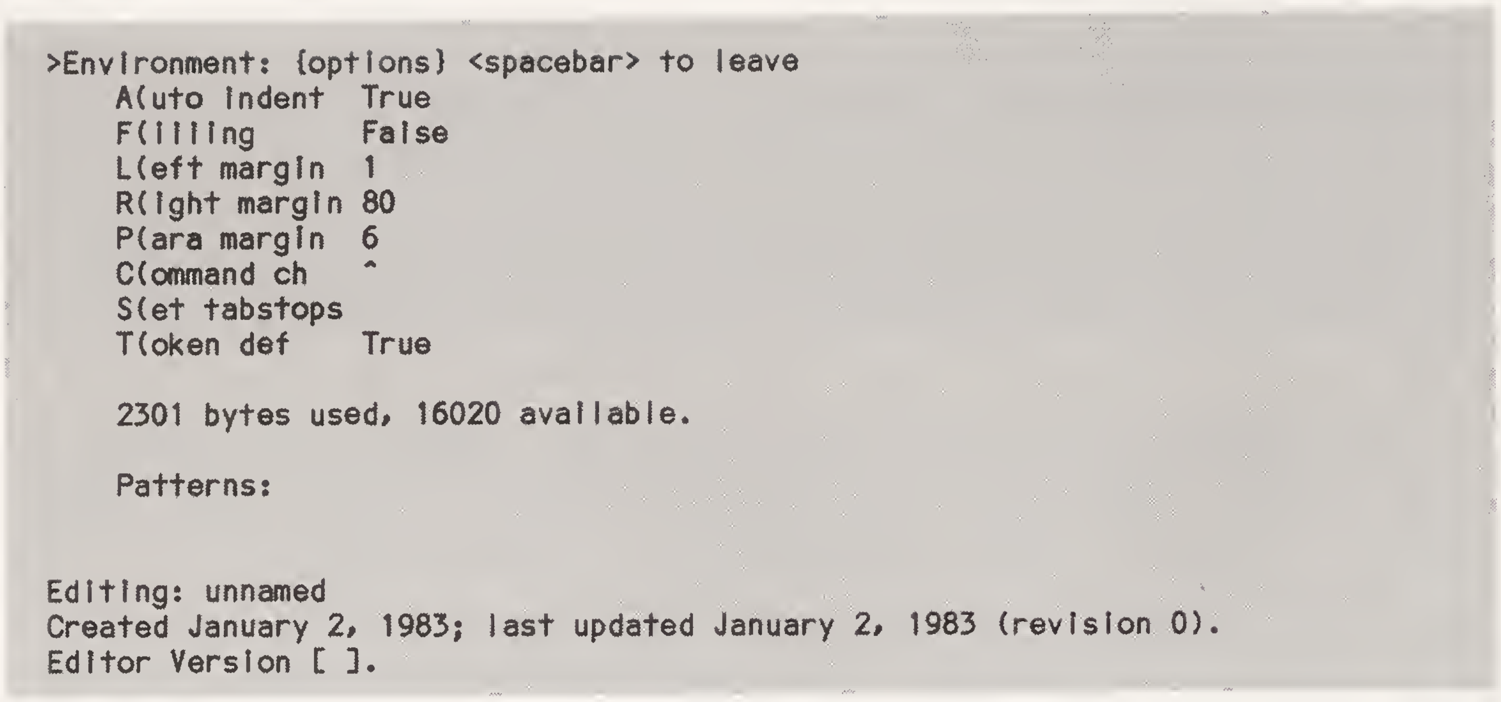


```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
THE RIGHTS OF BIRTHRIGHT: The Years at Home. Prep on All Fours: The Proper Pet.
  Regulating the Cash Flow: Well-to-Dos and Don'ts. THE ROOT OF ALL PREP:
  The Years at School.
  Preparing to Prep: Picking the School for You.
    Boarding vs. Day.
    Single-Sex vs. Coed.
  Breaking the Rules: The Importance
    of Getting Kicked Out.
```

Now, for the easy method! We need to change the Editor to a different mode of operation: a mode designed specifically for paragraph-oriented text. We deal with this mode change in the next section.

2.11 CHANGING EDITOR MODES

Type S E to invoke S(et E(nvironment. This activity allows you to change certain aspects of the Editor's behavior and get at useful information. You should see a display like that on the next page.



```
>Environment: {options} <spacebar> to leave
    A(uto indent  True
    F(illing      False
    L(eft margin  1
    R(ight margin 80
    P(ara margin  6
    C(ommand ch   ^
    S(et tabstops
    T(oken def    True

    2301 bytes used, 16020 available.

    Patterns:


Editing: unnamed
Created January 2, 1983; last updated January 2, 1983 (revision 0).
Editor Version [ ].
```

In this screen the first group of lines (ending with "T(oken def") deals with options that affect the Editor's operation in various ways. The values of these options can be modified. You choose the option you want to change by typing the first letter of its name. You can return to the Edit menu by typing [[space]].

The rest of the display provides information on the status of the Editor and the current workspace. For instance, it shows the name of the file from which this workspace was copied and how many characters (or "bytes") of information are in the workspace.

We deal with all these options and status values eventually in this book. For now, we are concerned about only two of the options: "A(uto indent" and "F(illing". These options determine whether the Editor is better suited to line-oriented text entry or to paragraph-oriented entry.

A(uto indent controls the automatic indentation that you saw in the previous section. If A(uto indent is True, the placement of the cursor at the beginning of a new line occurs as you saw it earlier. If A(uto indent is false, the cursor simply starts at the left margin.

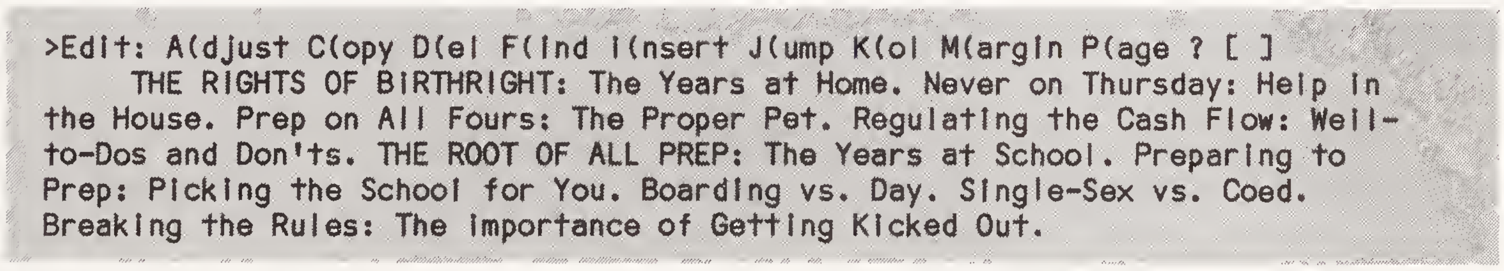
F(illing determines whether the Editor treats text as paragraph-oriented or line-oriented. You've already seen the Editor's behavior when F(illing is False. When F(illing is True, the Editor attempts to keep text within the left and right margins you've established. It breaks lines wherever necessary (between words) to maintain the margins.

When A(uto indent is False, and F(illing is True, the Editor makes handling of paragraph-oriented text very simple. To reach this blissful state, type A; the previous setting of A(uto indent is erased, and the Editor awaits the new value. All you need to type is the first letter: F, and the Editor does the rest. Typing F T sets F(illing to True in a similar fashion.

We go back now to the Edit menu to try the easy way of turning the outline into a respectable looking paragraph. Before you leave the Environment menu, take note of the values of the L(eft margin, R(ight margin, and P(ara margin options. They indicate that text is to be kept between columns 1 and 80, and that the first line of a new paragraph is to start on column 6. These values determine the appearance of the text when you return to the Edit menu. Do so now, by typing ⟦space⟧.

2.12 WORKING WITH PARAGRAPH-ORIENTED TEXT

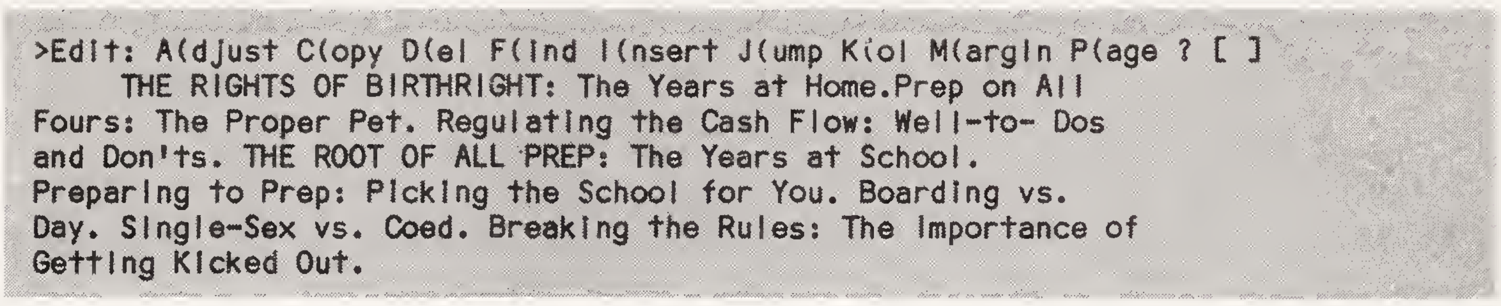
Why hasn't there been any change in the appearance of your workspace? The answer is that the Editor only applies the margin restrictions automatically when new text is being entered. To apply the margins to existing text in your workspace, you have to invoke the M(argin activity. Do that now by typing M; the screen should go blank for a few moments; then the following display should appear:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
     THE RIGHTS OF BIRTHRIGHT: The Years at Home. Never on Thursday: Help in
the House. Prep on All Fours: The Proper Pet. Regulating the Cash Flow: Well-
to-Dos and Don'ts. THE ROOT OF ALL PREP: The Years at School. Preparing to
Prep: Picking the School for You. Boarding vs. Day. Single-Sex vs. Coed.
Breaking the Rules: The Importance of Getting Kicked Out.
```

As you can see, the outline has become a paragraph. Now let's play with the values of the margin options and see what effects they have. Return to the Environment menu with S E. Just as before, you select an option for modification by typing the first letter of its name. Try R. The Editor awaits your entry of a new value for the R(ight margin option. For this option, and the other numeric options, you can enter a value as a simple integer (with four digits or fewer), followed by [[ret]]. Try 65 [[ret]]. Leave the other values as they are and return to the Edit menu with [[space]].

Once again you need to invoke M(argin to apply the new margin values to your workspace. When you do so, this screen results:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
     THE RIGHTS OF BIRTHRIGHT: The Years at Home.Prep on All
Fours: The Proper Pet. Regulating the Cash Flow: Well-to- Dos
and Don'ts. THE ROOT OF ALL PREP: The Years at School.
Preparing to Prep: Picking the School for You. Boarding vs.
Day. Single-Sex vs. Coed. Breaking the Rules: The Importance of
Getting Kicked Out.
```

When you insert text, the Editor automatically applies the current margins. As you enter words, the Editor checks each one to see if it goes past the right margin. If so, the entire word is moved down to the next line. You can continue typing without worrying about when to press [[ret]]. You can see this facility in action by using I(nsert to add a few sentences to the outline/paragraph in your workspace. (You may need to J(ump E(nd, first.) Be sure to close the insertion with [[etx]].

When you do an I(nsert within a paragraph, the Editor automatically reformats the remainder of the paragraph after you close the insertion. This automatic reformatting does not occur, however, when D(elete is used within a paragraph.

The Editor uses a very simplified notion of "word" when it makes decisions about where to break lines during automatic margin control. It takes a word to be a group of one or more letters bounded on each side by a space or a hyphen ("-"). Therefore "MYVOL:DIRECTORY.TEXT" would be treated as one word, and moved in its entirety to the next line if the right margin were threatened. On the other hand, "p-System" would be considered two words, and broken at the hyphen if necessary.

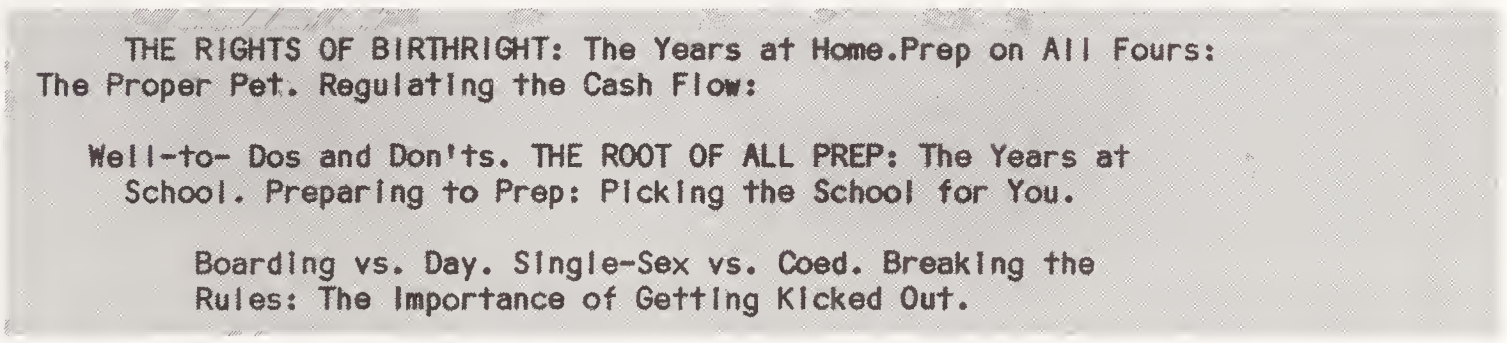
Paragraphs can be separated by one or more blank lines. When you're I(nserting, and you signal a paragraph break by typing [ret] twice, the Editor starts the cursor on the new line at the P(ara margin. When you invoke the M(argin command, it only modifies the paragraph that contains the cursor. No matter where the cursor is pointing in the paragraph, M(argin reformats the entire paragraph.

Experiment with the handling of paragraph boundaries by inserting a few strategically placed [ret]s to make several paragraphs. Also try adding some new paragraphs, if you like. You'll see how the process works.

You can also prove to yourself that different margin restrictions can be applied to different paragraphs. For each of two paragraphs you've entered, follow these steps:

- o Invoke S(et E(nvironment and change some or all of the margin options (L(eft, R(ight, or P(ara).
- o Move the cursor to the paragraph you'd like reformatted with those margins, and type M for M(argin.

Here is one way your workspace could end up:



```
    THE RIGHTS OF BIRTHRIGHT: The Years at Home.Prep on All Fours:
The Proper Pet. Regulating the Cash Flow:

   Well-to- Dos and Don'ts. THE ROOT OF ALL PREP: The Years at
     School. Preparing to Prep: Picking the School for You.

         Boarding vs. Day. Single-Sex vs. Coed. Breaking the
         Rules: The Importance of Getting Kicked Out.
```

For the three paragraphs shown on the previous page, the margin settings were:

Paragraph Number	Left Margin	Right Margin	Paragraph Margin
1	1	70	6
2	6	65	4
3	10	65	10

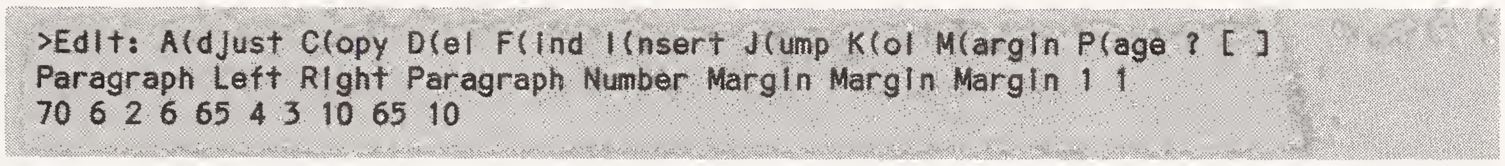
Table 3.1

Notice that a P(aragraph margin smaller than the L(eft margin setting can be used to create "bulleted" paragraphs.

The Editor keeps no record within the workspace of the margin settings that you have applied to a particular paragraph. Therefore, you must be careful to use M(argin (or do an I(nsertion!) within a paragraph only when the current margin settings are appropriate for that paragraph. Fortunately, even if you forget this warning occasionally, it is not hard to recover. (Just invoke S(et E(nvironment, adjust the margin settings, and use M(argin to reformat the paragraph.)

Just as you can have paragraphs with different margin settings in a single workspace, you can also have portions that are line-oriented rather than paragraph-oriented. One application of this capability is the inclusion of tables like Table 3.1. The Editor includes specific support for tables of this sort, including settable tab stops and the K(olumn activity. We aren't able to go into these facilities in this introductory chapter, but you may want to look over the relevant sections of Chapter 5.

You must be very careful when you work with a mixture of line-oriented and paragraph-oriented material. If you do an I(nsert or M(argin in a line-oriented section when F(illing is True, the filling operation destroys the line structure and is likely to cause you much grief. For example, consider the screen on the next page, which shows the text from Table 3.1 after an accidental M(argin operation.



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
Paragraph Left Right Paragraph Number Margin Margin Margin 1 1
70 6 2 6 65 4 3 10 65 10
```

We recommend that you set F(illing to False when you are working with line-oriented material. That will keep the Editor from doing automatic filling during or after an I(nsertion. Furthermore, if you accidentally type "M" and invoke M(argin, the Editor will disallow the operation.

We are now done with this Table of Contents workspace. Unless you want to save it for some perverse reason, leave the Editor now with Q(uit E(xit. (If you want to save the workspace, do so, and then leave the Editor.)

Now you have all the basic tools for doing simple text processing using the UCSD p-System. The next section provides some suggestions about one particular kind of text processing: producing memorandums.

2.13 PRODUCING MEMOS

We use the p-System ourselves for much of our professional work. When we write programs, we certainly use the p-System for that. But we also write design documents, as well as technical and administrative memos, using the facilities you've learned about in this chapter and the previous one. The purpose of this section is to pass on to you some approaches we've found for simplifying this use of the p-System.

If you write many memos, it becomes tedious to type, over and over, the heading portions that are shared by all memos. There is also the issue of setting up the Editor's environment (including margins, paragraph- vs. line-orientation, and so on).

Our solution to this problem is to prepare a "starter" file (which we call START.TEXT) in which all this work has been done. We'll show you in a moment how to build one of these files.

Here is how you can use START.TEXT, once you have built it. When you start a new memo, your first step is to invoke the Editor and request that the START.TEXT file be copied into the workspace. You can then modify that text appropriately for the specific memo you're preparing, and enter the memo, itself. Using the Q(uit W(rite activity, you can then write the workspace out to disk, with a file name specific to that memo.

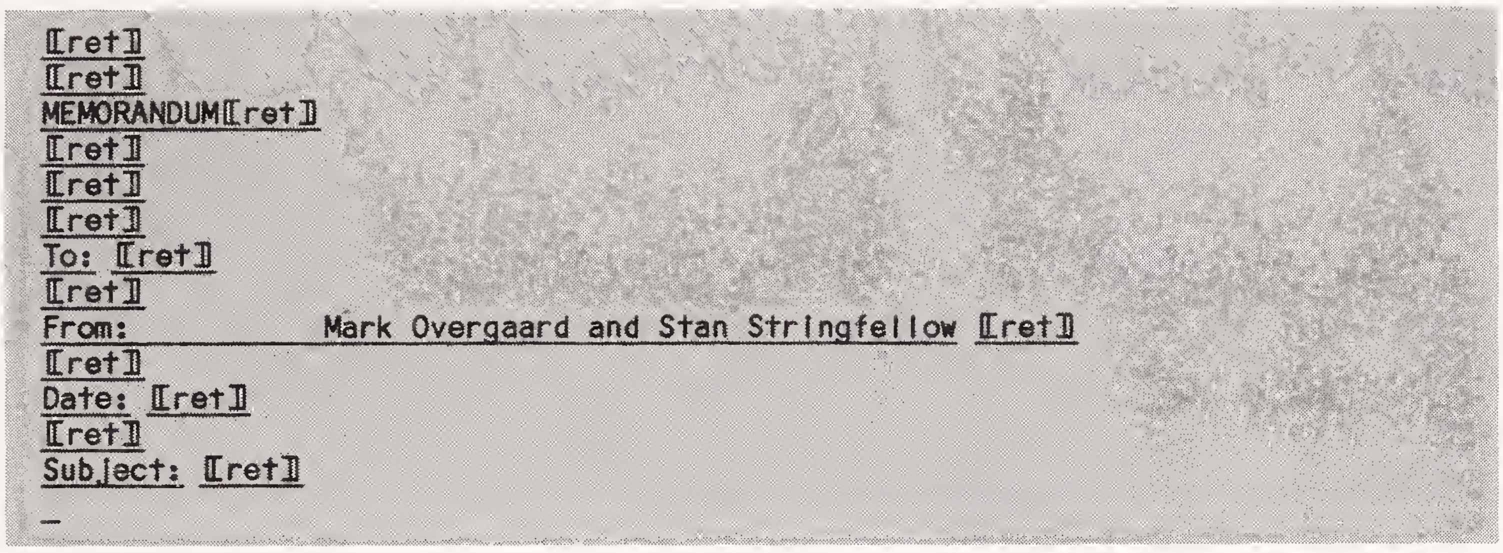
Enter the Editor now with an empty workspace. (If you forgot to leave the Editor at the end of the previous section, do that first, with Q E.) You're going to build a START.TEXT file using the conventions we have found convenient for our memos. Later you can modify it, if you like, to suit your style.

The first job is to set up the Editor environment. We'll leave the Editor in line-oriented (rather than paragraph-oriented) mode, so that entry of the heading lines is easy. Just before you enter the text of a particular memo, you will switch to paragraph orientation.

To choose unindented paragraphs and a right margin of 65, invoke S(et E(nvironment and type R 65 [[ret]] P 1 [[ret]]. Then return to the Edit menu with a [[space]].

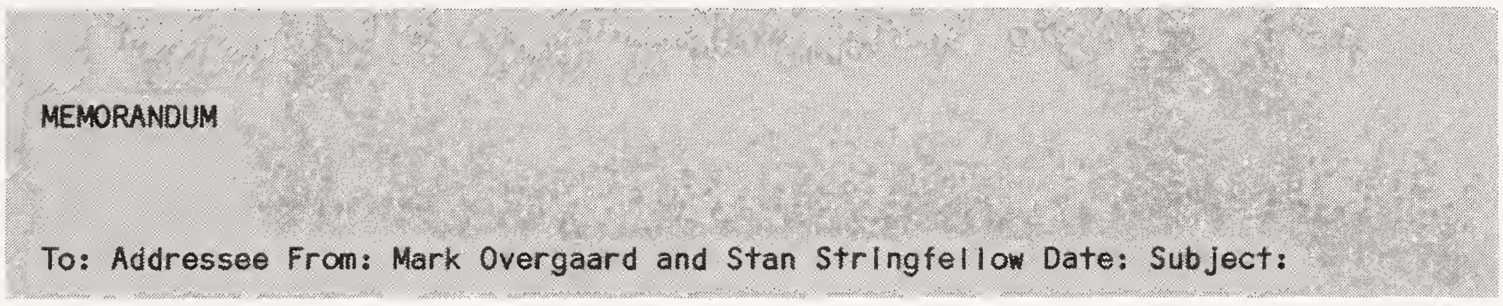
Since the Editor environment is saved on disk along with the workspace when you Q(uit W(rite, setting these options now will save you some time on each memo.

Now I(nsert the heading lines shown in the screen on the next page. The lines should be preceded by several [[ret]]s and separated from each other by a blank line. The contents of your workspace after you close the I(nsertion with [[etx]] are shown.



```
⟦ret⟧
⟦ret⟧
MEMORANDUM⟦ret⟧
⟦ret⟧
⟦ret⟧
⟦ret⟧
To: ⟦ret⟧
⟦ret⟧
From:          Mark Overgaard and Stan Stringfellow ⟦ret⟧
⟦ret⟧
Date: ⟦ret⟧
⟦ret⟧
Subject: ⟦ret⟧

_
```

Now you may see why we left the Editor in line-oriented mode. If the heading lines were treated as a single paragraph, the use of I(nsert to enter the addressee would result in this screen:

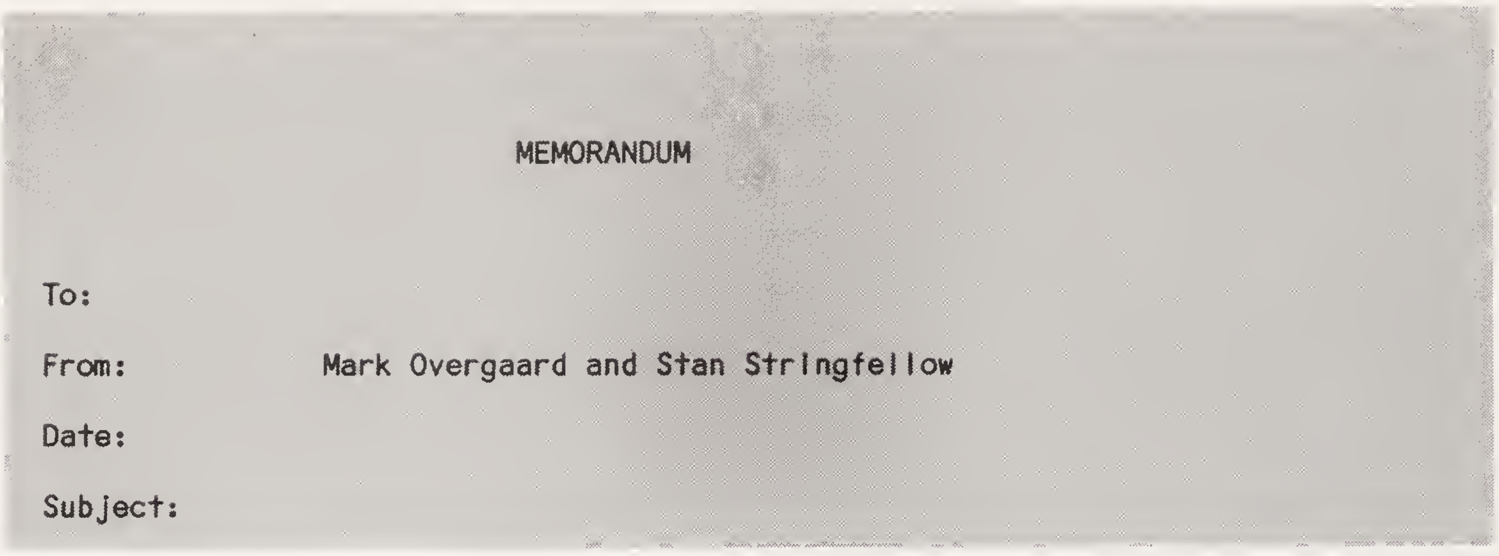


```

MEMORANDUM



To: Addressee From: Mark Overgaard and Stan Stringfellow Date: Subject:
```

Given the blank lines between heading items, the actual effect of such an insertion would simply be the compression of the first heading line, but you don't want that either. Naturally you would put your name after "From:" if you were preparing a START.TEXT file for yourself.

The "MEMORANDUM" line would certainly look much better if the word were centered. There is an easy way to center a line in the Editor, but it uses an activity that hasn't been introduced yet: A(djust. We leave a full description of A(djust to Chapter 5.

All you need to know right now is that to center a line, you should move the cursor so that it's somewhere in the line. Then type the sequence A C ⟦etx⟧, which invokes A(djust, causes the C(entering of the line, and accepts the adjustment. The completed START.TEXT workspace is shown on the next page.



```
                    MEMORANDUM


To:

From:          Mark Overgaard and Stan Stringfellow

Date:

Subject:
```

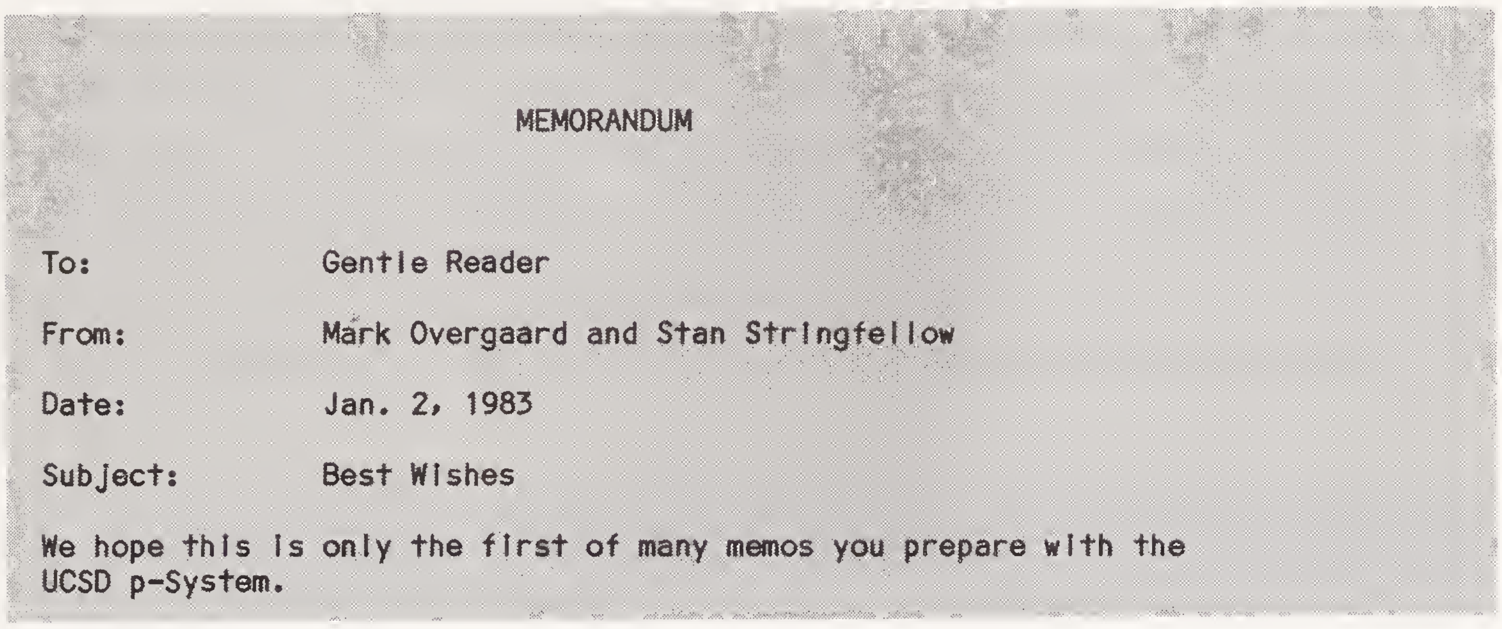
All that remains is to save the workspace on disk. Type Q W MYVOL:START [[ret]] to do that. Then E(xit the Editor.

Now we use the START.TEXT that you've created to send a small memo from us to you. Unfortunately, you're going to have to do the entering of this memo!

Enter the Editor and copy the file MYVOL:START into the workspace. (E MYVOL:START [[ret]] should do the job.) Move the cursor so that it is immediately after the "To:". Then follow this sequence of Editor input:

I [[tab]][[tab]]	Enter I(nsert and move to Addressee position.
Gentle Reader [[etx]]	Memo is addressed to YOU!
5 [[ret]] 5 [[space]]	Prepare to enter Date,
I [[tab]][[tab]]	
Jan. 3, 1982 [[etx]]	and then do it.
2 [[ret]] 8 [[space]]	Prepare to enter Subject,
I [[tab]][[tab]]	
Best Wishes [[etx]]	and do it!
J E	Prepare to enter the memo, itself.

Now go on to the memo. It's very brief. Before you enter it, type SE AF FT [[space]] to use S(et E(nvironment to establish paragraph-oriented mode. The screen on the next page shows the result of the final insertion.



```
                         MEMORANDUM


To:             Gentle Reader

From:           Mark Overgaard and Stan Stringfellow

Date:           Jan. 2, 1983

Subject:        Best Wishes

We hope this is only the first of many memos you prepare with the
UCSD p-System.
```

The last step is to copy the memo from the workspace out to disk. Invoke Q(uit W(rite. Don't yield to the temptation to enter "$" ⟦ret⟧ in response to the prompt. You don't want to modify the starter file. Instead, respond with MYVOL:BESTWISHES ⟦ret⟧; then E(xit. You've written your first p-System memo!

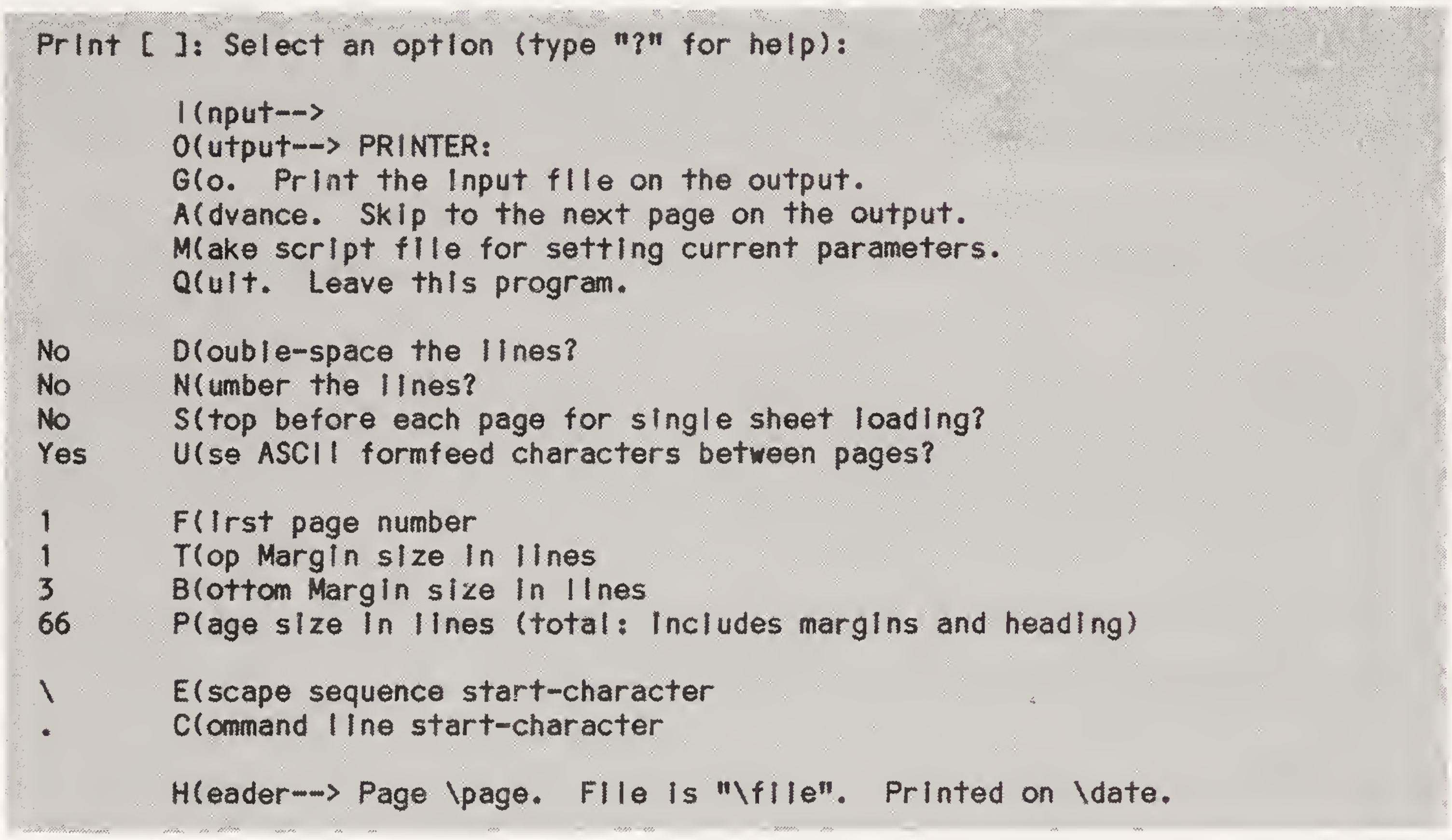
2.14 PRINTING TEXT FILES

Now that you know how to compose memos and letters, the remaining question is: "How can you print them?" There are several ways to print text files in the p-System. They range from the simple use of the T(ransfer activity in the Filer to the use of a sophisticated text formatter program like the one used to produce the master copies of this book.

In between these two extremes is a very convenient tool for routine printing: the Print utility, which is included in the most recent releases of Version IV.1. This utility can print your text files, and in the process, do useful things like inserting page breaks and putting a heading on each page. In addition, Print allows you to control other aspects of the printing process, including the spacing between lines (that is, double spacing or single spacing) and the number of lines printed on each page.

Let's try out Print on the memo you wrote in the previous section. If Print is on your system disk, then typing X PRINT [ret] should suffice to invoke it. If that doesn't work, scout around on your p-System disks to find PRINT.CODE; you may want to T(ransfer it to your system disk, since you'll probably be using it often. If you can't find the program, you may have a version of the p-System that was produced before Print was included.

Print produces a full screen menu that looks like this:



```
Print [ ]: Select an option (type "?" for help):

        I(nput-->
        O(utput--> PRINTER:
        G(o.  Print the input file on the output.
        A(dvance.  Skip to the next page on the output.
        M(ake script file for setting current parameters.
        Q(uit.  Leave this program.

No      D(ouble-space the lines?
No      N(umber the lines?
No      S(top before each page for single sheet loading?
Yes     U(se ASCII formfeed characters between pages?

1       F(irst page number
1       T(op Margin size in lines
3       B(ottom Margin size in lines
66      P(age size in lines (total: includes margins and heading)

\       E(scape sequence start-character
.       C(ommand line start-character

        H(eader--> Page \page.  File is "\file".  Printed on \date.
```

Even though the activities of this menu are listed on different lines, the approach to using it is similar to the one-line menus used in other parts of the p-System. There are two kinds of activities in this menu. One kind allows you to determine the setting of an option that guides subsequent print operations. (These are similar to the S(et E(nvironment options.) The other kind causes an immediate action. For instance, you could use an option activity (I(nput, in fact) to choose a file to print, and an action activity (G(o) to start the printing.

Let's try I(nput. When you invoke it, directions appear on the top line of the screen and the cursor is placed after "I(nput-->" to await your entry of the name of a file to print. Enter MYVOL:BESTWISHES [ret].

To print BESTWISHES, you need only select G(o. Before you do, however, make sure that you have paper in your printer and that it is ready to print. When the printer is ready, invoke G(o, and watch the printing of your first p-System memo. As the top line of the screen indicates, you can temporarily suspend the printing by typing [[space]], and cancel it by typing "Q". Try [[space]] if you like. The resulting prompt should be self-explanatory.

The printed version of BESTWISHES looks just like it did in the Editor's workspace, except that there is a header line at the top of the page that contains a page number, the input file name, and the current date. Print allows you to design your own header line. We discuss that below.

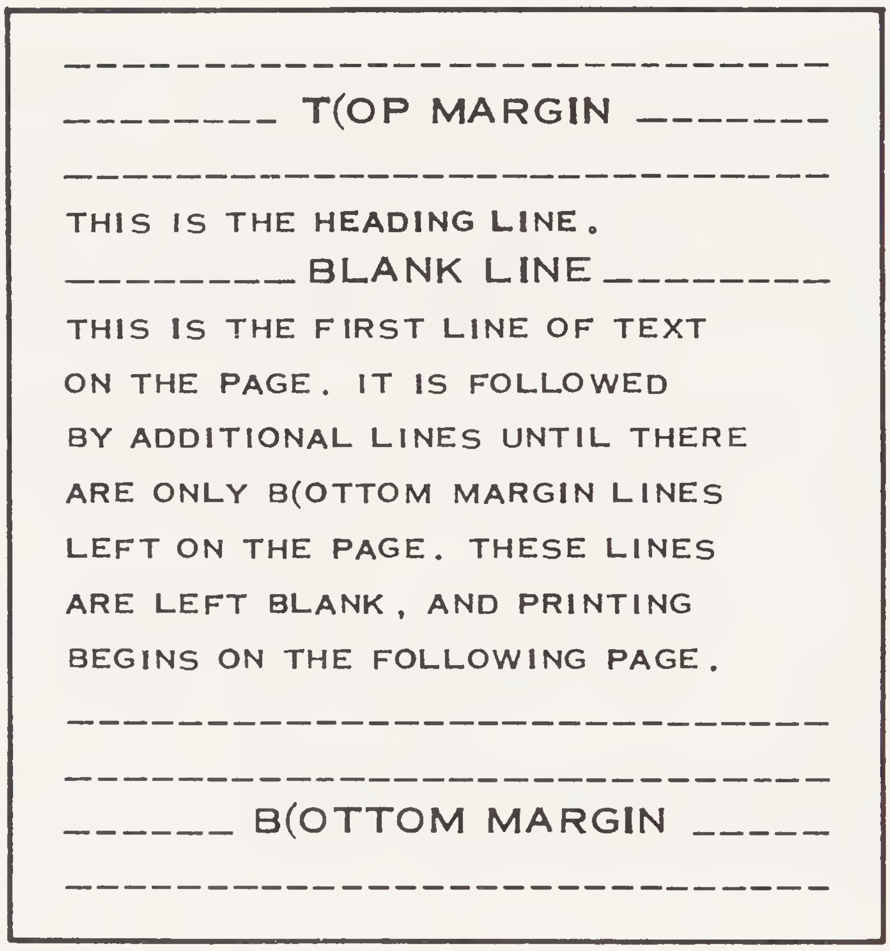
After the memo is printed, the paper should advance to the end of the page. If it doesn't do that, try the following recovery procedure:

> It may be that your printer doesn't respond to the standard form feed character that Print uses to signal the end of a page. You can tell Print not to use the form feed character by typing <u>U</u> <u>N</u>. Do that, and try printing BESTWISHES again. (You may need to advance the paper manually to the top of the next page.) If the new setting of the U(se form feed option results in success, be sure to establish that setting whenever you print a file in the future.

If you have to load each sheet of paper into your printer individually, then there's at least one more option that you need to change from its initial setting:

- o Use <u>S</u> <u>Y</u> to indicate to Print that you need a chance to load paper before each page.
- o Also, you may have to position the printing mechanism an inch or so into the page in order to make contact with the pinch rollers. If so, you'll want to modify your P(age size option. Assuming that your printer puts six lines on an inch of paper, the lost inch at the top of the page implies that your P(age size should be 60 lines for an 11-inch page, rather than 66 lines. Change that option if necessary.

Figure 2.5 shows how the layout of pages produced by Print is controlled by the P(age size, T(op margin, and B(ottom margin options. Try printing BESTWISHES with several different settings of these options to see what you prefer. You can even set P(age size ridiculously small (say 10 lines), to see what effect that has. Remember that each time you press "G" for G(o, the printing of the I(nput file is guided by the option settings at that time.



THIS IS THE HEADING LINE.

THIS IS THE FIRST LINE OF TEXT ON THE PAGE. IT IS FOLLOWED BY ADDITIONAL LINES UNTIL THERE ARE ONLY B(OTTOM MARGIN LINES LEFT ON THE PAGE. THESE LINES ARE LEFT BLANK, AND PRINTING BEGINS ON THE FOLLOWING PAGE.

Figure 2.5

If the standard heading line that you've seen on the printouts so far is not to your taste, you can change it by setting the H(eader option. For instance, typing "H", followed by [[ret]], would erase the header altogether (though two lines on the page would still be used, just as always).

If you want a heading line, but don't like the specific arrangement of the standard line, you can rearrange it. First you need to know something about **escape sequences.**

In any line produced by Print, the **escape sequence flag character** has a special meaning. If the word after the flag is one of the standard Print escape sequences, then some other string is substituted for the escape sequence when that line is printed. For instance, if the escape sequence "\date" is found, the current p-System date replaces it in the printed version. Similarly, "\page" is replaced by the current page number, and "\file" by the name of the file being printed.

This escape sequence facility is very useful in the heading line. You could, for example, set the heading line to "Best Wishes—Page \page" to get heading lines of the form: "Best Wishes—Page 1" and "Best Wishes--Page 2".

Escape sequences can also be useful within a memo, as well. Remember the START.TEXT file that you created above to serve as the starting point for writing memos? You could modify the "Date:" line in that file to have "\date" instead of any particular date. Then whenever you printed a memo based on START.TEXT, the printed version would contain the current date without explicit effort on your part.

Print has several more capabilities that we don't detail here. For instance, you can have **command lines** inside the file being printed. These can change the header line on the fly, cause an explicit page break, or perform other useful functions. It is also possible, with the M(ake script activity, to record the non-standard option settings that you routinely use in a **script file.** When you use this script file to invoke Print, those option settings are automatically established. This facility could save you considerable inconvenience. Chapter 9 directs you to further reading on these and other aspects of the Print utility.

DEVELOPING PROGRAMS 3

3.1 INTRODUCTION

In Chapter 2, we showed you how to edit text using the p-System. We didn't try to guide you on the content of the memos or other material you might be planning to write. Similarly, in this chapter, we get you started in p-System program development, but have little to say about the content of those programs or about the languages in which they are written.

Much of what you need to know to develop programs on a particular computer system has nothing to do with the composition of programs, or with the details of a computer language. You need to know how to enter the program into the computer, and how to "compile" it (or translate it from human terms to machine terms) and then how to run it after this translation has been done. Many programming texts ignore these logistic details because they are intended to be used in many different programming environments that may be very different from each other. Unfortunately, it is often these practical matters that are most troublesome for beginners. That's where we come in. This chapter, along with the previous chapters on editing text and using existing programs, is intended to get you to the point where you are comfortable with the logistic aspects of developing p-System programs. We leave the descriptions of the content and structure of programs to other books.

If you are already a relatively experienced programmer in a language supported by the p-System, a quick pass through this chapter, supplemented by appropriate language reference manuals, should allow you to do productive program development with the p-System.

If you don't yet know how to program, you will need a tutorial on programming in the language of your choice. Several such tutorials are listed in Chapter 9. These books can take you on from where this chapter leaves off.

Even though we're not trying to tutor you on the details of any particular language, we do need to provide you with some basic background on what computer languages are and why they are necessary. For instance, why can't we communicate with computers in ordinary English (or Papuan or Burmese)?

3.2 COMPUTER LANGUAGES

There are many areas where the capabilities of computers are superior to the corresponding abilities of humans. One example is the speed with which computers can do arithmetic. Another example is their unwavering attention to detail.

There are also many areas where human proficiencies far surpass the current capabilities of computers. One of these areas is the understanding of "natural" languages (such as English or Japanese). There are all sorts of subtleties and potential ambiguities that humans can easily untangle, but which would totally befuddle a computer.

Consider, for instance, the sentence:

Time flies like a bullet.

There are many possible interpretations of this sentence. For instance, if "time" is an adjective, "flies" a noun, and "like" a verb, this sentence would be a description of the preferences of a particular variety of flies. On the other hand, it could be a prescription for how to do timing measurements on flies: "You time flies just like you time a bullet, of course!"

People can use common sense and contextual clues to sort out which of several possible meanings for a sentence is intended. Computers are short on common sense.

Communication with computers, therefore, occurs in languages specifically designed for that purpose. These languages are very strict in their definitions of the meanings of words and sentences. They are also close enough to natural languages (using words like "begin" and "if") that they are quite comprehensible to humans.

Even though these computer languages are extremely restricted compared to natural languages, they are still much more complicated than the fundamental built-in capabilities of typical small computers. Therefore, it is usually necessary to have a translation process that converts the language text that is suitable for human consumption into a sequence of much more primitive operations that a computer can do directly. This translation process is called **compilation**, and the translator is a program called a **compiler**. During the translation process, the compiler also checks that the program obeys the rules that govern the structure of programs in the language (called its **syntax**).

On the next page, we list the steps involved in developing and running a program in one of these languages. After that, Figure 3.1 restates this process (with a slightly different viewpoint) in diagram form.

- o Use the Editor to create the text representation of the program. This representation (which is too complicated to be executed directly by the computer) is called the **source text,** and is stored in the **text files** that you read about in Chapters 1 and 2.
- o Use a compiler to translate the source text to **object code** that can be executed by the computer. This object code is stored in **code files** like those you used in Chapter 1. If errors of syntax are found during the compilation, return to the Editor to fix them in the source text and try the compilation again.
- o Run the program object code and test whether it performs as intended. If not, return to the Editor to change the source text of the program and start another cycle of compilation and testing.
- o After the program has successfully passed your tests, save it away for later use.

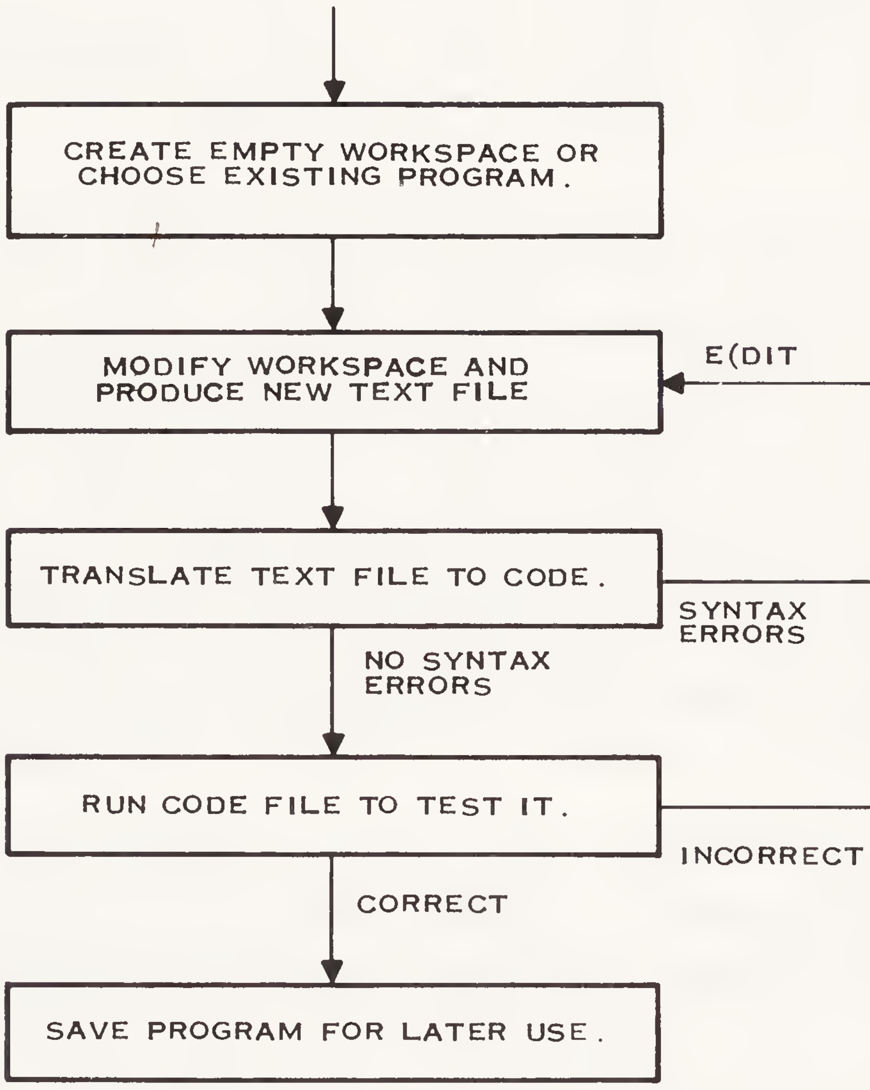

CREATE EMPTY WORKSPACE OR CHOOSE EXISTING PROGRAM.
MODIFY WORKSPACE AND PRODUCE NEW TEXT FILE
E(DIT
TRANSLATE TEXT FILE TO CODE.
SYNTAX ERRORS
NO SYNTAX ERRORS
RUN CODE FILE TO TEST IT.
INCORRECT
CORRECT
SAVE PROGRAM FOR LATER USE.

Figure 3.1

3.3 LANGUAGES SUPPORTED BY THE p-SYSTEM

The three principal languages supported by the p-System are UCSD Pascal, FORTRAN, and BASIC. Your choice of language for a particular program will be determined by your needs and experience.

UCSD Pascal is a variant of the language Pascal, which was first defined in 1968 by Swiss computer scientist Niklaus Wirth. Pascal is the most modern of the three languages. Originally designed for teaching programming, it is now probably the dominant language for introductory computer science courses (at least at the University level). In addition, Pascal is very widely used in industrial and business applications, particularly on microcomputers.

UCSD Pascal was originally the only language supported by the p-System. It is still the case that all major high level p-System components (such as the editors and file handler) are implemented in UCSD Pascal. It is generally the language of choice for new programs written specifically for the p-System environment.

FORTRAN is a mature language (first used in 1953) which has achieved dominance in the area of scientific applications of computers. The p-System implementation of FORTRAN is a subset of FORTRAN-77 (which is named after the year in which the definition was finalized). The main attraction of FORTRAN is the large number of programs that already exist, particularly in the area of numerical analysis. This momentum means that most new scientific programs are also written in FORTRAN. If you want to apply computers to scientific or engineering pursuits, you should probably be familiar with FORTRAN.

Like Pascal, BASIC was also originally designed for beginning programmers. (The name is an acronym for "Beginner's All-purpose Symbolic Instruction Code.") BASIC is very widely used (particularly on small computers). In most implementations of BASIC, the style of use is more interactive and immediate than the scenario described above: the computer directly "interprets" the source of your BASIC program without the complicating compilation step.

However, the BASIC in the p-System is implemented by a compiler, just as UCSD Pascal and FORTRAN-77 are. Because of this, p-System BASIC is probably no more suitable for beginner use than UCSD Pascal, and may be less so. The principal benefit of p-System BASIC is the ability to import existing BASIC programs from other software environments into the p-System environment.

In that p-System BASIC is not particularly suitable for beginners, we don't deal with it explicitly in this book. The rest of this chapter provides details for using UCSD Pascal and FORTRAN-77 in the p-System. Two separate sections cover the details of setting up and then using each of these two languages.

Before you can start using either language, however, you need to check that there's enough room on your system disk to store the programs you'll be working on. You need an area of at least 20 blocks to do the programs in this chapter. If you go on to write larger programs later, with the approach used in this chapter, you may need additional space.

Invoke the Filer now, and see what your situation is in this regard. Type F L * [[ret]]. The summary line of the resulting directory listing tells you the size of the largest area on your system disk. If that number is 15 or greater, you should be all right. If that number is smaller than 15, or if you go on later to work on larger programs, you may need to free up some space by moving some files off your system volume. In Chapter 4, in a section called "System Files," we describe the files that are typically on a system disk and that must stay there, and those files you can move to other volumes.

As soon as you have enough space available, go on to the next section (if you'll be using UCSD Pascal), or to the section after that (if you'll be using FORTRAN).

3.4 USING PASCAL IN THE p-SYSTEM

Before you can use UCSD Pascal, you must have the Pascal compiler on an on-line volume with the name SYSTEM.COMPILER. The first part of this section helps you get your p-System set up to meet that requirement. After this step is completed, you can go on to do some simple Pascal programming.

Setting Up For Pascal

Each p-System supplier organizes disks differently, so we don't know the packaging details of the Pascal compiler you have. At this point you need to find out the volume and file name of your Pascal compiler. The appropriate computer-specific appendix, in the section entitled "Pascal Set Up Details," provides guidance. Read that section, now.

If you discover that the Pascal compiler is already on your system disk with the name SYSTEM.COMPILER, then you don't need to do any further configuration. You can skip the rest of this subsection and begin using Pascal. If the Pascal compiler is not already on your system disk, the rest of this subsection tells you how make it available for your use.

You need to put a copy of your Pascal compiler on MYVOL: with the name SYSTEM.COMPILER. Make sure you know the file name and volume name where your Pascal compiler is stored. Now enter the Filer's T(ransfer activity by starting at the Command menu and typing <u>F</u> <u>T</u>. After you see the "Transfer what file?" prompt, insert the volume containing the compiler in one drive on your computer while leaving the MYVOL: volume in another drive.

Next enter the volume name and file name of the compiler, followed by [[ret]]. When you see the "To where?" prompt, enter <u>MYVOL:SYSTEM.COMPILER</u> <u>[[ret]]</u>.

Here is the screen you would see during the Transfer activity if you were getting the Pascal compiler from the volume PASCAL: and the file PASCALCOMP.CODE:

```
Transfer what file? PASCAL:PASCALCOMP.CODE [ret]
To where? MYVOL:SYSTEM.COMPILER [ret]
PASCAL:PASCALCOMP.CODE   --> MYVOL: SYSTEM.COMPILER
```

Your set up operation is now complete. Remove the disk from which your compiler was copied. If you removed your system disk during this operation, return it to the drive it was in before. Leave MYVOL: in a drive as well. Type Q to leave the Filer.

Using Pascal

Now you're ready to try your first Pascal program in the p-System. The first step is to use the Editor to enter your program into the computer. Invoke the Editor and type [ret] to the "File?" question. Then use I(nsert to put the simple Pascal program below into your workspace. Remember that you can use the auto-indentation feature of the Editor to do the two lines starting with "writeln". The other lines should be on the left margin in your workspace. When you enter the third line, replace "<your name>" by your real name (for example, Raoul or Millicent).

```
program MyFirst;
begin
  writeln ('Congratulations, <your name>,');
  writeln ('on your first Pascal program!');
end.
```

Each of the "writeln" (pronounced "write-lin") statements causes a line containing the text inside the quotes to be written to your computer display when the program is run.

Compare your workspace with the original program above to make sure that all the details are correct. Computer language compilers are very finicky about details! You should particularly check:

o that the left and right parentheses, "(" and ")", are matched,

- o that the congratulatory messages are marked at both ends by single quotes,
- o that the semicolons (;) are placed as shown above, and
- o that there is a period after the "end".

When your survey of this checklist is completed, prepare to write your workspace out to disk by invoking the Q(uit activity. For small program development, the Q(uit U(pdate option is the most convenient. Invoke it by typing <u>U</u>. After the Editor confirms the writing of your workspace to disk, it returns you to the Command menu.

What you need to do now is run the program you've just created. It must be compiled first, however, so invoke the C(ompile activity to do that. You should see the following screen:

```
Compiling...
Output file for compiled listing? (<cr> for none) _
```

The Compiler can produce an annotated **listing** of your program containing the source lines, along with line numbers and other information produced by the compiler. This prompt asks you to indicate where that annotated listing should be put. Enter a simple <u>⟦ret⟧</u> to indicate that no listing is needed.

If you made no typing errors in entering the program, some disk and screen activity occurs, and the Command menu is redisplayed on the top line of your screen, leaving the screen output of the compilation process below it:

```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug,?[ ]
Output file for compiled listing? (<cr> for none) ⟦ret⟧

Pascal Compiler - release level [ ]
<   0>..
MYFIRST
<   2>..

4 lines compiled.

MYFIRST.
```

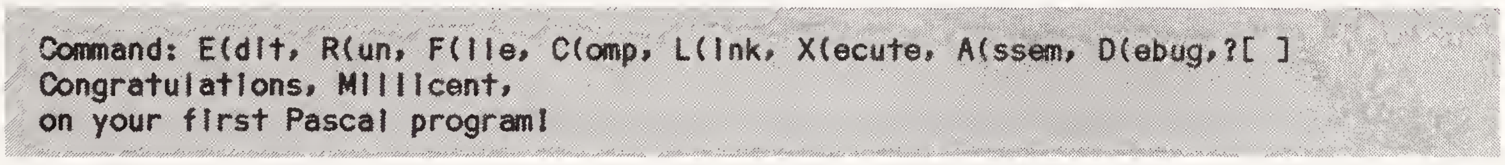
If you don't see a display like the one above, it's probably because you made a small typing error in entering your program. When the compiler detects such errors (called **syntax errors**), it sounds your computer's bell and stops. If this happens to you, we suggest you read on through the end of this section without typing anything further. After you know more about syntax errors and how to handle them, come back and deal with this one by going back in the editor and making sure that your workspace matches the original program exactly.

The main purpose of the screen output produced during compilation is to keep you posted on the Compiler's progress (and, particularly, to convince you that progress is occurring!). The compiler makes two "passes" across the program. In the first pass, it writes a dot to the screen for each line it processes, and a line number in angle brackets at the beginning of each line of dots. The compiler completes the first pass by reporting the total number of lines in your program.

The remainder of the display is produced by the second pass, where dots are also used to indicate progress.

To run the program that has just been compiled, type R.

Consider yourself congratulated! You are now back in the Command menu, with the leftover output of your first program on the screen:

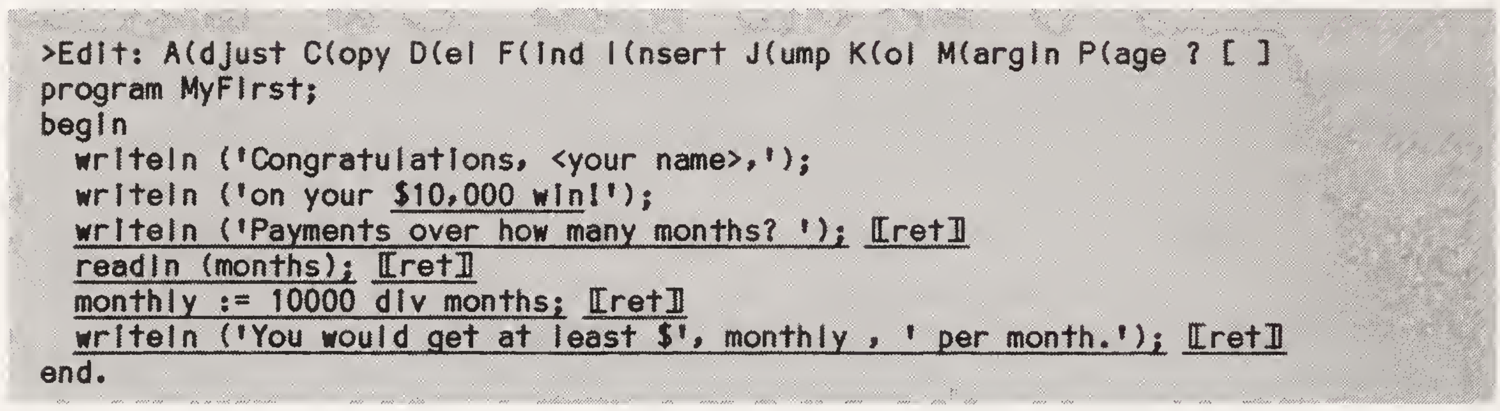


```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug,?[ ]
Congratulations, Millicent,
on your first Pascal program!
```

Let's return to the Editor and make some modifications to the program. This time when you enter the Editor, your program is automatically read into the workspace.

This next program shows you one way in which p-System programming ability can be useful to you. Say you happened to win $10,000 in a contest, and that you could choose the number of months over which the payment of the prize would be spread. The program presented below will prompt you for a number of months, and then calculate and display the minimum amount of the monthly payment for you. We realize that this calculation could also be done in your head or with the aid of any $10 calculator, but this program should prove a useful exercise, nevertheless.

Use D(elete and then I(nsert to change the second "writeln" statement and add four new lines as shown on this screen:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
program MyFirst;
begin
  writeln ('Congratulations, <your name>,');
  writeln ('on your $10,000 win!');
  writeln ('Payments over how many months? '); [ret]
  readln (months); [ret]
  monthly := 10000 div months; [ret]
  writeln ('You would get at least $', monthly , ' per month.'); [ret]
end.
```

What is the purpose of these new statements? When you run this program, the "readln" statement allows you to enter a number of months at the keyboard. The value you enter is stored in the **variable** "months". The variable holds (or "remembers") the number you type in so that it can be used in the subsequent calculation.

The next line accomplishes the main purpose of this program. The total amount of the prize money ($10,000) is divided by the number of months, and the result stored in another variable, called "monthly".

The final line reports the results to you on the screen. When the variable "monthly" is named in a "writeln" statement, the number stored in the variable is written to the screen, along with other text in the statement.

This completes your second program. As before, check each line for agreement with the printed version above.

Now Q(uit U(pdate from the Editor, and try invoking R(un immediately, without doing a C(ompile first. The p-System conveniently goes ahead and invokes the Compiler anyway.

Whenever you Q(uit U(pdate from the Editor, the p-System assumes you must have changed something in the source text (otherwise, why would you be saving a copy on disk?). Therefore, when you indicate your program is to be run, the p-System automatically calls the Compiler first, to translate your new program into machine understandable terms.

After you type ⟦ret⟧ to refuse the offer of the production of a listing, the behavior of the Compiler should initially be just as it was in the previous compilation. But then the bell on your computer sounds and the following display appears:

```
Compiling...
Output file for compiled listing? (<cr> for none) ⟦ret⟧

Pascal Compiler - release level [ ]
<   0>..
MYFIRST
<   2>...
  writeln ('Payments over how many months? ');
  readln (months <---
Undeclared identifier
Line 6
Type <sp> to continue, <esc> to exit, or 'e' to edit
```

The Compiler has detected a syntax error: a place in your program where the structure rules that govern Pascal programs are violated. The error is "Undeclared identifier" and the "<—" indicates the point in the program where the error was detected.

The syntax rules of the Pascal language require that all variables used in a program must be **declared** or named, before they are used. Names of variables or other objects in Pascal programs are referred to as **identifiers.** The identifier "months" was not declared in your program. We show you how to fix that problem shortly.

Textual error messages like that shown here are only displayed if the file SYSTEM.SYNTAX (which contains those messages) is present on your system disk. If the file is not present, then an error number is given (without a corresponding message), and you should look in Appendix C, "Syntax Errors," for the text of the error message. If you are missing the file SYSTEM.SYNTAX, your screen shows "Error #104" instead of "Undeclared identifier".

You have three choices at this point, as indicated by the menu:

o You can type [space] to continue the compilation. (You may want to see if there are any other syntax errors in the program.)

o You can type "e" to return to the Editor, presumably to fix the problem and try again.

o Finally, you can choose [esc] to give up on the compilation altogether and return to the Command menu.

Choose the edit option. In a short while you should be back in the Editor with the following screen displayed:

```
Undeclared identifier: Type <sp>
program MyFirst;
begin
  writeln ('Congratulations, <your name>,');
  writeln ('on your $10,000 win!');
  writeln ('Payments over how many months? ');
  readln (months);
  monthly := 10000 div months;
  writeln ('You would get at least $', monthly , ' per month.');
end.
```

On the top line of the screen is the same error message you saw during compilation. The cursor is positioned at the place in the workspace where the error was detected by the Compiler. The Editor waits for you to type [space], indicating that you have seen the error message. After the [space], you're all set to fix the error!

You need to declare the variables "months" and "monthly". To do so, move the cursor to the start of the "begin" line (JB [ret] should do it), and insert the following line:

```
    var months, monthly : integer;[[ret]]
```

This construct names the variables "months" and "monthly" so that the compiler knows about them before it begins translation of the program. The "integer" part of the line indicates that these variables can only hold whole numbers, like "31", but not "57.3".

After fixing the error, Q(uit U(pdate and R(un. This time the compilation should succeed and your program should begin running. When it asks you for a number of months, try entering 6 [[ret]]. The minimum monthly payment is immediately reported as $1666 (which is not the exact payment for a six month spread because this particular program can only calculate in whole numbers—no fractions).

When your program completes and the Command menu returns, you can R(un the program again. Notice that this time no compilation is needed, since no changes have been made to the text of the program. Feel free to pursue your fantasies of fabulous monthly incomes by trying various payment rates.

This concludes your initial experience with Pascal programming. The next section provides a similar treatment of FORTRAN-77. You should skip that and resume reading in Section 3.6, "p-System Workfiles."

3.5 USING FORTRAN IN THE p-SYSTEM

The first part of this section helps you get your p-System set up for FORTRAN. After this step is completed, you can go on to do some simple FORTRAN programming.

Setting up for FORTRAN

Before you can use FORTRAN, you must have the FORTRAN compiler on an on-line volume with the file name SYSTEM.COMPILER. You also need to have a **runtime library file** for FORTRAN available, as well. (The runtime library file contains program sections that are needed during the running of a FORTRAN program.)

You may have a choice to make for both the compiler and the runtime library. Remember the discussion of real numbers and their sizes in Chapter 1 (Section 1.18)? We mentioned that the p-System supports two sizes of real numbers (two-word and four-word), but only one size at a time. A particular FORTRAN compiler/runtime library set also supports only one of these sizes, either two-word or four-word. You need to choose the set that matches the real number size for which your p-System is configured. If both sizes have been provided by your p-System supplier, it is likely that the files in one set have "2" in their names, while the files in the other set have "4" in theirs. For example, one set might have the file names FORTLIB2.CODE and FORTRAN2.CODE.

Each p-System supplier organizes disks differently, so we don't know the packaging details of your FORTRAN compiler and runtime library files. The computer-specific appendices, in the section entitled "FORTRAN Set Up Details," provide guidance on this score. Read that section in the appropriate computer-specific appendix, now.

If you discover that the FORTRAN compiler is already on your system disk with the name SYSTEM.COMPILER, then you shouldn't need to do any further configuration. You can skip the rest of this subsection and begin using FORTRAN. If the FORTRAN compiler is not already on your system disk, the rest of this subsection tells you what you need to do before you can use FORTRAN.

Your first task is to place a copy of your FORTRAN compiler on MYVOL: with the name SYSTEM.COMPILER. You also need to place a copy of the runtime library file for FORTRAN on MYVOL: as well.

Now enter the Filer's T(ransfer activity by starting at the Command menu and typing F T. After you see the "Transfer what file?" prompt, insert the volume containing the compiler in one drive on your computer (removing your system volume if you have only two drives). Be sure to leave the MYVOL: volume in a second drive.

Next enter the volume name and file name of your FORTRAN compiler, followed by [[ret]]. When you see the "To where?" prompt, respond as shown in this screen (which assumes that the compiler was on the volume FORTRAN:, in the file FORTRAN.CODE):

```
Transfer what file? FORTRAN:FORTRAN.CODE [[ret]]
To where? MYVOL:SYSTEM.COMPILER [[ret]]
FORTRAN:FORTRAN.CODE   --> MYVOL: SYSTEM.COMPILER
```

The next step is to place a FORTRAN runtime library on MYVOL:. Invoke T(ransfer again, by typing T. In response to the first prompt, enter the volume and file name for the FORTRAN runtime library you chose earlier. In response to the second prompt, enter MYVOL: FORTLIB.CODE [[ret]].

To complete the installation of this runtime library, you must inform the p-System about it by creating a **library text file** that names it. If you want to know in general about library text files, see Chapter 4. It is sufficient right now for you to know that you need to create a simple text file that has one line in it. The line should contain the file name MYVOL:FORTLIB.CODE.

Remove the disk from which your compiler was copied and make sure that your system disk is installed in a drive. (You may have removed the system disk during the Transfer operation.) Also make sure that MYVOL: is still on-line. Type Q to leave the Filer.

Enter the Editor with an empty workspace and insert the line above. Typing the following text should do that:

E [[ret]] I MYVOL:FORTLIB.CODE [[ret]] [[etx]]

Now store the workspace on your system disk as USERLIB.TEXT and leave the Editor, by typing the input sequence shown on the next page.

Q W USERLIB [[ret]] E

There is one last chore you need to do. If your system disk was configured for Pascal programming, it may contain a file called SYSTEM.SYNTAX. This file contains error messages that may be produced by the Pascal compiler when it processes a Pascal program. Since you're doing FORTRAN programming, this file is not needed, and can, in fact, be a hindrance. We recommend you remove it. (We assume that you have made a back up copy of your system disk, so that if you want to do Pascal programming, and need this file again, you can get it.)

Enter the sequence F R *SYSTEM.SYNTAX [[ret]]. If you don't have SYSTEM.SYNTAX on your system disk, the Filer reports:

```
SYSTEM:SYSTEM.SYNTAX -- File not found <source>
```

(The "SYSTEM:" will be replaced by the name of your system disk.)

If you do have SYSTEM.SYNTAX on your system disk, the Filer reports the removal and requests your confirmation. Give that confirmation with a Y:

```
SYSTEM:SYSTEM.SYNTAX  --> removed
Update the directory? Y
```

You are now ready to do some FORTRAN programming.

Using FORTRAN

The first step is to use the Editor to enter your program into the computer. Invoke the Editor and type [[ret]] to the "File?" question. Then use I(nsert to put the simple FORTRAN program below into your workspace. When you enter the third line, replace "<your name>" by your real name (e.g., Jane or Sebastian). The statement number (in the second line) should be on the left margin of your workspace. The FORTRAN statements themselves should start in column 7.

```
      program First
100   format (A,I5)
      write (*,100) 'Congratulations, <your name>,'
      write (*,100) 'on your first FORTRAN-77 program!'
      end
```

When this program is run, each of the "write" statements causes a line containing the text inside the quotes to be written to your computer display. The "format" statement controls the appearance of those lines.

Compare your workspace with the original program above to make sure that all the details are correct. Computer language compilers are very finicky about details! You should particularly check:

- o that the left and right parentheses, "(" and ")", are matched,
- o that the congratulatory messages are marked at both ends by single quotes, and
- o that each statement starts in column 7. (The "format" statement is preceded by a statement number ("100"), starting in column 1.)

In addition, whenever you write a FORTRAN program in the p-System, be sure that you don't have any extra lines after the "end" statement. If you do have extra lines, the program will not compile. An easy way to check this aspect of your program is to enter J E and then make sure the cursor is on the line immediately below the "end". If necessary, delete text or blank lines from your workspace until this condition is met.

When your survey of this checklist is completed, prepare to write your workspace out to disk by invoking the Q(uit activity. For small program development, the Q(uit U(pdate option is the most convenient. Invoke it by typing U. After the Editor confirms the writing of your workspace to disk, it returns you to the Command menu.

What you need to do now is run the program you've just created. It must be compiled first, however, so invoke the C(ompile activity to do that. You should see the following screen:

```
Compiling...
Output file for compiled listing? (<cr> for none) _
```

The Compiler can produce an annotated **listing** of your program containing the source lines, along with line numbers and other information generated by the compiler. This prompt asks you to indicate where that annotated listing should be put. Enter a simple ⟦ret⟧ to indicate that no listing is needed. If you made no typing errors in entering the program, some disk and screen activity occurs, and then the Command menu is redisplayed on the top line of your screen, leaving the screen output of the compilation process below it:

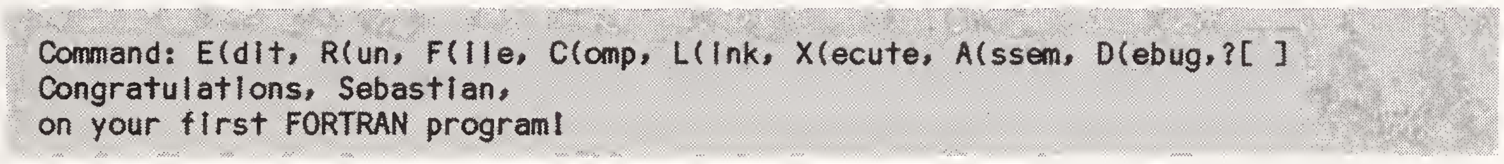
```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug,?[ ]
Output file for compiled listing? (<cr> for none) ⟦ret⟧


FORTRAN-77 - (C) 1981 Silicon Valley Software, Inc.

FORTRAN Compiler [ ]

<   0>..
FIRST
<   3>...
5 lines. 0 errors.
```

If you don't see a display like the one above, it's probably because you made a small typing error in entering your program. When the compiler detects such errors (called **syntax errors**), it sounds your computer's bell and stops. If this happens to you, we suggest you read on through the end of this section without typing anything further. After you know more about syntax errors and how to handle them, come back and deal with this one by going back in the editor and making sure that your workspace matches the original program exactly.

The main purpose of the screen output produced during compilation is to keep you posted on the Compiler's progress (and, particularly, to convince you that progress is occurring!). The compiler writes a dot to the screen for each line it processes, and a line number in angle brackets at the beginning of each line of dots. A summary line indicates the total number of lines processed and the number of errors detected.

To run the program that has just been compiled, type R.

Consider yourself congratulated! You are now back in the Command menu, with the leftover output of your first program on the screen:

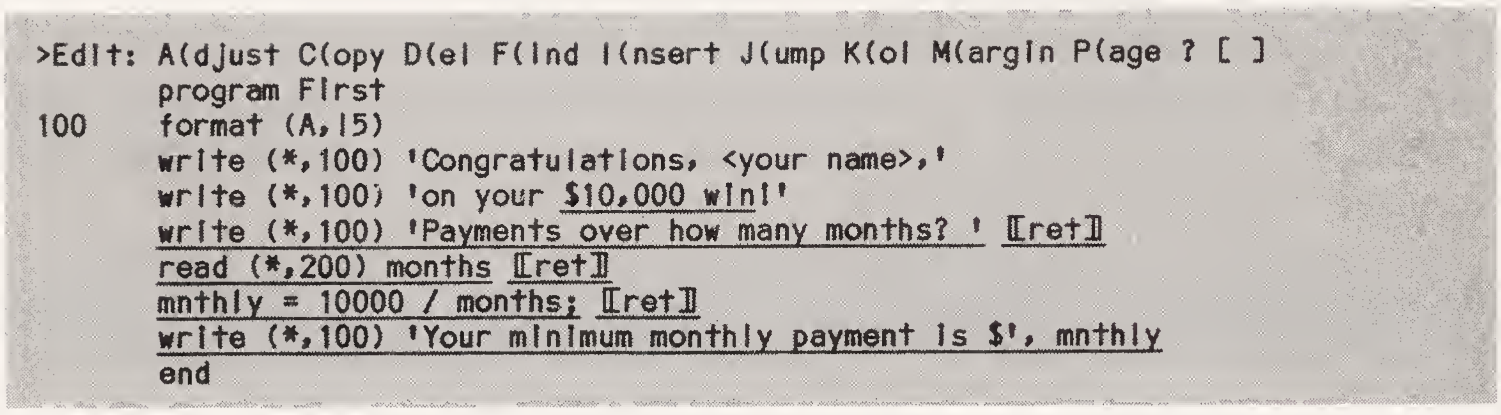


```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug,?[ ]
Congratulations, Sebastian,
on your first FORTRAN program!
```

Let's return to the Editor and make some modifications to the program. This time when you enter the Editor, your program is automatically read into the workspace.

The next program shows you one way in which p-System programming ability can be useful to you. Say you happened to win $10,000 in a contest, and that you could choose the number of months over which the payment of the prize would be spread. The program presented below will prompt you for a number of months, and then calculate and display the minimum amount of the monthly payment for you. We realize that this calculation could also be done in your head or with the aid of any $10 calculator, but this program should prove a useful exercise, nevertheless.

Use D(elete and then I(nsert to change the second "write" statement and add four new lines as shown on the screen on the next page.



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
       program First
100    format (A,I5)
       write (*,100) 'Congratulations, <your name>,'
       write (*,100) 'on your $10,000 win!'
       write (*,100) 'Payments over how many months? ' [ret]
       read (*,200) months [ret]
       mnthly = 10000 / months; [ret]
       write (*,100) 'Your minimum monthly payment is $', mnthly
       end
```

What is the purpose of these new statements? When you run this program, the "read" statement allows you to enter a number of months at the keyboard. Your response is stored in the **variable** "months". The variable holds (or "remembers") the number you type in so that it can be used in the subsequent calculation.

The next line accomplishes the main purpose of this program. The total amount of the prize money ($10,000) is divided by the number of months, and the result stored in another variable, called "mnthly".

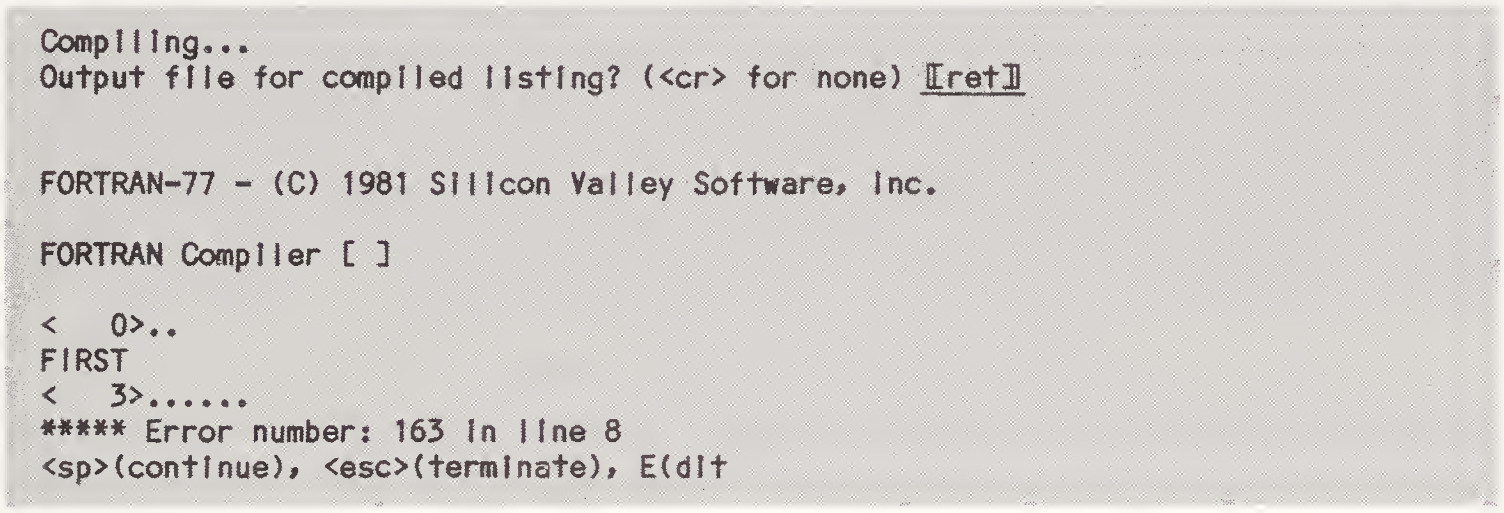
The final "write" line reports the results to you on the screen. When the variable "mnthly" is named in a "write" statement, the number stored in the variable is written to the screen, along with other text in the statement.

This completes your second program. As before, check each line for agreement with the printed version above.

Now Q(uit U(pdate from the Editor, and try invoking R(un immediately, without doing a C(ompile first. The p-System conveniently goes ahead and invokes the Compiler anyway.

Whenever you Q(uit U(pdate from the Editor, the p-System assumes you must have changed something in the source text (otherwise, why would you be saving a copy on disk?). Therefore, when you indicate your program is to be run, the p-System automatically calls the Compiler first, to translate your new program into machine understandable terms.

After you type [[ret]] to refuse the offer of the production of a listing, the behavior of the Compiler should initially be just as it was before. But then the bell on your computer sounds and the following display appears:



```
Compiling...
Output file for compiled listing? (<cr> for none) [[ret]]


FORTRAN-77 - (C) 1981 Silicon Valley Software, Inc.

FORTRAN Compiler [ ]

<   0>..
FIRST
<   3>......
***** Error number: 163 in line 8
<sp>(continue), <esc>(terminate), E(dit
```

The Compiler has detected a syntax error: a place in your program where the structure rules that govern FORTRAN programs are violated. The error is number 163, and it occurs in line 8 of your program.

When you look up this error number in FORTRAN section of Appendix C, "Syntax Errors, "or if you prefer, in your FORTRAN reference manual), you find this specific description:

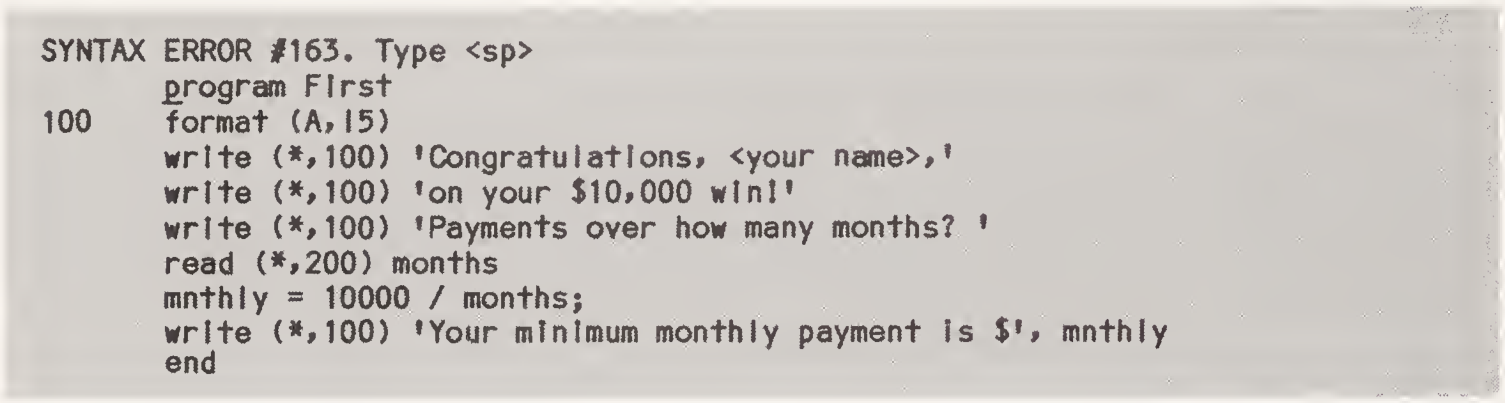
> Label used as format, but not defined in format statement.

The problem is that the "read" statement depends on a "format" statement labeled 200 to specify how the reading is to occur. But there is no statement 200 in the program!

You have three choices at this point, as indicated by the menu:

- o You can type [[space]] to continue the compilation. (You may want to see if there are any other syntax errors in the program.)
- o You can choose [[esc]] to give up on the compilation altogether and return to the Command menu.
- o Finally, you can type "E" to return to the Editor (presumably to fix the problem and try again).

Choose the E(dit option. In a few moments you should be back in the Editor with the following screen displayed:



```
SYNTAX ERROR #163. Type <sp>
      program First
100   format (A,I5)
      write (*,100) 'Congratulations, <your name>,'
      write (*,100) 'on your $10,000 win!'
      write (*,100) 'Payments over how many months? '
      read (*,200) months
      mnthly = 10000 / months;
      write (*,100) 'Your minimum monthly payment is $', mnthly
      end
```

On the top line of the screen is a reminder of the error. The Editor waits for you to type [[space]], indicating that you have seen the error message. After the <u>[[space]]</u>, you're ready to fix the error.

You need to add a "format" statement numbered 200 to control the reading of "months." Move the cursor to the end of the FORMAT statement that's in the program already, and I(nsert this new line:

<u>[[ret]]200   format(I2)</u>

This statement indicates that "months" should be entered as a two-digit whole number, such as "11" or "06", but not "5.6". When you run the program, be sure that you enter exactly two digits for this number (even if the first one has to be zero).

After fixing the error, Q(uit U(pdate and R(un. This time the compilation should succeed and your program should begin running. When it asks you for a number of months, enter <u>06</u> <u>[[ret]]</u>. The monthly payment is reported as $1666 (which is not the exact payment for a six month spread because this particular program can only calculate in whole numbers—not fractions).

When your program completes and the Command menu returns, you can R(un the program again. Notice that this time no compilation is needed, since no changes have been made to the text of the program. Feel free to try various payment rates.

This concludes your initial experience with FORTRAN programming. There are two Editor activities that are not covered in Part 1, but which can be particularly useful in FORTRAN programming because statements generally start at column 7 (unless they are numbered). We suggest that you refer to Chapter 5 for descriptions of the Editor activities X(change and A(djust. The first of these makes it easy to add statement numbers to existing statements. The second allows you to adjust indentations easily. Another useful activity is S(et tabstops within S(et E(nvironment. You could set a tab stop at column 7 and simplify your entry of FORTRAN statements.

3.6 p-SYSTEM WORKFILES

In this section we discuss an aspect of the p-System that you've already used (without knowing it) in developing your first p-System programs: the workfile facility. This p-System feature is intended to simplify program development, particularly on small programs. When a workfile exists, the Command menu activities E(dit, C(ompile, and R(un automatically apply to that workfile; you don't need to continually remember and type in a file name (as you did when using the Editor for ordinary text in Chapter 2).

Let's review the development process you just used to create your first p-System program, and see how the workfile facility was making life easy for you behind the scenes:

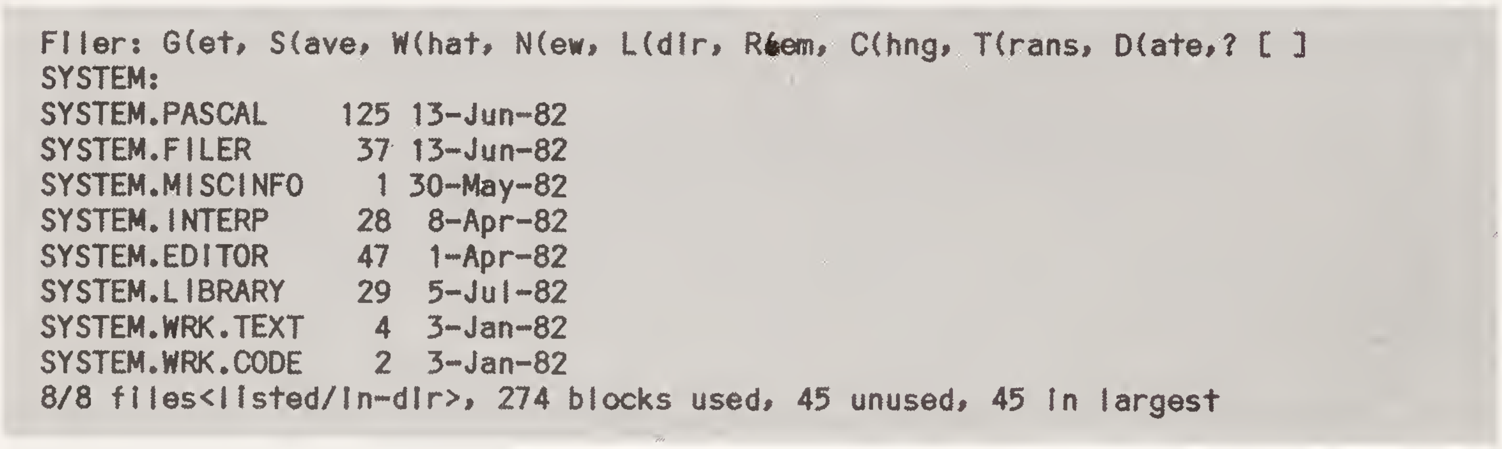
- o You started with an empty workspace and entered a small program. To write the workspace to disk, you used the Q(uit U(pdate activity. A file name must ordinarily be used when a workspace is written to disk, but the Editor did not bother you for a file name. Instead, it wrote the workspace out to a temporary file named SYSTEM.WRK.TEXT on the system disk. This file became the **workfile.**
- o Back in the Command menu, you then invoked the C(ompile activity. The Compiler just assumed that you wanted to translate the workfile, so it didn't bother you for a file name, either; it simply translated the

contents of SYSTEM.WRK.TEXT, and put the results in another temporary file: SYSTEM.WRK.CODE, also on the system disk. (As you may recall, it is .CODE files that are suitable for direct execution by your computer.)

- o You next invoked the R(un activity, which executed the program in SYSTEM.WRK.CODE. In fact, equivalent results would have occurred if, instead of typing R, you had typed X SYSTEM.WRK [ret]. Try it, and convince yourself!

- o You then re-entered the Editor. It didn't bother to ask you what file you wished to edit, but simply read SYSTEM.WRK.TEXT into the workspace. The Q(uit U(pdate by which you left the Editor created a fresh copy of SYSTEM.WRK.TEXT on the disk, and the subsequent R(un and E(dit activities affected that new version of the workfile.

Let's invoke the F(ile activity and make sure that those temporary workfiles are actually on the system disk. Type F L : [ret]. A screen similar to the following should appear:



```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
SYSTEM:
SYSTEM.PASCAL    125 13-Jun-82
SYSTEM.FILER      37 13-Jun-82
SYSTEM.MISCINFO    1 30-May-82
SYSTEM.INTERP     28  8-Apr-82
SYSTEM.EDITOR     47  1-Apr-82
SYSTEM.LIBRARY    29  5-Jul-82
SYSTEM.WRK.TEXT    4  3-Jan-82
SYSTEM.WRK.CODE    2  3-Jan-82
8/8 files<listed/in-dir>, 274 blocks used, 45 unused, 45 in largest
```

There is indeed a code workfile and a text workfile listed. We frequently refer to these related files collectively as "the workfile," even though there are often two files (and possibly a third: the temporary listing file called SYSTEM.LST.TEXT).

The workfile can be temporary and have a SYSTEM.WRK name, or it can have an "explicit" name, such as MYFILE. In the latter case, the components of the workfile could be MYFILE.CODE and MYFILE.TEXT.

There are four activities in the Filer menu that relate to the workfile facility. Here are their names, along with brief descriptions:

- o W(hat: used to find out the status of the workfile.
- o N(ew: used to clear out any existing workfile.
- o G(et: used to designate an existing file (or files) as the workfile. After the G(et, Command menu activities such as E(dit apply to that workfile automatically.
- o S(ave: used to store temporary SYSTEM.WRK files under explicit names.

Invoke the W(hat activity now, and you should see the following screen:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
not named (not saved)
```

The workfile is "unnamed" (that is, temporary) and "unsaved" because you have not used the S(ave activity to give it an explicit name.

When you invoke the S(ave activity, the Filer asks you for an explicit name to use for the workfile:

```
Save as what file? _
```

Type MYFIRST [[ret]] to save the workfiles under the name MYFIRST on the system volume. Notice that no suffix (either .TEXT or .CODE) can be used in the response to this prompt. The screen indicates that both the .CODE and .TEXT workfiles are saved:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
Text file saved & code file saved.
```

Feel free to type L : [[ret]] to check that MYFIRST.CODE and MYFIRST.TEXT actually showed up on your system disk, and that the temporary files disappeared.

Note that MYFIRST is still the workfile. If you were to Q(uit the Filer now, and re-enter the Editor, the familiar program in MYFIRST.TEXT would be read into the workspace. What if you aren't interested in MYFIRST any more, but want to work on another program instead? The N(ew activity can clear the workfile and break any association with MYFIRST. You can see how N(ew affects the workfile by invoking W(hat, then N(ew, followed by another W(hat. You should see these screens in quick succession:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
Workfile is SYSTEM:MYFIRST
```

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
Workfile cleared
```

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
No workfile
```

In your version of the first screen above, the name of your system disk, whatever that is, should appear instead of SYSTEM.

At this point there is no workfile known to the p-System. If you were to exit the Filer and enter the Editor, the familiar "File?" question would be asked, just as it was in Chapter 2.

You can now exercise the G(et activity on the file MYFIRST. After you type G MYFIRST ⟦ret⟧, the Filer reports:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
Text & code file loaded
```

And a W(hat indicates that the "Workfile is SYSTEM:MYFIRST".

The G(et activity doesn't do any copying of files; it simply establishes some file as the workfile. Any of the

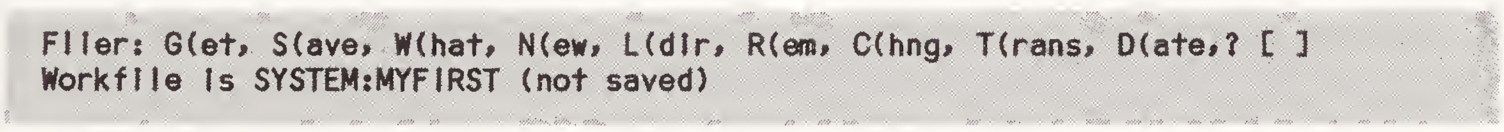
Command menu activities E(dit, C(ompile, and R(un now operate on the new workfile automatically.

As a final exercise with workfiles, let's see what would happen if you modified the workfile MYFIRST. Leave the Filer with Q and enter the Editor with E. As you would expect, the workfile is automatically read into the Editor's workspace. If you had been intending to change your program, you could do that and then Q(uit U(date. Since the p-System assumes that you have modified the workspace when you leave the Editor by Q(uit U(pdate, it is sufficient for the purposes of this exercise to simply type Q U, without making any changes at all.

Let's see what effects this excursion into the Editor has had on the workfile status.

The first check to make is L : ⟦ret⟧ to see what SYSTEM.WRK file(s) is (are) present. It appears that only SYSTEM.WRK.TEXT exists. This is reasonable, since you did a Q(uit U(pdate from the Editor, but no new compilation. Notice also, however, that the files MYFIRST.TEXT and MYFIRST.CODE are still on the disk, as well.

The second check is to invoke the W(hat activity. The result:



```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
Workfile is SYSTEM:MYFIRST (not saved)
```

The workfile is the permanent file SYSTEM:MYFIRST, but as the "not saved" indicates, the permanent file is now out of date. At least as far as the p-System knows, the file SYSTEM.WRK.TEXT contains the newest version of your program.

The logical next step is to S(ave this "newest version" of your program. When you invoke S(ave, the Filer asks you whether you want to retain the current name of the workfile for the new copy that is about to be made. The screen you will see is on the next page.

```
Save as SYSTEM:MYFIRST? _
```

If you respond with "N", you are able to choose a new name. Respond with a Y. Now the Filer requests confirmation that the old copy of MYFIRST.TEXT should be removed. Give that confirmation with a Y, and the screen reports:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
Text file saved & Code file removed.
```

What happened to the MYFIRST.CODE file that corresponded to the old version of MYFIRST.TEXT? It has been removed, since if it were left, the textfile and codefile would not be compatible with each other. (Go ahead and check, if you'd like, that MYFIRST.CODE is gone.) This is a very convenient service of the workfile facility, because it helps you avoid a lot of confusion.

The diagram in Figure 3.2 should help you remember how workfiles are used. We've taken the Figure 3.1 diagram and added the sequence of p-System activities that is involved in each of the major program development steps.

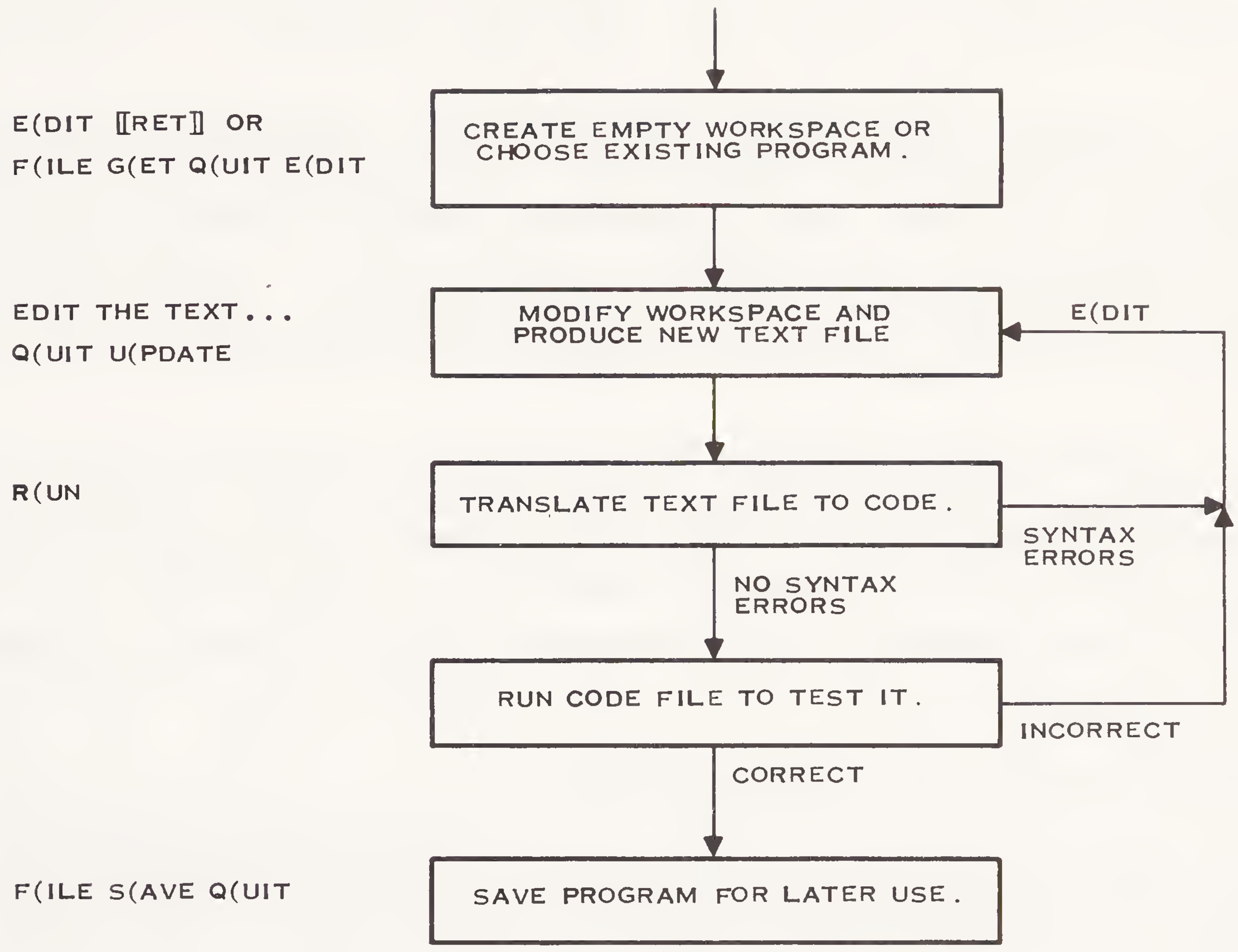

E(DIT [[RET]] OR
F(ILE G(ET Q(UIT E(DIT
CREATE EMPTY WORKSPACE OR CHOOSE EXISTING PROGRAM.
EDIT THE TEXT...
Q(UIT U(PDATE
MODIFY WORKSPACE AND PRODUCE NEW TEXT FILE
E(DIT
R(UN
TRANSLATE TEXT FILE TO CODE.
SYNTAX ERRORS
NO SYNTAX ERRORS
RUN CODE FILE TO TEST IT.
INCORRECT
CORRECT
F(ILE S(AVE Q(UIT
SAVE PROGRAM FOR LATER USE.

Figure 3.2

You may be wondering at this point if the workfile facility can be used for non-program text, such as the memos and poems that you worked on in Chapter 2. The answer: workfiles can be used for any text files, whether or not they contain programs.

Why then didn't we introduce the concept back in Chapter 2? The reason is that the use of workfiles doesn't necessarily offer a lot of benefits when you're working with ordinary text files: the simple Q(uit W(rite approach we used in Chapter 2 is fine.

The key observation is that the effort of designating a workfile is most worthwhile when you're going to do many operations with it (for instance, go many times through an E(dit, R(un cycle). If you're just going to E(dit, the use of G(et and S(ave doesn't save much time, and can introduce unneeded confusion. You're welcome, of course, to experiment and reach your own conclusion.

You should now know enough about workfiles to do simple program development using the p-System.

Another skill you need is the ability to design programs—to take a description of a problem and write a program to solve that problem. As we indicated in the introduction to this chapter, this program design skill is largely independent of the p-System, so we leave that to one of the many excellent texts on the subject.

Once you've designed your program, entered it into the workspace with the Editor, and convinced the Compiler to swallow it (probably after fixing some syntax errors like you did in this chapter), your program may still not do what you intended. For instance, the p-System may detect an "execution error" during the operation of your program (just as the Compiler can detect syntax errors). The next section deals with this possibility.

There are many other ways in which your program may fail to operate as you intended. For instance, the program may appear to operate normally, with no errors detected by the p-System, and still produce incorrect results. A program that doesn't do what it's supposed to is said to have **bugs.** Most techniques for stamping out bugs (or avoiding them in the first place) are not specific to the p-System, so we don't go into them in this book.

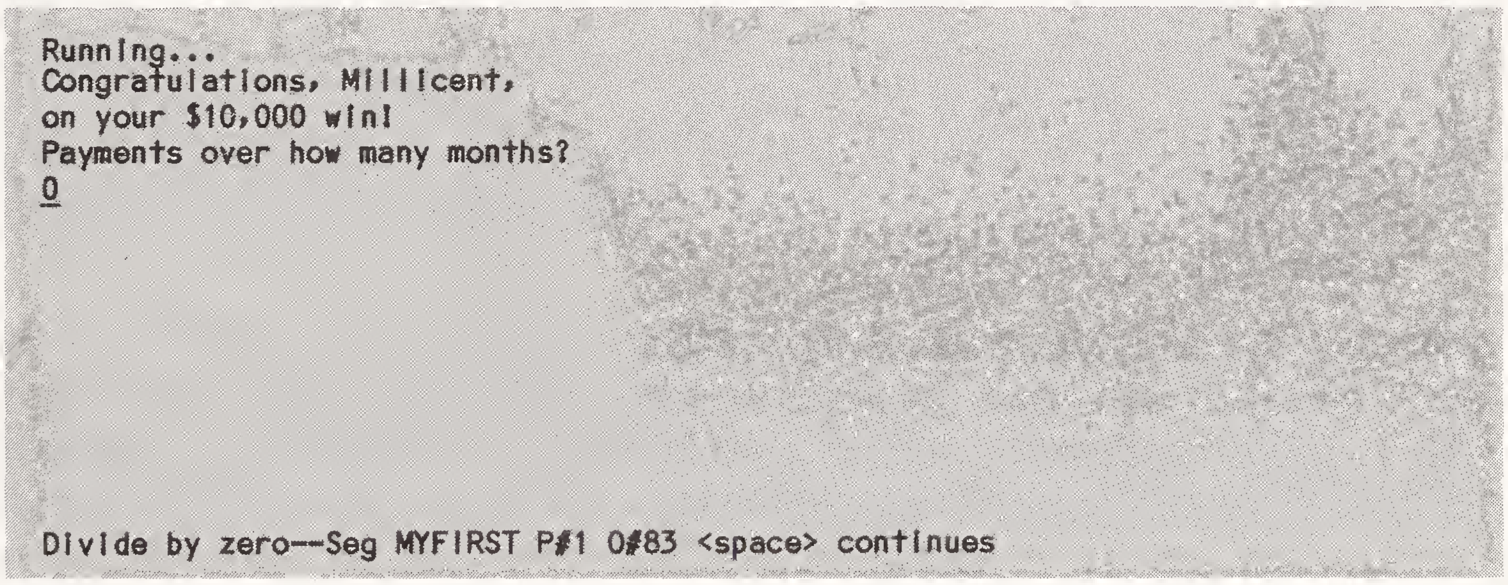
3.7 COPING WITH EXECUTION ERRORS

In a very limited sense, the computer can check its own actions to make sure that they are legal and sensible. When one of these checks reveals a problem, your program can be brought to a screeching halt. This is called an "execution error" to distinguish it from the "syntax" errors that are caught by the Compiler during the translation process.

When one of these execution errors occurs, it will be very obvious that the program has failed, and probably quite easy to discover the unhealthy symptoms that caused it to fail. However, the task of identifying and curing the program disease that caused the symptoms may be somewhat harder.

You can watch an execution error happen by running your MYFIRST program. Yes, there is a potential error lurking in that simple program! Use the Filer to G(et MYFIRST as the workfile and R(un. A compilation is automatically performed, since the code file that you produced earlier was removed.

When your program finally asks you the period over which you want the payment of your prize to be stretched, enter 0 [[ret]]. This would correspond to immediate payment of the entire prize. Almost immediately, trouble strikes. The bell sounds, and an execution error message appears on the bottom line of your screen:



```
Running...
Congratulations, Millicent,
on your $10,000 win!
Payments over how many months?
0








Divide by zero--Seg MYFIRST P#1 O#83 <space> continues
```

The screen shown here corresponds to the Pascal program that you would have produced if you followed the steps in Section 4.4. Some details will be different if you did your first program in FORTRAN.

You have just watched the occurrence of an execution error. Unlike the similar experience with the [[break]] key in Chapter 1, this is an honest-to-goodness error! As you may have already known, it is not possible (at least on a mere computer) to divide zero into 10,000. The p-System detected an attempt to do so in your program and complained loudly.

You know exactly where this difficulty occurred in your program, since there is only one divide operation. In other programs, it is often the case that you could isolate the location of the execution error because of program actions (such as output to the screen) that happen just before the error is detected. Circumstantial evidence of this sort is often sufficient to pinpoint the location in your program where the execution error was detected.

When circumstantial evidence is not enough, the p-System provides a more direct way to determine the error site. Within the execution error message, just after the error identification (for instance, "Divide by zero"), are the error coordinates that define exactly where the error occurred (in terms of the **compiled** version of your program). These coordinate items are:

- o The **segment name** (introduced by "Seg"). The "segments" of a program are major divisions within it, and each of them is named. In small programs like those you'll probably be writing, there is usually only one segment, and its name is the name of your program (such as "MYFIRST").
- o The **procedure number** (which follows the "P#"). In your initial small programs, this will generally be a "1". A "procedure" is a programmer-designated logical section of a program segment. When each procedure is translated, it is assigned a number by the compiler.
- o The **procedure offset** (introduced by "O#"), which designates the location in the procedure where the failure occurred. The translated procedure consists of a sequence of computer instructions. Each instruction occupies one or more **bytes** of storage space. This offset number indicates where in this series of bytes the error occurred.

These three items together constitute an "address" of the error location, just as a country code, area code, and phone number can uniquely identify a particular phone. The specific address shown above corresponds to the location of the division operation in the Pascal program from Section 3.4. If you did your first p-System program in FORTRAN, the address on your screen is different from that shown above.

Now the question is, how can you associate these error coordinates with a particular point in the text version of your program? Only then can you figure out what caused the problem. The answer lies in a compiled listing of your program. In such a listing the lines that make up your program are recorded, along with the "address" of each line, and other useful information. The next several paragraphs explain how to interpret the compiled listings produced by the Pascal and FORTRAN compilers and discover where in your program an execution error occurred.

Figure 3.3 contains a compiled listing of the Pascal program, MYFIRST. In a Pascal compiled listing, the first column of numbers is simply a line number. Of the remaining numbers on each line, the most interesting are in the third column, which contains the procedure number, and in the fifth column, which contains the procedure offset corresponding to the beginning of that line.

Given an error coordinate containing a procedure number and procedure offset, you can use these two columns to find the line where the error occurred. The error line must have a matching procedure number and an appropriate procedure offset. We have marked the error line in Figure 3.3 with an asterisk, "*". Notice that your error offset number is greater than that listed for the error line, and less than or equal to the listed offset for the line following.

```
 1   2    1:d    1  program myfirst;
 2   2    1:d    1  var months, monthly: integer;
 3   2    1:0    0  begin
 4   2    1:1    0    writeln ('Congratulations, <your name>,');
 5   2    1:1   20    writeln ('on your $10,000 win!');
 6   2    1:1   40    writeln ('Payments over how many months? ');
 7   2    1:1   60    readln (months);
 8   2    1:1   76*   monthly := 10000 div months;
 9   2    1:1   83    writeln ('You would get at least $', monthly, ' per month.');
10   2     :0    0  end.
```

Figure 3.3: Pascal Compiled Listing

Figure 3.4 shows a compiled listing for the FORTRAN program FIRST. The first number on each line is simply a line number. The second number is the procedure offset corresponding to the beginning of that line.

In the simple programs you write initially, any execution errors will probably have a procedure number equal to two (indicating that they occurred in the main program). We won't go into the more complex case where subprograms are present. Locating the line containing the execution error, then, is simply a matter of matching the procedure offset in the error coordinate to one of the lines of your listing.

In the example listing below, we have marked the line where the error occurred with a "*". Notice that your error offset number is greater than that listed for the error line, and less than or equal to the listed offset for the line following.

```
 0.      0        program First
 1.      0 100    format (A,I5)
 2.      0 200    format (I2)
 3.      0        write (*,100) 'Congratulations, <your name>,'
 4.     24        write (*,100) 'on your first FORTRAN-77 program!'
 5.     49        write (*,100) 'Payments over how many months? '
 6.     73        read (*,200) months
 7.    100*       mnthly = 10000 / months
 8.    108        write (*,100) 'Your minimum monthly payment is $', mnthly
 9.    136        end
```

Figure 3.4: FORTRAN Compiled Listing

We show you in the next section how to produce one of these compiled listings. Before we can do that, though, you need to leave the error site and return to the Command menu.

As the error message indicates, you should press [space] when you're ready to go on. "Go on," in this context, means "abandon the attempt to execute this program and return to the Command menu." When you type [space], there is a pause with some disk activity while the p-System reinitializes itself (to repair any damage that might have been caused by the execution error). Then the Command menu returns.

Instead of running into an execution error, your program could fail by stumbling into an "infinite loop," in which repetition of a particular section of the program goes on indefinitely.

Imagine the consequences if this kind of difficulty were to show up in a program directing the activities of an automated bank teller (one of those "money machines" that allow you to do bank transactions at odd hours). The program could get stuck in the "dispense cash" section and spew out twenty dollar bills indefinitely! In this situation, but also in your own programming work, it is sometimes highly desirable to get a program to halt unconditionally.

The ⟦break⟧ key that we introduced in Chapter 1 addresses this need very nicely. If your program appears to be stuck in an infinite loop, typing ⟦break⟧ causes an execution error, and error coordinates are given, just as with the "Divide by zero" error. (This doesn't necessarily work on every p-System implementation. On some computers, keys that you type may not be recognized by the system while a running program is doing pure calculation, with no input or output activity.)

After stopping a program with the ⟦break⟧ key, you can use the approach described above to locate the part of your program where the endless looping is occurring. (This will only work if the program is actually executing a part of your program when you press ⟦break⟧. It may be that some operating system section, or section of the FORTRAN runtime library is executing. In that case, the error coordinates shown in the execution error message will not correspond to your program at all.)

One drawback of using the ⟦break⟧ key to halt your program is that you cannot restart it. The program is aborted and the p-System re-initialized.

However, there is another approach that can be used to stop and restart your program: the ⟦stop/start⟧ key. The effect of pressing this key is to suspend output to the console until you press it again. Therefore, if your program is producing output to the console when the key is pressed, the program will pause until the key is pressed again, allowing output to resume. If, however, your program is simply computing, and not producing output, then ⟦stop/start⟧ has no effect on its progress.

We mentioned the benefits of compiled listings above, but didn't describe how to produce one. That is the last topic of this section.

Go ahead and invoke the Compiler (assuming your workfile is still MYFIRST). You should soon see the familiar prompt:

```
Output file for compiled listing? (<cr> for none) _
```

Instead of responding with ⟦ret⟧, as you have in previous compilations, type PRINTER: ⟦ret⟧, or CONSOLE: ⟦ret⟧. Each of these responses causes a listing to be produced on the corresponding device. You should use PRINTER: if you have a printer, since a listing on paper is usually more useful than the memory of a listing flashing by on the screen.

If you do choose the CONSOLE:, you may need to use the ⟦stop/start⟧ key that was just mentioned; otherwise, the listing may go by so quickly on the display that you won't be able to read it. Also, a standard formfeed character is sent to the console at the beginning of each page. On the printer, this character causes a new page to be started. On the console, these characters may show up as strange visible characters, or may cause the screen to be cleared at the beginning of each page.

You can choose to send a listing to a disk file such as MYLIST.TEXT, rather than using CONSOLE: or PRINTER: as the destination. To do this, substitute the desired file name where CONSOLE: or PRINTER: were used above. Once a listing file is complete on the disk, you can transfer it to PRINTER: or CONSOLE:. You could even peruse the file with the Editor, but that might be a bit awkward, since the file is likely to have wider lines (up to 120 columns) than your screen can display.

THE OPERATING SYSTEM 4

4.1 INTRODUCTION

The first three chapters of this book were designed to lead you on an interesting tour of the UCSD p-System and give you a feeling for how it works. If you are fairly experienced with computers, you may have decided to skim those chapters and start here.

The next three chapters provide a more thorough and systematic discussion of the p-System. In this chapter, we cover general p-System concepts and the Command menu items. The next two chapters deal with two of the most frequently used p-System components, the Editor and the Filer.

4.2 STARTING THE p-SYSTEM

Before you can do anything with the p-System, you must start it running on your hardware. This process is sometimes called "bootstrapping." It is usually very easy and involves two or three steps similar to these:

- o Turn your computer on.
- o Place your system disk in the appropriate drive.
- o Perhaps press a button or two.

Then, a greeting message and the main p-System menu is displayed. The disk that you use to bootstrap the p-System is called the **system disk.**

If you do not already know how to start the UCSD p-System on your computer, you should look at the appendix for that particular computer at the end of this book. If you are using a computer for which an appendix has not been included, consult the appendix "The p-System on Other Computers."

4.3 MENUS AND PROMPTS

When the p-System first starts running, the Command menu is displayed:

```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug,? [  ]
```

Whenever a question mark is the last item on a menu, as in this case, there is more to the menu than can be displayed on the screen. If you type "?", the rest of this menu is displayed:

```
Command: H(alt, I(nitialize, U(ser restart, M(onitor [ ]
```

The Command menu is at the outermost level of the UCSD p-System. An item on this menu is selected by typing its first letter. The first letter is always in upper case and is separated from the rest of the word by a "(". For example, to select E(dit, you should type "E".

Most of the activities on this menu have menus or prompts of their own. For example, the Editor has the following main menu:

```
Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
```

This menu is said to be one level below the Command menu. Several of the activities on it have menus of their own. A(djust, for instance, has a menu that looks like this:

```
>Adjust: L(just R(just C(enter <arrow keys> {<etx> to leave}
```

There is always some way to return from a lower level to a higher level. Usually, you can select Q(uit, or type ⟦etx⟧ or ⟦esc⟧, depending upon where you are. (The ⟦etx⟧ and ⟦esc⟧ keys are known as special keys and are described in the next section. We indicate special keys in this book by using the double square brackets, as shown.) Normally, the current menu tells you how to return to a higher level.

Notice that typing the same letter at different levels can have a different effect. For example, "A" selects the A(ssembler from the Command menu, but it selects A(djust from the Edit menu.

It is often the case that a prompt is displayed rather than a menu. A menu, as we just pointed out, requires that you type a single letter to select an item. A prompt requires that you type in some information, followed by ⟦ret⟧.

For example, if you select X(ecute from the Command menu, you see this prompt:

```
Execute what file ? _
```

You are expected to type in the name of a file followed by [[ret]], as follows (responses are underlined in this book):

```
Execute what file ? A.PROGRAM [[ret]]
```

(We explain more about files below. For now we are simply concerned with how to respond to any sort of prompt.)

If you make a mistake while responding to a prompt, you can use [[bs]] to move the cursor backward. As you do this, characters are erased. You can then retype the response correctly.

There is a kind of prompt that only requires you to enter a single letter. This is one where the response is either "Y" for yes, or "N" for no. You can use lower case or upper case letters. Here is an example of one of these prompts:

```
Are there 320 blocks on the disk ? (Y/N) Y
```

Often the "(Y/N)" is not displayed, but it should be obvious from the context that a yes/no answer is required.

4.4 SPECIAL KEYS

There are several keys which have special significance to the p-System. We already mentioned several of them in the previous section.

Most computers do not have physical keys to correspond to every special key the p-System uses. You should look at the appendix for your particular computer at the end of this book (or general computer appendix) in order to see what you should type for these keys.

NOTE: These keys are summarized on the inside front cover of this book.

Often, you may need to press two keys at once in order to produce one of the p-System's special keys. For example, many computers require that you hold down the ⟦control⟧ key and type "C" in order to produce the ⟦eof⟧ key.

The Editor uses all of the keys described in this section, and more. It gives a slightly different meaning to some of them. The Editor's use of special keys is described in Chapter 5.

Here are the special keys which are used throughout the p-System:

⟦ret⟧	This key indicates that you have finished typing your response to a prompt. When it is shown on a prompt or menu, it is placed in angle brackets in one of these forms: <ret> or <cr>. The first version is derived from "return" and the second from "carriage return."
⟦space⟧	The space bar usually produces a blank space in the text you are typing (just as on a typewriter). There are some situations where prompts or menus require a space either by itself, or as a separator between items of input. It is shown on menus and prompts like this: <space>, <spacebar>, or <sp>.
⟦bs⟧	The back space key allows you to move the cursor backward, erasing what you have typed so far. It is usually used for correcting mistakes while responding to a prompt. It is shown on menus and prompts like this: <bs>.
⟦esc⟧	The escape key often allows you to escape (exit without doing anything) from a prompt or menu to the next higher level prompt or menu. It is displayed like this: <esc>

⟦delete line⟧	This key erases the entire line that you have entered while responding to a prompt. It is a quick way to backspace over all of your input. It is rarely displayed as a menu item except in the Editor where it appears as <del>.
⟦break⟧	This key allows you to manually interrupt a program's execution. When this key is typed, the program that is running is immediately terminated. An execution error message is displayed and you are asked to type ⟦space⟧ to continue. When you do the p-System is reinitialized.
⟦stop/start⟧	This key allows you to temporarily stop the program that is currently running. (That program may also be a p-System component such as the Editor or Filer.) When this key is typed, the running program is halted before the next I/O operation is performed. In order to resume execution, type ⟦stop/start⟧ again.
⟦flush⟧	This key causes output to the console to be suppressed. This means that characters normally displayed on the screen will not appear. To return the situation to normal, type ⟦flush⟧ again.
⟦eof⟧	This key signals the end of file from the console. When the keyboard is used as an input file, this key indicates that you have finished typing in the contents of that "file."

4.5 DISK FILES AND FILE NAMES

The p-System makes extensive use of disk storage. It runs on computers that use 8 inch, 5-1/4 inch, and 3-1/2 inch diskettes, as well as large capacity hard disks.

When information is stored on a disk, it is placed in a **file.** Each file is a collection of information that can be accessed, changed, removed, and so forth. There may be as many as 77 files on a disk at one time. If you have a need to place more files on one disk, you can use the **subsidiary volumes** facility (if you have p-System version IV.1). Subsidiary volumes are described in Chapter 6.

There are several types of files. **Text files** are generally created by the Editor and contain textual material, such as letters, memos, poems, or human readable computer programs. **Code files** are created by the compilers and the assemblers, and contain code which can be run by the computer. **Data files** can be created in a variety of ways and may contain miscellaneous sorts of data such as names and addresses, or part names and part numbers. There are other types of files as well.

Each file has a **file name.** This name must contain 15 or fewer characters. The valid characters that may be used to make up a file name are shown in the following table:

Valid Characters for File Names

Letters	A through Z
Numbers	0 through 9
Period	.
Underline	_
Dash	-
Slash	/
Back Slash	\

A file name may have a **file suffix** which usually indicates the type of the file. Here are the file suffixes (this book does not cover all of the files types):

File Suffix:	File Type:
.TEXT	A text file
.BACK	A backup text file
.CODE	A code file
.SVOL	A subsidiary volume file
.BAD	A bad block file
.FOTO	A graphics image file
No suffix	A data file

Usually, you are responsible for choosing the file name. Here are some valid and invalid file names:

Valid File Names:

```
PROGRAM.TEXT
PROGRAM.CODE
A-DATA_FILE
MY/FILE123/NEW
BAD.00192.BAD
PICTURE.FOTO
MY-VOL.SVOL
```

Invalid File Names:

```
A_FILE_NAME_THAT_IS_TOO_LONG
MY,FILE
```

The first invalid example exceeds the 15 character limit. The second name contains an illegal comma.

A file name can be followed by an optional **size specification.** The size specification is only used when a file is created (by the Filer's M(ake activity or by a program). The size specification indicates the file's length and is bounded by square brackets. It has these forms:

File Size Specification:

```
FILE-NAME [number]
FILE.NAME or FILE-NAME [0]
FILE-NAME [*]
```

If a number is used (other than 0), the file is created to occupy that number of **blocks.** A block is 512 bytes (or 512 characters). The file is created in the first area on the disk that contains that many blocks. If [0] is used, or if no size specification appears, the file is created to occupy the largest unused area on the disk. If an asterisk is used, the file is created to occupy half of the largest area, or all of the second largest area, whichever is larger.

NOTE: The information presented in this section is summarized on the inside back cover of this book.

4.6 STORAGE VOLUMES AND VOLUME IDs

Disks of all types are called **storage volumes.** A storage volume is said to be **on-line** when it is placed correctly in a drive. The Filer has an activity called V(olumes which shows you all the volumes that are on-line.

Volumes are assigned **volume names.** The same characters that are valid for file names are valid for volume names. However, a volume name may have at most seven characters. Also, volume names are followed by a colon, ":". Here are some valid volume names.

Example Volume Names:

```
A.VOL:
1234567:
BACKUP1:
```

A storage volume can also be referred to by the **device number** of the drive in which it is mounted. Most computers that run the UCSD p-System have at least two disk drives. These drives are assigned device numbers 4 and 5. If there are any additional drives, they are assigned numbers starting at 9. Device numbers are preceded by a number sign, "#", and usually followed by a colon.

Example Device Numbers:

```
#4:
#9
```

An asterisk, "*", can be used to indicate the **system disk** (the disk you bootstrap with). A colon, ":", can be used to indicate the **default disk.** The default disk is covered in the next section.

The term **volume ID** is the generic term for volume specification. It refers to a volume name, device number, asterisk, colon, or empty volume specification (default disk).

NOTE: The information presented in this section is summarized on the inside back cover of this book.

4.7 FILE SPECIFICATION

A **file specification** consists of a volume ID, a file name, and a size specification. Any of these three may be missing from the file specification. Taken together they indicate a disk and a file on that disk. Here are some samples:

Example File Specifications:

```
MY_VOL:PROGRAM.CODE
#5:LETTER.TEXT
*SYSTEM.PASCAL
DATA/BASE/2
NEWFILE[10]
#9:NEWFILE[*]
#4:
*
:
```

A volume name, by itself, should only be thought of as a file specification in the context where the volume "acts" like a file. This is the case when the volume is a source or destination for a stream of information. In the context where a volume "contains files," the term file specification does not apply.

When you use a file name without the associated volume ID, the file is assumed to reside on the **default disk** (also known as the **prefix volume**). The default disk, at least initially, is the system disk. You can designate another disk as the default disk if you like. This can be convenient. For example, here are some miscellaneous p-System prompts. The responses all indicate files on the disk BACKUP:

```
Execute what file ? BACKUP:A.PROG [[ret]]
Transfer what file ? BACKUP:FILE1,BACKUP:FILE2 [[ret]]
Compile what file ? BACKUP:TEST [[ret]]
List what vol ? BACKUP: [[ret]]
```

If the prefix disk is BACKUP:, you can more easily respond to these prompts like this:

```
Execute what file  ? A.PROG [[ret]]
Transfer what file ? FILE1,FILE2 [[ret]]
Compile what file ? TEST [[ret]]
List what vol ? : [[ret]]
```

You can change the default disk by using the Filer's P(refix activity. You can also change it using **execution option strings** (which are described later).

Notice that a colon, by itself, stands for the default disk (as shown in the last example prompt).

Using an asterisk, you can easily indicate the system disk in this manner:

```
Execute what file ? *A/PROG [[ret]]
Edit what file ? *SONG-LYRIC [[ret]]
List what vol ? * [[ret]]
```

NOTE: The information presented in this section is summarized on the inside back cover of this book.

4.8 THE ARRANGEMENT OF FILES ON A DISK

In order to effectively manage files, it is important to understand how they are physically arranged on a disk. You may want to move files around, add and remove them, determine how much free space is left on a disk, and so forth. If you have a good conceptual understanding of what files look like on a disk, all of this is made easier.

At the beginning of every disk used by the p-System, an area is set aside for the **directory.** The directory contains information about the files that currently reside on the disk. The name of each file, its size, location, and several other pieces of information about each file are stored in the directory. The Filer's L(ist directory activity displays this information for you.

A disk may optionally contain a **duplicate directory.** A duplicate directory is a copy of the main directory which can be kept as a backup in case the main directory is lost. When you use the Filer's Z(ero activity to initialize a disk, you are asked if you want to maintain a duplicate directory. If you elect to do so, all future updates to the main directory will be recorded in the duplicate directory as well. If the main directory is somehow lost, the COPYDUPDIR utility (described in Chapter 6) can be used to copy the duplicate directory into the main directory's location on disk. The MARKDUPDIR utility (also described in Chapter 6) is able to create a duplicate directory on a disk if you didn't initially do so using Z(ero.

The size of a file on a disk is measured in terms of **blocks.** (As already mentioned, a block is 512 bytes.) A file is always an integral number of blocks in length. The size of a disk is also measured in blocks. (In fact, a disk is sometimes called a **blocked volume.**) The first block on a disk is block 0. The next are block 1, block 2, and so forth. The highest number depends upon the storage capacity of your disk. A file is always stored on disk as a sequence of contiguous blocks. For example, a file that covers blocks 32 through 40 would be 9 blocks long.

The directory resides in blocks 2 through 5. If you are maintaining a duplicate directory, it resides in blocks 6 through 9. Blocks 0 and 1 are not used for files. On system disks, those blocks often contain bootstrap code.

Figure 4.1 gives you an idea of how files are stored on a disk. It shows a directory and several files:

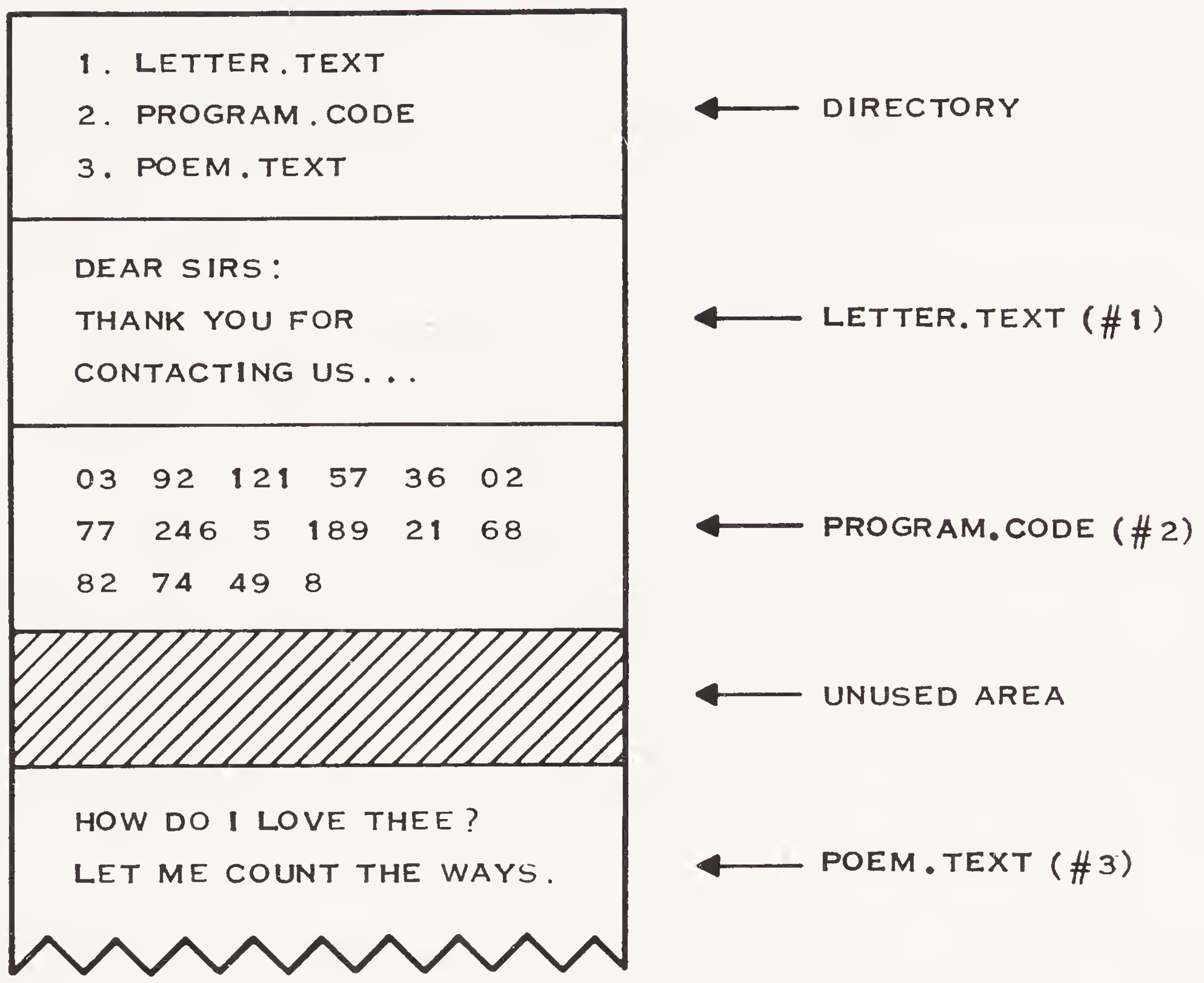


Figure 4.1

There may be unused disk space between files. The Filer's E(xtended list directory activity shows the files on disk as well as the unused space that lies between them. You may run into situations where it is desirable to move all of the files on a disk as close together as they can be. The Filer's K(runch activity does this for you. The result of using K(runch is that the unused space is consolidated into one large area. This is convenient when a large area is needed (to store a new file, for example).

On some computers, a portion of each disk is normally inaccessible to the p-System. Special utilities must be used to deal with areas of this type. For instance, an area at the beginning of the disk is often reserved for bootstrap code that won't fit in blocks 0 and 1. A utility (often called "Booter") is used to copy bootstrap code into this area.

4.9 THE SYSTEM FILES

There are several special files that are important in using the UCSD p-System. These are called **system files.** Some system files are always required and must be on the system disk. Others are only needed it you want to use the particular feature that they offer. Most of the files in this second group can reside on any on-line disk, but a few must be on the system disk. Here are the standard system files:

```
SYSTEM.PASCAL
SYSTEM.MISCINFO
SYSTEM.INTERP
SYSTEM.FILER
SYSTEM.EDITOR
SYSTEM.COMPILER
SYSTEM.SYNTAX
SYSTEM.ASSMBLER
xxxx.OPCODES
xxxx.ERRORS
SYSTEM.LINKER
SYSTEM.LIBRARY
SYSTEM.STARTUP
SYSTEM.MENU
SYSTEM.WRK.TEXT
SYSTEM.WRK.CODE
```

The bulk of the UCSD p-System is contained in these files and, in several cases, their functionality is beyond the scope of this book. However, the following descriptions of them should provide good reference material as well as give you some idea of how the p-System is divided up into several major components.

SYSTEM.PASCAL is the operating system. It is required and must reside on the system disk.

SYSTEM.MISCINFO contains miscellaneous information that the p-System needs so that it can correctly interface with your hardware. Most of this information pertains to your screen and keyboard. This file is required on the system disk.

SYSTEM.INTERP is the p-machine emulator which is the portion of the UCSD p-System which is specific to a particular computer (such as an Osborne or an IBM Personal Computer). On some computers this system file has different names such as SYSTEM.PDP-11 or SYSTEM.IBM. It is required on the system disk.

SYSTEM.FILER contains the Filer. The Filer manages disk files and is covered in Chapter 6. This file is only required when you want to use the Filer. It can reside on any on-line volume.

SYSTEM.EDITOR contains the Editor. The Editor is used to create human-readable text files. This system file is only required when you want to use the Editor and it can reside on any on-line volume. The Screen-oriented Editor is described in Chapter 5. If you plan to use EDVANCE (the advanced editor) or YALOE (the line oriented editor), you need to rename the appropriate code file SYSTEM.EDITOR. Chapter 8 contains some suggestions concerning EDVANCE. You should consult Chapter 9 for further reading suggestions concerning EDVANCE and YALOE.

SYSTEM.COMPILER contains a compiler. This may be the UCSD Pascal, BASIC, or FORTRAN compiler. It is only required when you want to compile a program and may reside on any on-line volume. Compilers are described later in this chapter.

SYSTEM.SYNTAX contains Pascal compiler error messages. These messages are displayed when the compiler finds syntax errors in your program text. If SYSTEM.SYNTAX is not available, you receive error numbers (instead of error messages) and you must refer to a list of compiler errors to see what the problem is. (Lists of compiler errors for Pascal and FORTRAN is provided in the "Syntax Errors" appendix.) Since this system file is only a convenience, it is never required. However, it must reside on the system disk if it is to be used. (SYSTEM.SYNTAX should not be present on the system disk if compilers other than Pascal are used.)

SYSTEM.ASSMBLER contains an assembler. Assemblers work with machine-level languages and are briefly described later in this chapter. This file is only required when you want to assemble a file and it can be on any on-line volume.

The xxxx.ERRORS and xxxx.OPCODES files are used by the assemblers. The error file is an optional convenience. It contains English error messages which the assemblers display in place of error numbers. The opcodes file is required by the assemblers. The "xxxx" is actually an indication of a particular processor, for example: Z80.ERRORS and Z80.OPCODES, 68000.ERRORS and 68000.OPCODES, and so forth. These files can be on any on-line volume. (The 8086 assembler also requires the 8087.FOPS file if the 8087 floating point processor is to be used.)

SYSTEM.LINKER is the link editor. It is used to combine two or more assembled code files into a single code file. It can also combine assembled code files with host compiled code files. The linker is briefly described later in this chapter. It may reside on any on-line volume.

SYSTEM.LIBRARY contains separately compiled or assembled code files that can be used by your programs. There is a "long integer" package which allows your programs to use numbers of up to 36 decimal digit arithmetic. This package is usually contained in SYSTEM.LIBRARY. Applications building blocks, such as the Turtlegraphics unit, may reside here. Also, the special input and output routines for FORTRAN and BASIC can be here if you intend to use those languages. SYSTEM.LIBRARY may also contain code that you write. This file is only required if you want to use the routines that are within it. It must be on the system disk in order to be used. The section "Libraries and Units," below, contains more information about SYSTEM.LIBRARY.

SYSTEM.STARTUP is an optional file that may contain any executable program. This program is automatically executed when the p-System is bootstrapped. This facility can be used, for instance, to put a company logo on the screen when the p-System is bootstrapped. (If this happens on your computer and you don't want the logo to appear, simply remove SYSTEM.STARTUP or change its name.) SYSTEM.STARTUP must be on the system disk if it is to be used.

SYSTEM.MENU is similar to SYSTEM.STARTUP. It may contain any executable program and is executed whenever the p-System is about to display the Command menu. This file is optional, but must reside on the system disk if it is to be used.

SYSTEM.WRK.TEXT and SYSTEM.WRK.CODE are the temporary workfiles. Workfiles are described below. You can create these two files when you use the Editor and Compiler. When workfiles are in use, they always reside on the system disk.

SYSTEM.LST.TEXT is the default destination for a compiled or assembled listing. These listings are optionally produced by the three compilers or the assemblers and contain detailed information about the code created.

4.10 WORKFILES

The p-System has some special facilities to deal with **workfiles.** Workfiles are convenient when you are developing small programs.

The Editor is used to create the human readable form of a program and store it on disk as a text file. One of the p-System compilers then takes such a text file and creates a corresponding code file that is suitable for execution. Then X(ecute or R(un is used to actually run the program.

When you are not using workfiles you must tell the Editor what file you want to edit. You must also inform the compiler what text file to compile and what code file should be produced. And, if you want to run the program, you must select X(ecute and again enter the name of the same file. If you are constantly making small changes in the Editor, recompiling, and rerunning a program, this can amount to a lot of typing.

Using workfiles, all of this can be done with much less typing. The Editor automatically reads a workfile into the workspace. The compiler automatically compiles it and gives the code file a standard name. And R(un automatically executes that file. You can go through this cycle of editing, compiling, and running as many times as you want without ever having to enter the name of the file that you are working with.

There are two kinds of workfiles: temporary workfiles and permanent workfiles. Temporary workfiles may be created from scratch but they may also be temporary versions of existing permanent workfiles. The temporary workfiles are:

```
SYSTEM.WRK.TEXT
SYSTEM.WRK.CODE
SYSTEM.LST.TEXT
```

SYSTEM.WRK.TEXT is created when you leave the Editor by selecting Q(uit U(pdate. SYSTEM.WRK.CODE is created by a compiler whenever you compile a workfile. Here is a typical cycle that you might go through when workfiles are used:

o Enter the Editor; modify the workspace

o From the Editor, select Q(uit U(pdate

o From the Command menu, select R(un

o See the results of your program running

o Repeat this cycle as many times as needed

Permanent workfiles (sometimes called "named" workfiles) are similar to temporary workfiles. They consist of a text file and/or code file (which correspond to SYSTEM.WRK.TEXT and SYSTEM.WRK.CODE). However, they may have any valid file names that end with .TEXT or .CODE.

It is possible to have permanent workfiles and temporary workfiles at the same time. As we mentioned, this means that the temporary workfiles are temporary versions of the permanent workfiles. The Editor can make a temporary version of a permanent text workfile. A compiler can create a temporary version of a permanent code workfile. The Filer can convert temporary workfiles to permanent status (removing the old permanent version if necessary).

The Filer has four activities that are related to workfiles: G(et, S(ave, N(ew, and W(hat. G(et allows you to designate an "ordinary" text and/or code file as the permanent workfile. N(ew clears the workfile altogether. S(ave changes temporary workfiles to permanent workfiles. W(hat tells you what the name of your workfile is (if it has one) and whether or not it has been saved.

For some experience with workfiles you should work with Chapter 3. The relevant Filer activities are covered in Chapter 6.

4.11 COMMUNICATION VOLUMES

There are two types of volumes in the p-System environment: storage volumes and communication volumes. A volume is any sort of computer peripheral to which (or from which) information can be transferred. The console (screen and keyboard) is considered to be a volume. So is the printer. These volumes are communication volumes. Disks, as mentioned earlier, are storage volumes.

The distinction is that communication volumes do not store information. A printer, for example, accepts what is sent to it and prints it. But, a storage volume actually saves the information (relatively) permanently and allows later access to it.

Communication volumes have names like storage volumes except that they are standard names (unlike the names that you give to your disks). Here are the communication volumes usually available with the p-System.

Communication Volume	Device Number
CONSOLE:	#1:
SYSTERM:	#2:
PRINTER:	#6:
REMIN:	#7:
REMOUT:	#8:

CONSOLE: and SYSTERM: are very similar. Both refer to the screen/keyboard. CONSOLE: echoes the characters that are typed on the screen. SYSTERM: (which stands for system terminal) does not echo those characters. PRINTER:, of course, is the printer. REMIN: and REMOUT: refer to the serial communication line (which can be used, for instance, to communicate with distant data sources over the phone). It is possible for you to have many more serial devices than these if the p-System on your computer allows it.

The device numbers can be used in place of the corresponding volume name. For example, you can use the Filer's T(ransfer activity to display a text file on the screen with either of these responses:

```
Transfer what file ? A.POEM.TEXT [ret]
To where ? CONSOLE: [ret]
```

```
Transfer what file ? A.POEM.TEXT [ret]
To where ? #1: [ret]
```

As mentioned earlier, a storage volume is on-line when it is accessible to the p-System. A communication volume is on-line when the peripheral device (console or printer, for instance) is properly connected and turned on. The Filer's V(olumes activity displays which volumes (both storage and communication) are currently on-line.

4.12 SUBSIDIARY VOLUMES

If the p-System that you are using is version IV.1, you can use the subsidiary volumes facility. A subsidiary volume is a regular disk file which contains a directory and is treated as if it was a separate disk altogether.

Subsidiary volumes are accessed directly just like any other volume. You don't have to specify two levels of volume names to access files on a subsidiary volume.

Subsidiary volumes are especially useful when dealing with large capacity disks. By using subsidiary volumes, such disks can be divided into logical portions. More importantly, the p-System is able to store many more files than it otherwise could on such disks. On any given volume, the p-System is able to store 77 files, which is too few to make good use of a large capacity disk. However, each subsidiary volume is able to hold 77 files of its own. This means that you could conceivably have as many as 77 times 77 files on a disk.

In Chapter 6 there is an entire section that deals with subsidiary volumes, so we won't go into any further detail concerning them here.

4.13 LIBRARIES AND UNITS

The p-System allows you to separately prepare pieces of code which can later function together as a unified program. This is referred to as **separate compilation** when you use a compiler to produce the code. (An assembler can also be used as we discuss later.) The separately compiled portions of a program are called **units.**

A program may use several units. Units, themselves, may use other units. The program or unit which uses other units is called the **client.** If it is a program, it may also be called a **host.** You can combine a host program with all of its units into a single executable code file if you wish.

Alternatively, you can leave the units in one or more disk files called **libraries.** If the p-System is correctly informed about the whereabouts of these libraries, it can find all of the necessary units when a program is executed. You might want to use libraries (instead of placing all of units the directly into the host's file) if the units are used by several clients. In this way, the disk space required by the units is not duplicated for every program or unit which uses them.

The main library is called SYSTEM.LIBRARY and must be on the system disk if it is to be used. Any units that you place in SYSTEM.LIBRARY are available for clients to use. A unit can be inserted into SYSTEM.LIBRARY (or into a client program or unit) using the Library utility which is briefly discussed in Chapter 8.

It may be convenient for you to have several libraries. To designate a code file as a library, you should use a **library text file.** A library text file is an ordinary text file that contains the names of code files which you want to designate as libraries. The standard library text file is USERLIB.TEXT and should reside on the system disk. For example, you can use the Editor to place the following lines in a text file:

```
INIT.UNITS.CODE
MY.LIB
#5:MORE.UNITS.CODE
#5:SYSTEM.LIBRARY
```

You can then name that file USERLIB.TEXT and place it on the system disk. The four files are designated as libraries, along with the standard SYSTEM.LIBRARY on the system disk. The .CODE suffix is appended to these names if necessary.

It is possible to use other library text files besides USERLIB.TEXT. This can be done with execution option strings which are described under the X(ecute activity, below.

The assembler can also separately produce portions of a host program or unit. These portions are known as **external routines.** External routines must be bound directly into the client program or unit that needs them. The L(inker, which is briefly described in this chapter, is used to do this.

4.14 REDIRECTION

Normally, the p-System is used by a person typing on a keyboard and watching the screen. However, it is possible to **redirect** the p-System's input (to come from someplace other than the keyboard) and/or its output (to go to someplace other than the screen).

You can, for example, create a **script file** which contains characters that you would normally type in response to p-System prompts and menus. If you then redirect the p-System's input to that file, it reads those characters one at a time and selects the corresponding activities. There are many instances in which repetitive tasks can be automated in this manner.

The X(ecute activity is used to redirect input and output. This is accomplished using a facility called **execution option strings** (covered under X(ecute, below).

You can use the M(onitor activity to assist you in creating script files. It causes the p-System to monitor and store away the keys that you type from the keyboard. The resulting script file can be used by X(ecute to duplicate those actions. M(onitor is also described below.

4.15 ERROR MESSAGES

Error messages are displayed by the p-System and its various components under certain circumstances. For example, you may inadvertently take a disk out of its drive before some necessary code is read from it into main memory. Or, a program that you are compiling might not be syntactically correct. There are many other possibilities as well.

Syntax errors for the compilers along with the operating system, Filer, and Editor error messages are listed in the appendices to this book. There are two types of operating system errors that are important enough to introduce here.

The p-System often needs to read code from a disk file into main memory. If you have removed a disk when code is needed from it, you receive a message like this (usually on the bottom line of the screen):

```
Need segment MYSEG:  Put volume MYDISK in unit 5 then type <space>
```

In this example, MYSEG is the name of the code segment that is required. MYDISK is the name of the volume that contains that code. And 5 refers to device #5:, where the disk should be placed. Usually, you don't need to concern yourself about the code segment name. Just place the disk in the indicated drive and press [[space]].

If an error occurs while a program is running, the operating system produces an **execution error** message. If, for example, a program attempts to divide a number by zero (which is an illegal operation), an error similar to this appears:

```
Divide by zero -- Seg MYSEG  P# 3  O# 125  <space> continues
```

The pieces of information displayed in this message show where the error occured in the program and are called **error coordinates.** If this kind of error occurs, you should note the error coordinates and then type [[space]]. The p-System reinitializes itself and displays the Command menu. Unless you are debugging the program, the error coordinates are probably not important to you. However, they will be important to the supplier or developer of the program.

4.16 NOTATIONAL CONVENTIONS

There are several notational conventions used in Part 2 of this book for referring to volumes and files. The following generic terms, with hyphens, are used:

FILE-SPEC
FILE-NAME
VOLUME-ID
VOLUME-NAME:
SIZE-SPEC

FILE-SPEC refers to "file specification," and SIZE-SPEC refers to "size specification." These generic terms may appear together, like this:

VOLUME-NAME:FILE-NAME
FILE-NAME SIZE-SPEC

When more than one file or volume are referred to, self-explanatory conventions such as these are used:

FILE-NAME-1
FILE-NAME-2
etc.

NEW-VOLUME-ID
OLD-VOLUME-ID

Multiple number signs are used to indicate a numeric value:

Scan for ### blocks (Y/N) ?
Block ## is bad

Prompt and menu responses are underlined and may contain extraneous words such as "or":

```
Execute what file ? FILE-SPEC [ret]
Throw away current workfile ? Y or N
```

Some prompts are shown with several responses. This means that you can respond in any of the indicated ways:

```
  Dir listing of what vol ? VOLUME-ID [ret]
                            FILE-SPEC [ret]
                            VOLUME-ID , FILE-SPEC [ret]
```

4.17 THE COMMAND MENU

Whenever the p-System is booted or initialized, the Command menu is displayed. Also, whenever a program finishes execution, or a p-System component (such as the Editor or Filer) is exited, this menu reappears. It provides a platform from which all programs, including the major p-System components, may be selected. The Command menu looks like this:

```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug,? [ ]
```

Typing "?" displays the rest of of it:

```
Command: H(alt, I(nitialize, U(ser restart, M(onitor [ ]
```

The activities on this menu are covered in this section in alphabetical order. This section is intended as reference material as well as general interest reading.

A(ssemble

An assembler translates the assembly language for a particular microprocessor into machine code consisting of the basic computer instructions. These instructions do such things as add two numbers, store the result in a memory location, compare two numbers, and so forth.

The high-level languages that the compilers accept have more elegant and powerful capabilities. This means that programming in Pascal, for example, can be a lot less tedious than programming in assembly language. There are two reasons why assembly language is attractive to use in certain circumstances, however.

The first is that machine-level code executes faster than the **p-code** which is a compiler's output. P-code is a powerful and compact "pseudo code" that can run on any computer on which the p-System is installed. It is executed by the p-machine emulator (which is written in the assembly language of the host computer). Because of this emulation approach, p-code doesn't run as fast as machine-level code. Therefore, you may want to write time critical portions of a program in assembly language.

The second attractive attribute of assembly language is that it is very fundamentally close to the computer hardware on which it runs. One implication of this is that you can perform low-level machine-specific tasks which are much more difficult (if even possible) from high-level languages. Plus, assembly language can run with or without the underlying p-System because it is directly executed by the processor. A drawback of machine-level code is that it is specific to a particular processor. This means, for example, that you can't move the assembler's output for an 8086-based computer to a 68000-based computer.

In order to use an Assembler, its code file must be named SYSTEM.ASSMBLER (notice the missing "E") and placed on-line. Also, there is an opcodes file and an errors file that must be on-line. These have names that depend upon the processor you are using (e.g., 8086.OPCODES and 8086.ERRORS, Z80.OPCODES and Z80.ERRORS, and so forth).

When you select A(ssemble, you are asked what file to assemble. You should enter the name of the text file which contains your assembly language source. You should not include the ".TEXT" because that suffix is assumed:

```
Assemble what text ? MY.PROC [[ret]]
```

This response causes the file MY.PROC.TEXT to be assembled. The next prompt asks you to give the name that you want the code file to have. You should not include the ".CODE" in your response:

```
To what code file ? MY.PROC [[ret]]
```

This response causes the output file to be called MY.PROC.CODE. If, instead, you answer this prompt with a dollar sign:

```
To what code file ? $ [[ret]]
```

the code file is given the name which corresponds to the text file. In this case it is still MY.PROC.CODE.

You should be careful if you enter the text file with a volume name, such as VOL2:MY.PROC, and then use the dollar sign for the code file. In this case, the code file is not necessarily placed on the same volume as the text file. Rather, it is placed on the prefixed volume. For example, if the prefix is VOL1:, responding like this:

```
Assemble what text ? VOL2:MY.PROC [ret]
To what code file ? $ [ret]
```

creates the code file VOL1:MY.PROC.CODE.

Next the Assembler prompts you for a listing file:

```
Output file for assembled listing (<cr> for none) _
```

An assembled listing shows your original text along with the machine code that was generated and other information. The details of assembled listings are beyond the scope of this book. In response to this prompt, you can enter a file specification in which case the assembled listing is placed in that file. If you enter CONSOLE: or PRINTER:, the listing is displayed or printed, respectively. If you simply type [ret], no listing is produced.

As the assembling process proceeds, dots are displayed on the screen. Each dot represents one line of your source text.

The resulting code file is generally linked, using the Linker, to a high level host program. Unless this is done, the assembly language code can't be executed within the p-System environment. However, it is possible to use the **Compress** utility on the assembled code file. This modifies your code file so that it can run without the underlying p-System. It is also possible to link assembled code files together. (You should consult Chapter 9 for further reading suggestions concerning all of these topics.)

C(ompile

C(ompile starts a compiler. The p-System has compilers for Pascal, BASIC, and FORTRAN. You should make sure that the compiler that you want to use is named SYSTEM.COMPILER and resides on an on-line volume. When you are using BASIC or FORTRAN, you also need to have the runtime support package in a library. Chapter 3, sections 3.4 and 3.5, describe the steps you need to take in order to use Pascal or FORTRAN.

If you do not have a workfile, you are asked what file you want to compile. This is assumed to be a text file so you should not include ".TEXT" in your response. For instance:

```
Compile what file ? MY.PROG [ret]
```

compiles the file MY.PROG.TEXT.

Next you are asked what you would like to call the code file that is produced. This is assumed to be a code file, so you should not include the .CODE suffix in your response. For example:

```
To what code file ? MY.PROG [ret]
```

causes the resulting file to be called MY.PROG.CODE. If you answer this prompt with a dollar sign like this:

```
To what code file ? $ [ret]
```

the resulting code file is given the name that corresponds to the text file, in this case MY.PROG.CODE. Using a dollar sign not only reduces typing, it saves you from possibly making a confusing mistake by entering an incorrect name, such as MY.PRUG.

You should be careful if you enter the text file with a volume name, such as VOL2:MY.PROC, and then use the dollar sign for the code file. In this case, the code file is not necessarily placed on the same volume as the text file. Rather, it is placed on the prefixed volume. For example, if the prefix is VOL1:, responding like this:

```
Compile what text ? VOL2:MY.PROG [ret]
To what code file ? $ [ret]
```

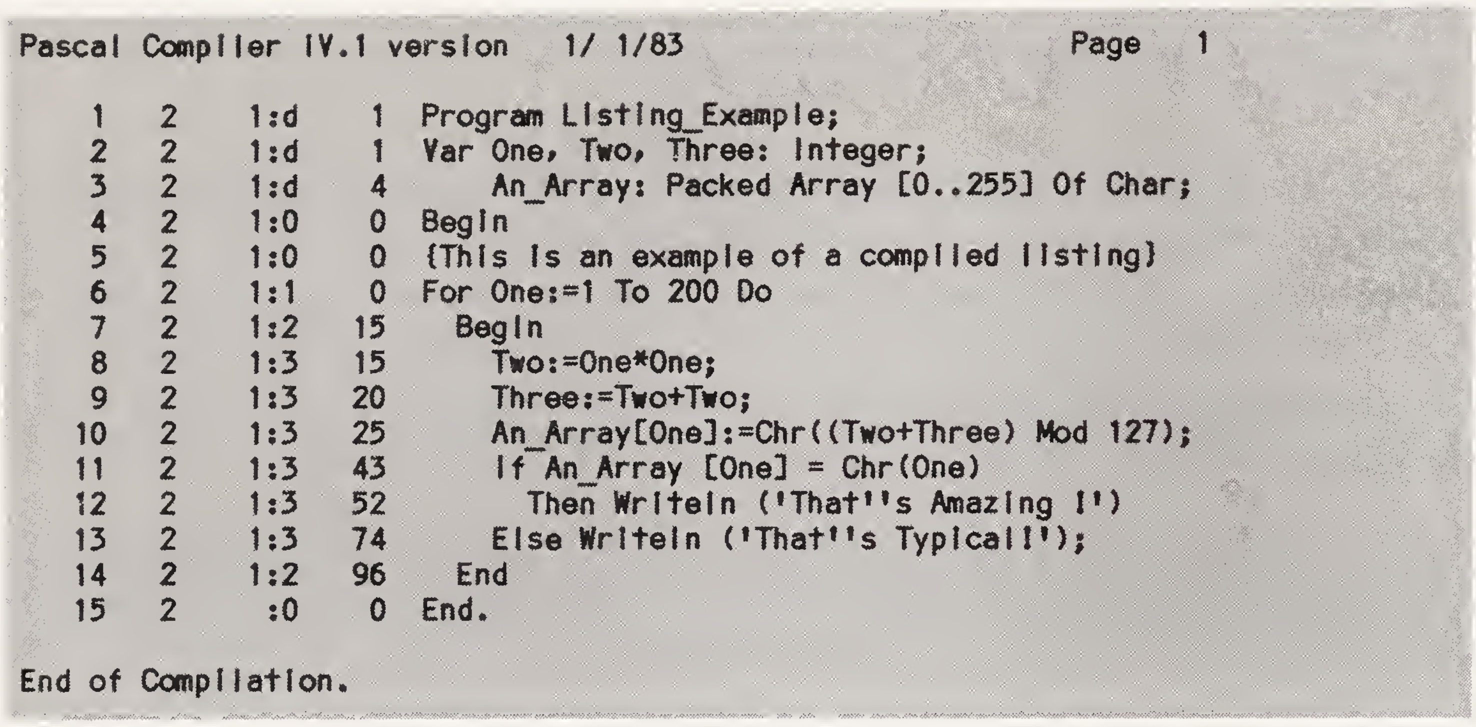
creates the code file VOL1:MY.PROG.CODE.

If you have a workfile, neither of these two prompts is displayed. Instead, the p-System assumes that you want to compile the workfile and that you want the code file to be called SYSTEM.WRK.CODE (the temporary code workfile).

Next, you are asked if you want a listing of the compiled text:

```
Output file for compiled listing? (<cr> for none) _
```

If you simply type [ret], no compiled listing is produced. You can enter a disk file name, in which case a file is created on disk which contains the listing. You can also answer this prompt with a communication volume such as PRINTER: or CONSOLE:. These two responses send the listing to the printer or the screen respectively. Here is an example of a Pascal compiled listing:



```
Pascal Compiler IV.1 version   1/ 1/83                       Page   1

     1   2    1:d    1  Program Listing_Example;
     2   2    1:d    1  Var One, Two, Three: Integer;
     3   2    1:d    4      An_Array: Packed Array [0..255] Of Char;
     4   2    1:0    0  Begin
     5   2    1:0    0  {This is an example of a compiled listing}
     6   2    1:1    0  For One:=1 To 200 Do
     7   2    1:2   15    Begin
     8   2    1:3   15      Two:=One*One;
     9   2    1:3   20      Three:=Two+Two;
    10   2    1:3   25      An_Array[One]:=Chr((Two+Three) Mod 127);
    11   2    1:3   43      If An_Array [One] = Chr(One)
    12   2    1:3   52        Then Writeln ('That''s Amazing !')
    13   2    1:3   74      Else Writeln ('That''s Typical!');
    14   2    1:2   96    End
    15   2     :0    0  End.

End of Compilation.
```

The information contained in this listing is useful for debugging and analysis purposes. It is beyond the scope of this book, however.

The compiler makes two passes through the Pascal text. As the compiler does its first pass, dots are displayed on the screen for every line in the text. During the second pass dots are displayed for each major segment of your program. Also, during the second pass, the compiled listing is produced if you indicate that you want one.

If you intend to do a substantial amount of programming, we suggest that you consult Chapter 9 for further reading suggestions.

D(ebug

If you are going to develop programs with the UCSD p-System, the Debugger is a tool that can help you to diagnose errors in them.

With it, you can stop a running program at any point and look closely at what is going on. You can allow the program to continue for a while and then stop it again. Or you can step very slowly through the code. There are several other operations that the Debugger can perform which help you to determine what might be causing your program to malfunction.

When you enter the Debugger, the following two lines appear:

```
Debug [ ]
(
```

The Debugger is the only major p-System component that does not use menus or prompts. This is because any such displays could interfere with the output of the program being debugged. In order to return to the Command menu from here, you should select the invisible Q(uit activity.

It is not our intention to explain very much about the Debugger in this book although there is a section in Chapter 8 which gives a little more information about it. If you want to use the Debugger, please see Chapter 9 for further reading.

E(dit

Selecting E(dit starts the Editor. The Editor is used to work with text files. You can create a new text file or edit an existing one. When you select E(dit you are usually prompted:

```
>Edit:
No workfile is present. File? ( <ret> for no file )
```

This prompt is asking you what file you want to edit. It is covered in Chapter 5. When you have correctly answered it and entered the Editor, the Edit menu is displayed:

```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ? [ ]
```

All of the Editor activities are described in Chapter 5.

F(ile

Selecting F(ile starts the Filer. It's menu looks like this:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,? [ ]
```

The Filer is used to work with disk files, storage volumes, and communication volumes. It is described in Chapter 6.

To return to the Command menu, select Q(uit.

H(alt

H(alt terminates all p-System activity. If you want to use the p-System after you have halted it, you need to reboot.

I(nitialize

This activity causes the entire p-System to "reinitialize" itself. This resets the p-System's status to very nearly what it is when you first start it up. However, if you have changed the prefix, that change remains in effect. Also, if you have redirected any I/O, it remains redirected.

L(ink

Selecting L(ink starts the Linker. The Linker is used to combine two or more assembled code files into a single code file. It also links assembled code files to high-level language hosts.

If you need to do a substantial amount of assembly language programming, it may be very convenient to separately assemble the pieces and then link them together.

If you want to execute assembly language code within the p-System environment, it is required that you link the code to a high-level host. Only programs (which are written in high-level languages) can be X(ecuted Command menu.

The following display is an example of the prompts that appear when the Linker is used:

```
Host file ? MY.HOST [ret]
Opening MYDISK:MY.HOST.CODE
Lib file ? AN.ASSM [ret]
Opening MYDISK:AN.ASSM.CODE
Lib file ? 1.MORE [ret]
Opening MYDISK:1.MORE.CODE
Lib file ?  [ret]
Map name ?  [ret]
Reading MYHOST
Reading ANASSEM
Reading ONEMORE
Output file ? LINKED.UP.CODE [ret]
Linking MYHOST  #2
  Copying proc ANASSEM
  Copying proc ONEMORE
```

The first prompt asks for a host file. (This is usually the program or unit that uses an assembled routine.)

Then a recurring prompt asks you for as many assembled library files, or "lib" files, as you need. When you have entered all of them, you should type an empty [[ret]] in response to this prompt.

The next prompt asks for a map file name. If you enter the name of a text file, internal details of the linkage will be placed there.

The Linker then displays the names of the files that it is linking as it reads them.

Next, you are asked for an output file.

Finally, you are told the names of the routines as they are linked together.

M(onitor

The M(onitor activity helps you to automate repetitive operations with the p-System. It assists you in creating script files which can serve as a source for redirected input. (For more information on redirection, see Section 4.14, page 159. Execution option strings are used to perform redirection as described under X(ecute, below.)

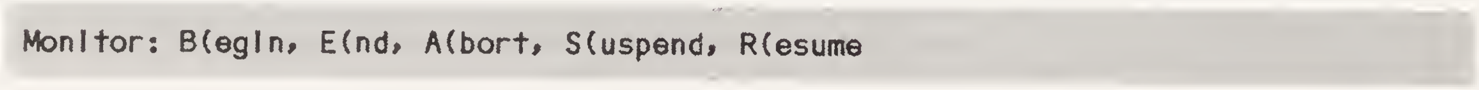
Script files contain a series of characters that you would normally enter at the keyboard. When the p-System's input, or a program's input, is redirected to a script file, that file becomes the source of the characters that you would otherwise have to type. Script files can be very convenient for long and repetitive sequences of operations. A simple script file might contain the characters:

```
FV
```

If you redirect the p-System's input to this file, it would enter the Filer, "F", and select V(olumes, "V".

M(onitor can be used to place the p-System into a mode where it keeps track of what you are typing at the keyboard. All keys that you type, including special keys, are placed into a script file automatically.

When you select M(onitor, this menu appears:



```
Monitor: B(egin, E(nd, A(bort, S(uspend, R(esume
```

In order to start monitoring, you must first select B(egin. B(egin requests that you enter the name of the script file that you want to create.

The next thing that you should do is select R(esume. R(esume returns you to the Command menu. Any keys you type after that are stored in the script file.

If you are finished recording keyboard input, enter the M(onitor again and select E(nd. E(nd closes the script file so that it can now be used as a source of redirected input. After using E(nd, you should use R(esume to return to the Command menu.

If you want to temporarily halt the monitoring process, select S(uspend. After you do this, you are returned to the Command menu. However, nothing that you type is recorded. Later you can re-enter the M(onitor and use R(esume to continue monitoring from where you left off.

A(bort causes the script file that you are creating to be thrown away.

R(un

R(un is used either to execute, or to compile and execute a program. The main purpose of R(un is to assist you in using workfiles. It is convenient in this situation because it saves you from excess typing.

If you have a code workfile, selecting R(un automatically executes it. If you only have a text workfile, R(un compiles it and then executes it. There is a slight twist to this, however: if you have just created a new version of the text workfile (by using Q(uit U(pdate from the Editor), R(un compiles and executes it even if an old version of the code workfile exists.

If you do not have a workfile, R(un executes the most recently compiled code file. If you haven't compiled a file since booting the p-System, R(un asks for a text file to compile and execute.

U(ser Restart

U(ser restart is used to restart any program that just completed execution. If, for example, you have just X(ecuted a program like this:

```
Execute what file ? MY.PROG [ret]
```

and the Command menu has reappeared, you can now run it again by simply typing "U". This is convenient when you need to run the same program several times.

There are some programs that take a relatively long time to begin running because of **associate time.** This is the time that it takes the p-System to collect information about the units that a program uses. When programs are restarted with U(ser restart, association time is not a factor because the units are still "associated." This means that programs which use a large number of units start noticeably quicker with U(ser-restart. (The Quickstart utility, introduced in Chapter 8, provides a mechanism for reducing associate time in general.)

X(ecute

Programs that are ready to run may be started by selecting X(ecute. This activity prompts you:

```
Execute what file ? _
```

You should enter the name of an executable code file. Do not include the .CODE suffix. For example, if you want to execute a file called MY.PROG.CODE, respond to the X(ecute prompt like this:

```
Execute what file ? MY.PROG [ret]
```

It is possible to respond to this prompt with the entire name of a code file, if you add a period, ".", to the end of the file name:

```
Execute what file ? MY.PROG.CODE. [ret]
```

This can be useful since a code file's name is not required to end with .CODE. For example, you can X(ecute SYSTEM.FILER like this:

```
Execute what file ? SYSTEM.FILER. [ret]
```

If you type in the ".CODE" without a period, the file won't be found or executed. For example, if you enter "PROG.CODE", X(ecute tries to find the file "PROG.CODE.CODE" which is not what you intended.

It is possible to do several other useful things with X(ecute by using **execution option strings.** An execution option string is an optional part of your response to the "Execute what file ?" prompt. For example:

```
Execute what file ? I=SCRIPT.TEXT [ret]
```

is a valid way to use the "I" option, as described below.

Execution option strings were mentioned in the section on redirection earlier in this chapter (see Section 4.14, page 159). Using them you can redirect the p-System's input and output. You can also redirect a particular program's input and output. There are several other tasks that execution option strings can perform. Here is a summary of the six execution options:

Execution Option:	Action:
I=	This option can be followed by a quoted string or a file specification. (The file specification could indicate a script file or a communication volume such as REMIN:). The **p-System's input** is redirected to come from that input source instead of the keyboard.
O=	This option is followed by a file specification (which could indicate a disk file or a communication volume such as PRINTER:). The **p-System's output** is sent to that destination instead of the screen.

PI=	This option can be followed by a quoted string or a file specification. (The file specification could indicate a script file or a communication volume, such as REMIN:). The **program's input** is redirected to come from that input source instead of the keyboard.
PO=	This option is followed by a file specification (which could indicate a disk file or a communication volume such as PRINTER:). The **program's output** is redirected to that destination.
P=	This option is followed by a volume ID for a storage volume. It sets the **prefix** to the indicated volume ID. This is the same operation performed by the Filer's P(refix activity. You must not include the colon after the volume ID.
L=	This option is followed by a text file specification. The .TEXT suffix is optional. The indicated text file is designated as the **library text file** (see Section 4.13, page 157).

Any execution options which you use should appear after the program's file specification. You don't have to include a program if you don't want to execute one. You can just use X(ecute to perform execution options by themselves.

If you use more than one execution option, you should separate them using space characters. The order in which you use them does not matter as long as the program name is first (if you are executing one). The prefix option, however, is always processed before anything else.

Here are some examples:

```
Execute what file ? I=MY.SCRIPT.TEXT [ret]
```

This response redirects the p-System's input to come from your file MY.SCRIPT.TEXT. If this file contains the characters:

FL#5:[ret]

then this causes the p-System to enter the Filer, "F", select L(ist, "L", and list the directory of the disk in drive #5, "#5:[ret]". When all the characters from the input file have been read, standard input from the keyboard is resumed.

```
Execute what file ? I="FL#5:," O=PRINTER: [ret]
```

Here, the p-System's input is redirected to a string which, causes it to enter the Filer and list the directory of the disk in drive #5. The comma within the string is interpreted as [ret].

In addition, the p-System's output is redirected to the printer. When this is done, all prompts, menus, and other displays are printed rather than displayed on the screen. This means that the Filer's menu, the L(ist directory prompt and response, and the directory listing of the disk in drive are all printed rather than displayed on the screen. This handling of output continues until another redirection command makes a change.

```
Execute what file ? MY.PROG P=#5 L=USERLIB2 PO=PRINTER: [ret]
```

In this example, the file #5:MY.PROG.CODE is executed. Before that program actually starts, however, the following execution options are performed:

The prefix is changed to #5:.

The library text file is changed to #5:USERLIB2.TEXT.

The program's output is redirected to the printer. This means that everything the program normally writes to the screen is printed instead. After the program finishes, output resumes to the console screen.

THE EDITOR 5

5.1 INTRODUCTION

One area in which computers are extremely valuable is text editing. With a typewriter you can produce text on paper, but it can't be rearranged, corrected, and printed out again. An editor can save the text you create on disk. Later that text can be printed, or, if it is a program, compiled.

There are three editors available with the p-System. The first is the Screen-oriented Editor which is described in this chapter. The second is the advanced editor, EDVANCE, which is similar to the Screen-oriented Editor, but contains several more sophisticated features. EDVANCE is introduced in Chapter 8. The third editor is called YALOE (Yet Another Line Oriented Editor). It is meant for computers that have a hard copy output instead of a screen. YALOE is not covered in this book.

We introduced the Screen-oriented Editor in the first part of this book. In this chapter we cover the Editor and its activities more thoroughly and systematically.

We have laid out this chapter so that, after you read it through, you can use it as a reference guide in the future. It begins with a quick overview of the Editor. Next, the general Editor facilities are introduced. Finally, the items on the Editor menu are covered in detail.

5.2 OVERVIEW OF THE EDITOR

The Editor works with text files. Text files always have names that end with .TEXT. Here are some examples:

```
POEM.TEXT
PROPOSAL.TEXT
SYSTEM.WRK.TEXT
```

When an editing session begins, you may either create a new file from scratch, or you may edit an existing file. In either case, the copy of the file that you are editing exists in main memory and is called your **workspace.** The amount of main memory that you have determines the maximum size of your workspace. When you are finished editing the workspace, you can write it to disk. Alternatively, you can leave the Editor without saving the workspace on disk.

If you are editing an existing file and you store your workspace on disk using its original name, the old copy of the file is removed (because you can't have two files with the same name on the same volume).

During an edit session, the portion of your workspace that is displayed on the screen is said to be in the **window.** This window may be moved forward (toward the end of the workspace) or backward. In this way you can view the entire contents of your workspace, although not all at one time. (See Figure 3.1.) In order to move the window, you need to move the cursor. This is done with the cursor moving keys and activities.

The Editor may be used in various ways to insert, delete, overwrite, copy, and locate text. It can also automatically rearrange the words in a paragraph to make the lines fit within the margins. The editing environment can be set so the Editor is especially suited for creating line-oriented text or paragraph-oriented text.

In order to use the Editor, the file SYSTEM.EDITOR must be present on an on-line volume. This file must contain the Screen-oriented Editor.

5.3 CURSOR MOVEMENT

During an editing session, the cursor may be moved to any part of your workspace by typing certain keys, or by using the appropriate Editor activities. You may examine and/or change text anywhere in your workspace by first moving the cursor to the location of that text.

The cursor movement keys are:

⟦space⟧
⟦bs⟧
⟦ret⟧
⟦tab⟧
⟦up⟧
⟦down⟧
⟦left⟧
⟦right⟧
⟦=⟧

The cursor movement activities are:

P(age
J(ump
F(ind

Before we describe these keys and activities, there are a couple of general concepts that need to be introduced. These are the **direction indicator** and the **repeat factor.**

Direction Indicator

The direction indicator determines whether the cursor is moved in the forward direction, or in the backward direction for certain keys and activities. For example, typing [[space]] normally moves the cursor one place to the right, as on a typewriter. If the direction indicator is reversed, however, typing [[space]] moves the cursor to the left (which is also what [[bs]] does).

You can tell what the direction is by looking at the character in the upper left hand corner of the screen. If it is a right angle bracket, ">", then the direction is forward. If it is a left angle bracket, "<", then the direction is backward. You can think of the angle bracket as an arrow pointing forward or backward.

In order to change the direction indicator, type the right angle bracket to make it forward or the left angle bracket to make it backward. The period, ".", and plus sign, "+", also set the direction indicator forward. Similarly, the comma, ",", and minus sign, "-", also set the direction indicator backward.

The direction indicator affects [[space]], [[ret]], [[tab]], P(age, F(ind, and R(eplace.

Repeat Factor

A repeat factor is a number that you may type just before using a cursor movement key or activity. The cursor movement is then performed that many times. For example, if you type "3" before using [[space]], the cursor moves three spaces instead of just one.

The repeat factor is always 1 unless you cause it to be otherwise. You can use repeat factors in the range 1 to 9999. You can also use a slash, "/", to indicate the infinite repeat factor. The infinite repeat factor causes the cursor movement to be repeated as many times as is possible in the workspace. For example, typing "/" followed by [[down]] moves the cursor down to the very last line in the workspace. As soon as you have used the cursor movement key or activity, the repeat factor returns to 1.

All cursor movement keys except ⟦=⟧ are affected by the repeat factor. P(age, J(ump, F(ind, and R(eplace are affected as well. In addition, when the cursor movement keys are used within A(djust, D(elete, and K(olumn, the repeat factor applies.

Another way to repeat cursor movement on some computers is to hold down ⟦repeat⟧ and the cursor movement key at the same time. As long as both keys are pressed down, the cursor movement is repeated. For example, holding down ⟦repeat⟧ and ⟦up⟧ causes the cursor to keep moving upward until the keys are released (or the first line of the workspace is reached).

On other computers, this sort of repeated cursor movement is accomplished by simply holding down the cursor movement key for a longer than normal length of time, generally over one second. For example, holding down ⟦space⟧ for less than a second moves the cursor only one space. Holding it down for more than a second causes the cursor to continue moving until the space bar is released.

Cursor Movement Keys

This section describes the cursor movement keys. The following table summarizes their actions:

Key	Cursor Movement
⟦space⟧	One column right
⟦bs⟧	One column left
⟦ret⟧	To beginning of line below
⟦tab⟧	To next tab stop
⟦up⟧	Up one line
⟦down⟧	Down one line
⟦left⟧	One column left
⟦right⟧	One column right
⟦=⟧	To beginning of last I(nsert, F(ind, or R(eplace

⟦space⟧

The space bar moves the cursor one position to the right as on a typewriter. At the end of a line it does an automatic carriage return. A repeat factor may be used to move several spaces at a time. If the direction indicator is set backwards, the space bar moves the cursor to the left. Generally, ⟦space⟧ is used to move only a few characters from the present cursor position. If you need to move further, ⟦tab⟧ is often a better key to use.

⟦bs⟧

This key moves the cursor one position to the left. If the cursor is already occupying the first position on the line, it is moved to the last position on the line above. A repeat factor may be used with ⟦bs⟧. Like ⟦space⟧, ⟦bs⟧ is usually most effective if you are only going to move the cursor a few places.

If you are at the end of a long line and want to move quickly to the beginning, it is easier to type ⟦ret⟧ followed by ⟦up⟧ (or ⟦up⟧ followed by ⟦ret⟧) than it is to use ⟦bs⟧ several times. Several backward ⟦tab⟧s can also be used to move quickly to the left.

⟦ret⟧

This key acts like a carriage return on a typewriter. It moves the cursor to the beginning of the line below. If the direction indicator is backwards, ⟦ret⟧ moves the cursor to the beginning of the line above. Several ⟦ret⟧s can be done by using a repeat factor. However, if you need to do quite a few (say 20 or 30) it is usually better to use P(age.

⟦tab⟧

This key moves the cursor to the right until it reaches the next tab stop, again in similar fashion to a typewriter. Tab stops are normally set at every eighth space across a line. However, you can set them wherever you want by using the S(et tabstops option described under S(et E(nvironment later in this chapter.

If the direction indicator is set backwards, the cursor is moved to the next tab stop on the left. A repeat factor may be used to tab several stops beyond the current cursor position.

Arrow Keys

The ⟦up⟧, ⟦down⟧, ⟦left⟧, and ⟦right⟧ keys move the cursor in the indicated directions. The arrow keys always move the cursor in the direction that they indicate; they are not affected by the direction indicator. They are, however, affected by the repeat factor.

Sometimes ⟦up⟧ or ⟦down⟧ can seem to move the cursor "off the text," that is, to a position that is really beyond the left or right margins of the current line. In this case, the cursor may seem to jump around when you use the next cursor movement key. To understand this "jumping" you should realize that the cursor is not logically located beyond the margin. (It is either at the first character or the last character of the line.)

⟦=⟧	The ⟦=⟧ key moves the cursor to the beginning of the portion of text that was just inserted with I(nsert, found with F(ind, or replaced with R(eplace. When ⟦=⟧ is typed again, the cursor returns to where it was. The ⟦=⟧ key is often useful if you are inserting text somewhere in your workspace, and you need to look at some other part of the workspace. You can move to that other area and, when ready, return to where you last used I(nsert by simply typing ⟦=⟧.

5.4 SPECIAL EDITOR KEYS

The Editor uses all of the p-System's special keys as described in Chapter 4. However, the meaning of ⟦esc⟧ and ⟦delete line⟧ are subtly different. The Editor also uses some additional special keys.

⟦etx⟧	This key accepts the changes that you have just made with an Editor activity. After you enter ⟦etx⟧, those changes become effective within your workspace and you are returned to the main Editor menu. For example, when you enter text using I(nsert, you must type ⟦etx⟧ to accept the insertion.
⟦esc⟧	This key discards the changes that you have made with an Editor activity. For example, when you use I(nsert to enter text, you can use ⟦esc⟧ to discard the insertion.
⟦delete line⟧	This key allows you to erase one line at a time when you I(nsert text. It is convenient if you don't want to use ⟦bs⟧ several times.

⟦exch-ins⟧ This key inserts a blank character when you are using X(change. It is convenient since you don`t have to quit X(change and use I(nsert to place the extra blank in your workspace.

If you want to insert a single character while in X(change, you can type ⟦exch-ins⟧ followed by that character. The character is placed in the blank position opened by ⟦exch-ins⟧. You can, in fact, insert several characters in this manner.

⟦exch-del⟧ This key deletes one character when you are using X(change. It is convenient since you don`t have to quit X(change and use D(elete to remove a character.

5.5 ENTERING AND REMOVING TEXT

The Editor's insertion and deletion activities usually apply at the location of the cursor. Thus, by placing the cursor appropriately, you may alter text anywhere in your workspace.

The I(nsert activity is used to place new text in your workspace. The Editor functions in one mode where, as text is being inserted, the bell beeps when you approach the end of a line (in a similar fashion to a typewriter). In this mode, you need to type ⟦ret⟧ at the end of every line to go on to the next one.

Alternatively, the Editor can function in a mode where it automatically starts a new line when the word that you are typing does not fit onto the current line.

The first mode is most often used for line-oriented editing such as creating tables or writing programs. The second mode is used to create paragraphs. In conjunction with the paragraph mode, it is possible to specify where you want the left and right margins to be, as well as how much indentation you would like for the first line of a paragraph. These two modes of inserting text are covered under I(nsert. S(et E(nvironment is used to change from one mode to another.

There are two activities that allow you to delete text: D(elete and Z(ap. With D(elete you can move the cursor around and delete text as you go. Z(ap performs an instantaneous deletion of a certain portion of text. Z(ap can be useful for deleting a very large portion of text (since it may be inconvenient to move the cursor a long distance with D(elete).

X(change is used to overwrite old text directly with new text. You can do the same thing by I(nserting the new material and then D(eleting the old material. X(change is often much easier for this sort of task, however.

C(opy can move a portion of text from one place to another within your workspace. You can duplicate that text several times if you want. You can even copy text from a disk file into your workspace using this activity.

R(eplace is able to change one sequence of characters into another. You indicate the sequence of characters to change as well as the replacement sequence. Several instances of the target sequence of characters may be replaced at once.

5.6 TEXT APPEARANCE

There are several ways in which you can affect the way your text appears. For example, you may wish to rearrange paragraphs so that each line fits within certain margins. You might want to move columns closer together or further apart. This sort of text manipulation is possible with the Editor activities introduced here.

A(djust allows you to change the indentation of one or more lines. With it you can move a single line to the right or to the left. Then, other lines (above or below) can be moved in a similar fashion.

K(olumn works like A(djust except it only affects the portion of a line which is to the right of the cursor. K(olumn is most useful for moving columns closer together or further apart.

S(et E(nvironment and M(argin work together. They enable you to automatically rearrange the words within a paragraph so that each line is as wide as possible within the margins that you specify. I(nsert is also able to rearrange text in this way.

There are several ways that you can print your text once it is in final form. These are discussed in Chapter 8 under "Editing and Printing Tools."

5.7 PARAGRAPH SEPARATION

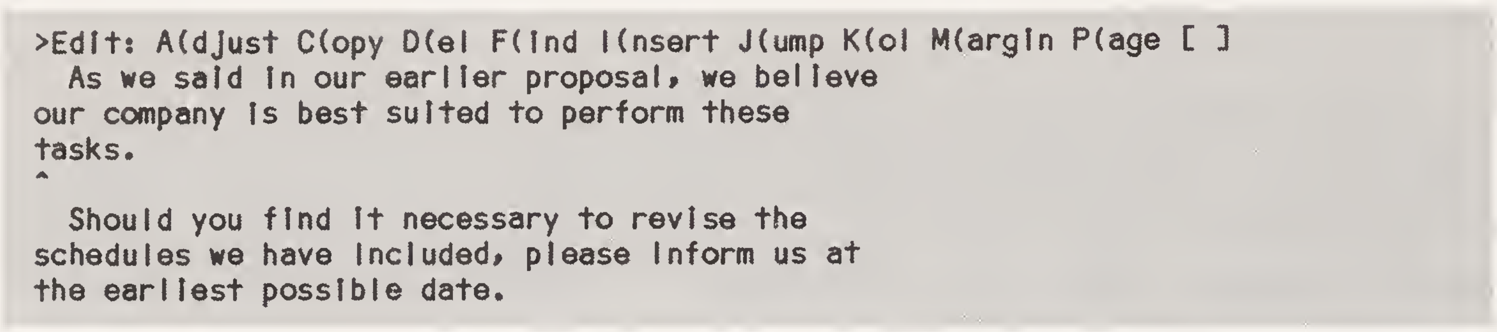
I(nsert and M(argin, as just mentioned, are able to rearrange paragraphs. In order for this to work, however, the paragraphs must be correctly separated from each other and from any adjacent tables or columns.

I(nsert and M(argin consider a paragraph to be any single spaced text which is preceded and followed by paragraph delimiters. A paragraph delimiter is one of four items:

- o A blank line
- o The beginning of the workspace
- o The end of the workspace
- o A line that starts with the **command character**

This usually means that a blank line must exist between paragraphs if they are to be treated separately.

Alternatively, the command character may be used to indicate the beginning or ending of a paragraph by placing it as the first character on a line. The command character can be any character you choose. S(et E(nvironment allows you to change it. If, for example, the command character is carat, "^", the following two paragraphs are properly separated:

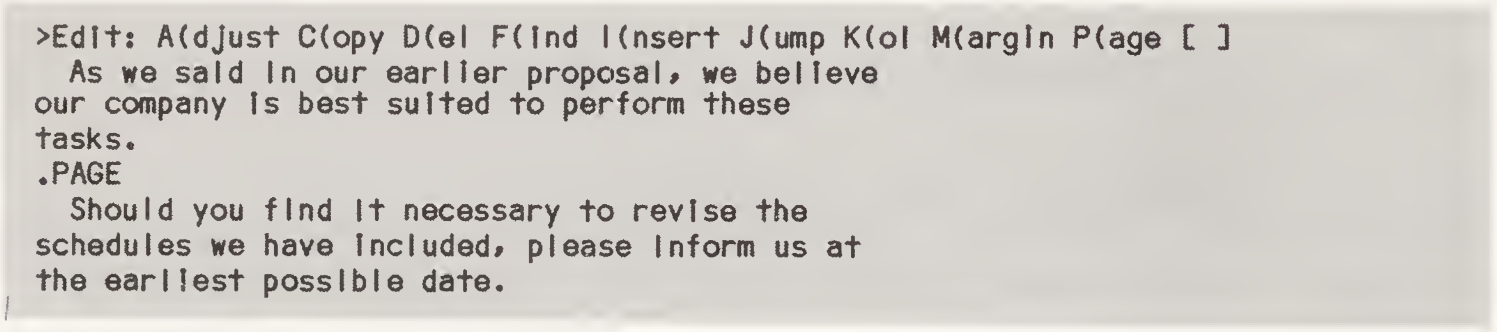


```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age [ ]
  As we said in our earlier proposal, we believe
our company is best suited to perform these
tasks.
^
  Should you find it necessary to revise the
schedules we have included, please inform us at
the earliest possible date.
```

Although it is often easier to use blank lines between paragraphs, it is sometimes convenient to have a character such as this so that text formatting can be done in conjunction with paragraph-oriented editing.

A text formatter is a program which takes a text file and, rather than just printing it as is, formats the text before it is sent to the printer. This can mean doing proportional spacing, left and right margin justification, bold and underlined printing, and so forth.

Many text formatters use commands that start with "." (period). For example, the Print utility (which is a simple text formatting utility) can use a ".PAGE" command which means to do a page break at that point in the printing. In this case, you could set the command character to "." and create paragraphs such as:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age [ ]
  As we said in our earlier proposal, we believe
our company is best suited to perform these
tasks.
.PAGE
  Should you find it necessary to revise the
schedules we have included, please inform us at
the earliest possible date.
```

In this way, you can use M(argin or I(nsert on either of the paragraphs above without disturbing the other paragraph. And, at the same time, you can put text formatting commands conveniently between paragraphs.

Also, the Print utility (and most text formatters) do not print lines which begin with the proper command character. This enables you to separate paragraphs (in order to edit them in paragraph mode) but print them without a blank line in between.

5.8 MARKERS

The Editor allows you to place as many as 20 invisible flags, called **markers**, at arbitrary locations within your workspace. Markers have names which you assign to them. These names may have as many as eight alphabetic or numeric characters.

The S(et M(arker activity is used to place a marker in your workspace. The markers you set remain there even after the workspace is written to disk.

Once a marker is set, you can J(ump there from any place in the workspace. You may want to set markers at locations that you frequently need to look at. They are especially useful in a large workspace.

The C(opy F(rom file activity also uses markers. This activity enables you to copy material from a disk file directly into your workspace. If you only want to copy a portion of that file, you need to indicate two markers. The text between those markers (which must already exist in the file) is copied.

5.9 THE COPY BUFFER

The copy buffer is a "scratch pad" area of memory where the Editor keeps a copy of the text that you have just inserted or deleted. Whatever is in the copy buffer may be copied back into your workspace. The copy buffer is useful for creating several copies of a piece of text, or for restoring material to your workspace that you accidentally delete.

Text inserted with the I(nsert activity is placed in the copy buffer (as well as in the workspace itself). This only happens, however, if you accept the inserted text (by typing ⟦etx⟧). If you decide to discard the insertion (by using ⟦esc⟧ instead of ⟦etx⟧) the text is not placed in the copy buffer. In this case, the copy buffer is left empty and any text it previously contained is discarded.

When you delete text using D(elete or Z(ap, it is placed in the copy buffer. This is done whether or not you accept the deletion (with ⟦etx⟧).

Once something is in the copy buffer, it may be copied into the workspace if you wish. This is done by placing the cursor where you would like the copying to occur and selecting C(opy B(uffer.

Using C(opy B(uffer does not change the contents of the copy buffer. This means that you can use it to place the same piece of text into your workspace several times. However, the next time that you do an insertion or deletion, the newly inserted or deleted material replaces what was previously in the copy buffer. As we mentioned, if you use I(nsert followed by ⟦esc⟧, the copy buffer is left empty. Using the M(argin activity also leaves the copy buffer empty.

If you want to have another copy of some text which already exists in your workspace, you can place it into the copy buffer by deleting it with D(elete, and then typing ⟦esc⟧. This leaves the original copy of the text unaltered. You can then move the cursor, if desired, and duplicate the text someplace in your workspace by selecting C(opy B(uffer. In this way, you end up with two copies of the original text.

If you D(elete text and then use ⟦etx⟧ (instead of ⟦esc⟧), the original text is removed from the workspace and placed in the copy buffer. You can then place the text back into the workspace somewhere else, leaving only one copy of the original text. This can also be done using Z(ap.

With both D(elete and Z(ap, you may receive an error message which indicates there is no room to copy the deletion. This means that if you proceed, the deleted text will not be placed in the copy buffer because of memory space limitations. That text will then be lost. (This error message is covered in Appendix A, "Error Messages for Major Activities.")

5.10 TOKENS AND LITERAL STRINGS

The F(ind and R(eplace activities locate or replace sequences of characters such as "Hi" or "Section 12". These character sequences are either viewed as **tokens** or as **literal strings.** The difference has to do with the context in which a given character sequence can be identified by F(ind or R(eplace.

A token must not be directly adjacent to a letter or digit. A literal string, on the other hand, may be placed in any context. For example, these sequences contain the token "Hi":

```
Hi
Hi there
.Hi.
Like Hi?
```

All of the above also contain the literal string "Hi". Each of these next four sequences contain the literal string (but not the token) "Hi":

```
8Hi9
Hithere
Hit parade
WATCHit
```

F(ind, for example, is able to locate only the first four of these sequences when it is searching for tokens. However, it can locate all eight of them as literal strings.

There is another difference between tokens and literal strings. Blank spaces and carriage returns are not significant parts of a token. However, they are significant within literal strings. For example, if you try to F(ind the token:

Hi there

you could conceivably locate:

Hithere

However, if you search for it as a literal string, you won't find "Hithere" because the space is missing.

In either literal strings or tokens, upper and lower case distinctions are made. For instance, each of these is considered to be a different sequence:

Hi
HI
hi

S(et E(nvironment is used to determine whether F(ind and R(eplace search for tokens or literal strings by default. F(ind and R(eplace can override this default, however.

5.11 ENTERING THE EDITOR

To begin an edit session, select E(dit from the Command menu. If you have a workfile (see Chapter 4) then it is read into your workspace and displayed automatically. Otherwise, the following prompt asks you what file you would like to edit:

```
>Edit:
No workfile is present. File? (<ret> for no file ) FILE-SPEC [ret]
```

Type the file specification for the desired text file but do not include the .TEXT suffix. For example:

```
>Edit:
No workfile is present. File? (<ret> for no file ) #5:MY.FILE [ret]
```

reads in MY.FILE.TEXT from the disk in drive #5. If the Editor cannot find the file that you indicated, you are asked to type in a file name once again:

```
>Edit:
No workfile is present. File? (<ret> for no file ) FILE-SPEC [ret]
Not present. File? FILE-SPEC [ret]
```

You may keep trying until you correctly indicate an existing text file which is on the correct disk.

If, instead of editing an existing file, you want to create a new file, respond to the prompt by simply typing [ret]:

```
>Edit:
No workfile is present. File? (<ret> for no file )  [ret]
```

If you change your mind and would rather not enter the Editor at all, respond to the prompt by typing [esc].

When the Editor is entered, its main menu appears on the top line of the screen:

```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ?  [ ]
```

Below this menu, the first portion of the text within your workspace (if any) is displayed.

5.12 LEAVING THE EDITOR

In order to leave the Editor, select Q(uit. When you do this, the following options are displayed:

```
>Quit:
     U(pdate the workfile and leave
     E(xit without updating
     R(eturn to the editor without updating
     W(rite to a file name and return
```

If you select:

U(pdate the workfile and leave

your workspace is placed on the system disk and called SYSTEM.WRK.TEXT. The Editor is then exited and the Command menu returns. SYSTEM.WRK.TEXT is now your workfile. If you receive the message "ERROR writing out the file," several problems may have occurred. These are covered below.

If you select:

E(xit without updating

your workspace is not saved on disk. Instead, the Editor is simply exited. Any changes that you may have made are not saved.

If you select:

R(eturn to the editor without updating

you do not leave the Editor at all. Nothing is saved on disk. The material that was previously on the screen is redisplayed just as it was before you selected Q(uit.

If you select:

W(rite to a file name and return

you are able to write your workspace to disk and give it a name other than SYSTEM.WRK.TEXT. If you created your current workspace from scratch, selecting W(rite causes this prompt to be displayed:

```
Quit:
Name of output file (<cr> to return)  --> FILE-SPEC [ret]
```

This prompt is asking what you would like to name the output text file. When you specify the file name, do not include the .TEXT suffix. For example:

```
Quit:
Name of output file (<cr> to return)  --> MYDISK:FILE.NAME [[ret]]
```

saves your workspace as FILE.NAME.TEXT on MYDISK:. If your current workspace was read in from a disk file, when you select W(rite, you are prompted:

```
Quit:
'$'<ret> writes to OLD-FILE-NAME
Name of output file (<cr> to return)  --> FILE-SPEC [[ret]]
                                          $ [[ret]]
```

There are two possible responses. You can enter a file specification (as before). However, you may, if you wish, enter dollar sign, "$", followed by [[ret]]. This writes the workspace to disk and gives it the same name that it originally had.

You can simply type [[ret]] in answer to either version of the W(rite prompt. This returns you to the Editor without saving anything on disk.

If the name that you give to your file is the same as some other file currently on the disk, the old file is removed. The Editor assumes you realize what you are doing and does not warn you about this.

As your workspace is written to disk, the word "Writing" is displayed, usually followed by several dots. If there is some problem in saving the workspace, you receive the message:

```
Writing......
ERROR writing out the file.  Please press <spacebar> to continue.
```

This indicates one of several problems:

- o There is not enough room on the disk for the file that the Editor is trying to create there. When you type [[space]], you are returned to your workspace. You can then Q(uit W(rite it to some other disk. Later you can try to fit it on the disk where you wanted to save it originally.

  When the Editor saves a workspace on disk, it removes the old file with the same name if one exists (as we already mentioned). However, the old file isn't removed until after the workspace is saved. This means that there must be enough room for two copies of the file in order for the Editor to save it.

  If you have to resort to writing it to another disk, you may be able to use the Filer's T(ransfer activity to move it back to the original disk. T(ransfer removes the existing file before it places the new file on disk.

  Sometimes, even this may not work because the newest version of your file has grown larger than the older version. In this case, even though the old version is removed, there is still not enough room for the new one. You may be able to explicitly R(emove unnecessary files and/or K(runch the disk to make more room. R(emove and K(runch are both Filer activities and are described, along with T(ransfer, in Chapter 6.

- o The volume where you are saving the file isn't on-line. If you didn't indicate a volume, this could still be the problem (when the prefixed volume isn't on-line). The solution is to place the appropriate disk back in the drive. When you type [[space]], you can try again to save the workspace on that volume. Alternatively, you can save it on another volume.

- o The file name that you specified was syntactically incorrect. For example, you may have entered a name that is longer than the 15 character limit. (Remember that ".TEXT" is appended to the name you enter.) In this case, you should type [[space]] and try again with a valid file name.

When your workspace is successfully written to disk using W(rite, you are notified in this fashion:

```
>Quit:
Writing...............
Your file is 15297 bytes long.
Do you want to E(xit from or R(eturn to the editor?
```

The dots after "Writing" appear as your workspace is saved on disk. The third line tells you the length of your file in bytes (or characters). The last line prompts you to select E(xit to leave the Editor or R(eturn to re-enter it and continue editing from where you left off. You might use R(eturn if you are simply writing your workspace to disk for safety, and you want to continue editing.

5.13 THE EDITOR MENU

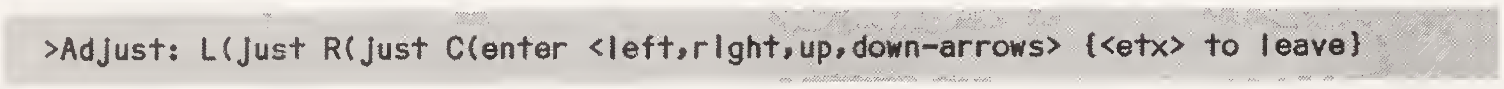
In this section, the Editor's menu items are covered individually in alphabetical order. Most of these items display error messages under certain circumstances. These error messages are covered in Appendix A, "Error Messages for Major Activities."

A(djust

A(djust changes the horizontal position of one or more lines of text.

How to use it:

Place the cursor on the line you wish to adjust. Select A(djust and this line is displayed:



```
>Adjust: L(just R(just C(enter <left,right,up,down-arrows> {<etx> to leave}
```

Pressing [[right]] moves the line one place to the right. Pressing [[left]] moves it to the left. Pressing [[up]] or [[down]] causes the adjustment that was done to the current line to be repeated on the line just above or below.

Selecting L(just moves the line to be flush against the left margin. Selecting R(just moves the line to the right margin. And selecting C(enter causes the line to be centered between the margins. (These margins are not necessarily the left and right screen boundaries; they are the L(eft and R(ight margins which can be set to any column using S(et E(nvironment.)

A line can only be moved to the left until it is flush against the left screen boundary. When moving to the right, however, the line may be moved beyond the edge of the screen. Text may seem to disappear off the screen to the right but it is still present. An exclamation mark, "!", is displayed in the right-most column as an indicator whenever text lies beyond it.

When you move vertically in A(djust, you can accumulate horizontal movement by using [[left]] or [[right]] on any given line. The accumulated horizontal adjustment is then applied to succeeding lines, above or below, if you continue moving vertically.

When you have finished with A(djust, you must use [[etx]] to accept the changes that you have made. It is not possible to use [[esc]] to leave A(djust.

Example:

If you want to indent your entire workspace 2 columns, place the cursor at the beginning and select A(djust. Type [[right]] twice to adjust the first line:

```
This is the first line.   <-- BEFORE ADJUST
  This is the first line. <-- AFTER ADJUST
```

Then type the infinite repeat factor, "/", followed by [[down]]. Every line in your workspace is moved two places to the right.

As an example of accumulated horizontal movement, you could A(djust a line three places to the right:

```
>Adjust: L(just R(just C(enter <left,right,up,down-arrows> {<etx> to leave}
Monthly Report:
1. The Good News ....... Page 3
2. The Bad News ........ Page 4
```

```
>Adjust: L(just R(just C(enter <left,right,up,down-arrows> {<etx> to leave}
   Monthly Report:
1. The Good News ....... Page 3
2. The Bad News ........ Page 4
```

type [[down]] once, adjusting the line below:

```
>Adjust: L(just R(just C(enter <left,right,up,down-arrows> {<etx> to leave}
   Monthly Report:
   1. The Good News ....... Page 3
2. The Bad News ........ Page 4
```

and then adjust that line three more places to the right:

```
>Adjust: L(just R(just C(enter <left,right,up,down-arrows> {<etx> to leave}
   Monthly Report:
      1. The Good News ....... Page 3
2. The Bad News ........ Page 4
```

and finally type ⟦down⟧ once more:

```
>Adjust: L(just R(just C(enter <left,right,up,down-arrows> {<etx> to leave}
   Monthly Report:
      1. The Good News ....... Page 3
      2. The Bad News ........ Page 4
```

the last line is indented 6 places which corresponds to the accumulated horizontal movement up to that point.

C(opy

C(opy inserts text from the copy buffer, or from a text file on disk, into your workspace.

How to use it:

Select C(opy and this menu is displayed:

```
>Copy: B(uffer  F(rom file  <esc>
```

Typing ⟦esc⟧ exits the C(opy activity.

Selecting B(uffer causes the contents of the copy buffer to be inserted into the workspace where the cursor is. The cursor is then left at the end of the inserted text. (As covered earlier in this chapter, the copy buffer contains whatever you last inserted with I(nsert, or deleted with D(elete or Z(ap.)

Selecting F(rom file allows you to copy material from a text file stored on disk into your workspace:

```
>Copy: From what file [marker,marker] ?  FILE-SPEC ⟦ret⟧
                                         FILE-SPEC [MARKER1,MARKER2] ⟦ret⟧
                                         FILE-SPEC [,MARKER] ⟦ret⟧
                                         FILE-SPEC [MARKER,] ⟦ret⟧
```

The .TEXT suffix should not be included in your response to this prompt.

The first response copies all of the specified file into your workspace.

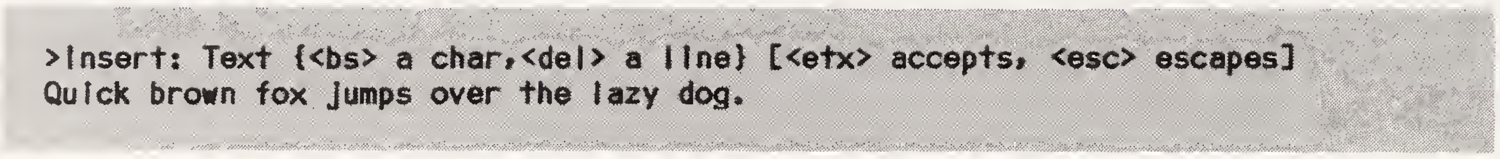
The second response only copies that portion of the file which lies between the two indicated markers.

The third response copies from the beginning of the file to the indicated marker.

And the fourth response copies from the marker to the end of FILE.TEXT.

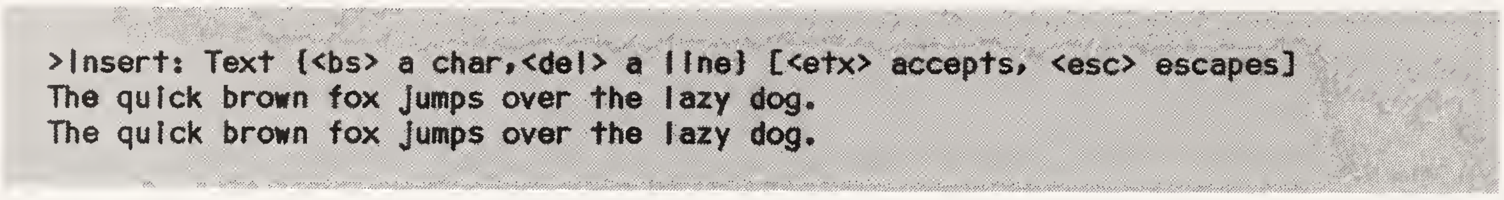
Example:

If you insert:



```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
Quick brown fox jumps over the lazy dog.
```

with a final carriage return as shown, and accept it with [[etx]], that line is placed in the copy buffer. Now, if you type "CB", for C(opy B(uffer, the line is duplicated:



```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
The quick brown fox jumps over the lazy dog.
The quick brown fox jumps over the lazy dog.
```

D(elete

D(elete removes text from your workspace.

How to use it:

Select D(elete and this line is displayed:

```
>Delete: < > <Moving commands> {<etx> to delete, <esc> to abort}
```

You can now delete text by moving the cursor with any cursor movement key. The original cursor position is called the anchor. When you move the cursor away from the anchor, text is deleted. When you move the cursor toward the anchor, the deleted text is restored.

When you are satisfied, type ⟦etx⟧ to accept the deletion or ⟦esc⟧ to exit D(elete and leave the workspace unaltered.

If you accidentally delete something valuable, you can restore it by using C(opy B(uffer.

Example:

In order to remove "John" from the line below, place the cursor as indicated:

```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age ?
Mr. John Smythe,
```

Select D(elete and type ⟦space⟧ five times:

```
>Delete: < > <Moving commands> {<etx> to delete, <esc> to abort}
Mr.      Smythe,
```

Now type [[etx]], and the deletion is accepted:

```
>Delete: < > <Moving commands> {<etx> to delete, <esc> to abort}
Mr. Smythe,
```

In order to remove the end of the second line below, place the cursor immediately after "Cash" and select D(elete:

```
>Delete: < > <Moving commands> {<etx> to delete, <esc> to abort}
Check No. 972    $  43.22     Food
Check No. 973    $ 100.00     Cash_   VERIFY THIS AMOUNT
Check No. 974    $  21.74     Misc
```

Type [[ret]]:

```
>Delete: < > <Moving commands> {<etx> to delete, <esc> to abort}
Check No. 972    $  43.22     Food
Check No. 973    $ 100.00     Cash
Check No. 974    $  21.74     Misc
```

Now you must type [[bs]] to get the cursor back up to the second line:

```
>Delete: < > <Moving commands> {<etx> to delete, <esc> to abort}
Check No. 972    $  43.22     Food
Check No. 973    $ 100.00     Cash_
Check No. 974    $  21.74     Misc
```

At this point you can use [[etx]]. (If you don't use [[bs]] first, the "Check 974" line is pulled up immediately after "Cash". If you ever do this accidentally, you can select I(nsert and type [[ret]] to correct the situation.)

F(ind

Find attempts to locate a sequence of characters that you specify.

How to use it:

Select F(ind and one of the following prompts is displayed:

```
>Find[n]: L(it <target> => _
```

```
>Find[n]: T(ok <target> => _
```

First enter a **delimiter** (which is any special character such as ".", ",", or "/"). Next, enter the sequence of characters that you want to locate (the **target**). Finally enter a matching delimiter.

F(ind can search forward or backward depending upon the direction indicator. If no repeat factor is used, F(ind searches for the first occurrence of the target. If a repeat factor is used, F(ind attempts to locate that occurrence of the target. (The [n] in the prompt indicates the repeat factor. The "n" will be a number or a slash.)

F(ind can search for either tokens or literal strings (see Section 5.10, page 199). F(ind assumes that you are looking for a token if T(oken default (within S(et E(nvironment) is true. Likewise, it assumes that you are searching for a literal string if T(oken default is set to false. If the assumed mode is token, the prompt displays "L(it". If the assumed mode is literal, the prompt displays "T(ok". You can override the default and specifically search for a literal string or a token by selecting L(it or T(ok before entering the target string.

Once you have used F(ind to locate a target, you can find another instance of the same target without retyping the delimiters and the sequence of characters. Instead, you can simply type "FS", for F(ind "same".

Example:

This use of F(ind:

```
>Find[1]: L(it <target> => .Section 3.
```

searches for the first occurrence of the token "Section 3" in the forward direction. In order to find "Section 3.2" you would need to use a delimiter other than period:

```
>Find[1]: L(it <target> =>/Section 3.2/
```

If you then change the direction indicator, enter a repeat factor of 10, select F(ind, and respond:

```
<Find[10]: L(it <target> =>LS
```

F(ind attempts to locate the tenth occurrence of the "same" literal string ("Section 3.2") in the backward direction. It is possible that "Section 3.21" could be found because you are searching for a literal string.

I(nsert

I(nsert places new text into your workspace.

How to use it:

Select I(nsert and this line is displayed:

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
```

You can now enter whatever text you want. The [[bs]] key erases characters that you have inserted. The [[ret]] key moves the cursor to the next line, as on a typewriter. The [[delete line]] key erases one entire line of inserted text. The [[etx]] key leaves I(nsert after accepting the new material into your workspace. The [[esc]] key leaves I(nsert after discarding everything that you have entered.

When you I(nsert in the middle of existing text, the new material is inserted between the character just to the left of the cursor, and the character that the cursor is directly over. (See Figure 2.3.) The line of text on which the cursor is located is split to indicate where the new text will go. When you leave I(nsert, the gap is closed.

Only the line where you are inserting is split; any text on lines above or below remains unchanged on the screen. As you proceed with the insertion, however, you may overflow the current line or you may specifically type [[ret]]. In either case, the text below the current line disappears from the screen. When you leave I(nsert, the text below is redisplayed.

Within S(et E(nvironment there are options which allow you to I(nsert text in two different modes. One of these modes is best for creating line-oriented text (such as programs, tables, or columns). The other is more suitable for paragraphs. In the line-oriented mode, you must explicitly type [[ret]] at the end of every line. The bell sounds a warning as you approach the end of a line (as on a typewriter).

When you are using line-oriented mode, you can also use automatic indentation if you wish. Automatic indentation means that when you type [[ret]], the next line begins at the same level of indentation as the current line. (You can move the cursor left or right if you don't want the line to start there.) If you are not using automatic indentation, the cursor always moves to the left margin when you type [[ret]].

In the paragraph-oriented mode, a carriage return is done automatically whenever the word you are entering doesn't fit onto the current line. That word is moved down to the next line. This is convenient since you don't have to concern yourself about typing [[ret]].

Also, in the paragraph-oriented mode, when you accept the insertion, the rest of the paragraph (below what you have just entered) is rearranged to fit within the left and right margins. This rearrangement is convenient because it automatically keeps a paragraph within the proper margins even if you I(nsert something in the middle of it.

The default I(nsert mode is line-oriented with automatic indentation. The S(et E(nvironment options which determine the I(nsert mode are called A(uto indent and F(illing.

NOTE: You should be careful not to I(nsert in the middle of line-structured text while using the paragraph-oriented mode. If you do this to a table or set of columns, for example, they will be turned into one large paragraph!

NOTE: You should be sure your paragraphs are properly separated from each other and from any other text (see Section 5.7, page 195).

Example:

In order to insert "John" into "Mr. Smythe", place the cursor as follows:

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
Mr. Smythe
```

Select I(nsert and the line is split:

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
Mr. _                                                             Smythe
```

Type in "John" followed by a space to separate it from "Smythe":

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
Mr. John _                                                        Smythe
```

And type [[etx]]:

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
Mr. John Smythe
```

As an example of automatic indentation, you might start an outline by inserting this line followed by [[ret]]:

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
Chapter 1: Insects

_
```

You can now type [[space]] twice (for indentation) and enter the next line:

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
Chapter 1: Insects
  Section 1.1 Butterflies_
```

When you type [[ret]] again, the cursor is moved to the same indentation as the current line:

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
Chapter 1: Insects
  Section 1.1 Butterflies

  _
```

This makes it easy to continue at that level of indentation:

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
Chapter 1: Insects
  Section 1.1 Butterflies
  Section 1.2 Beetles_
```

In paragraph mode, you might I(nsert this quote from Thoreau:

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
"If one advances confidently in the direction of his dreams, and
endeavors to live the life which he has imagined, he will meet with
a success unexpected in common hours."_
```

In this example the right margin is set at column 70. Now if you I(nsert:

" Thoreau writes, "

after "dreams," and press ⟦etx⟧, the paragraph is rearranged to fit within 70 character lines:

```
>Insert: Text {<bs> a char,<del> a line} [<etx> accepts, <esc> escapes]
"If one advances confidently in the direction of his dreams,"
Thoreau writes, "_and endeavors to live the life which he has
imagined, he will meet with a success unexpected in common hours."
```

Note that it wasn't necessary to type ⟦ret⟧ while inserting this.

J(ump

J(ump moves the cursor to the beginning of your workspace, to the end of your workspace, or to a marker.

How to use it:

Select J(ump and this menu is displayed:

```
> JUMP: B(eginning E(nd M(arker <esc>
```

Selecting B(eginning moves the cursor to the beginning of your workspace. Selecting E(nd moves the cursor to the end of your workspace. Typing ⟦esc⟧ exits J(ump. If you select M(arker, you are asked which marker to jump to:

```
Jump to what marker? _
```

You should enter the name of a marker; the cursor is relocated there. If you simply type ⟦ret⟧, J(ump is exited.

Example:

When you are editing in the middle of your workspace, you may need to look briefly at some material near the beginning and then return to where you were working. You can use J(ump to get to the beginning:

```
> JUMP: B(eginning E(nd M(arker <esc> B
```

When you want to return you may be able to use J(ump again if you are editing near a marker or near the end of the file. Otherwise, you could return using ⟦=⟧, P(age, or F(ind. (You may want to set a marker before you leave.)

K(olumn

K(olumn, abbreviated K(ol, changes the horizontal position of the text which lies to the right of the cursor on one or more lines.

How to use it:

Select K(olumn and this line is displayed:

```
>Kolumn: <vector keys> {<etx>,<esc> CURRENT line}
```

Typing [[right]] moves the text to the right of the cursor one position to the right. Typing [[left]] moves the text to the right of the cursor one position to the left. Typing [[up]] or [[down]] cause the lines above or below, respectively, to be affected in the same manner as the current line.

You can move text beyond the right margin of the screen without losing it. However, any text moved in the left direction which disappears "into" the cursor is removed from the workspace. This text isn't placed in the copy buffer and can't be recovered.

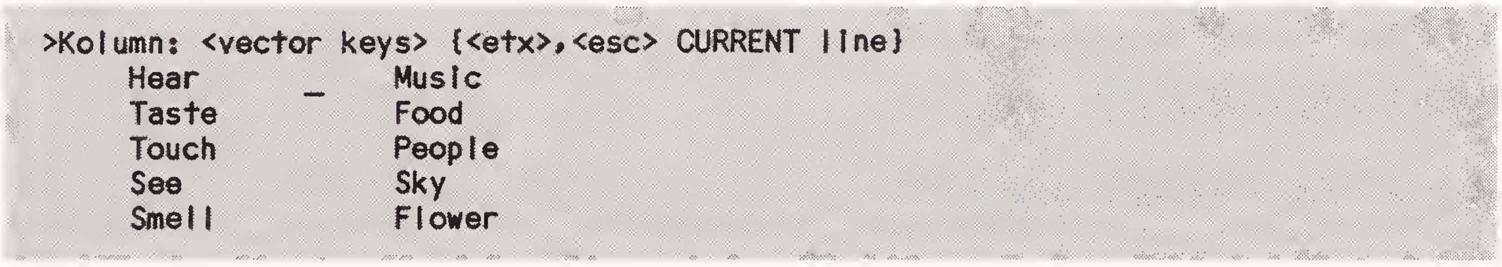
When you move the cursor vertically within K(olumn, you can accumulate horizontal movement by using [[left]] or [[right]] on the current line. The accumulated horizontal movement will be applied to succeeding lines above or below.

You should use [[etx]] to accept any changes that you have made. You can use [[esc]] to exit K(olumn, but only the most recent changes on the current line are thrown away; any other changes made while using K(olumn are accepted.

NOTE: When K(olumn deletes text, that text is irrecoverable. You should be especially careful when [[left]] is used followed by vertical movement. The use of repeat factors in this situation is even more risky.

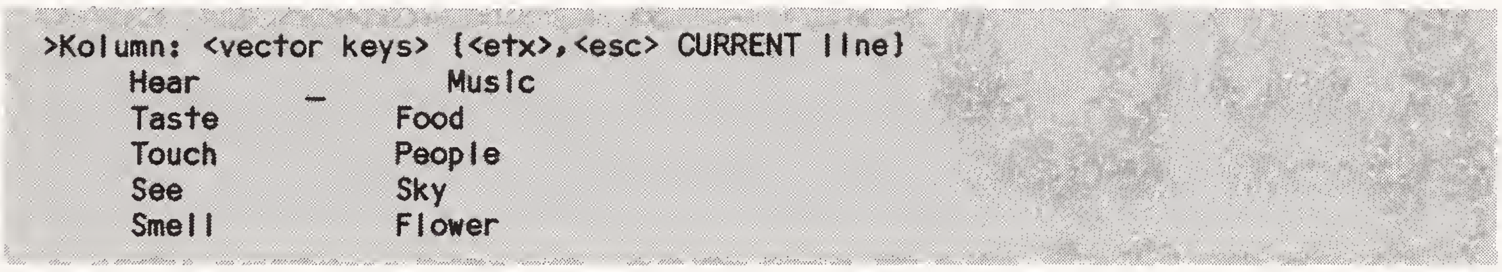
Example:

One of the most useful ways to use K(olumn is to align or manipulate columns. For example, if you place the cursor, as shown, between two columns:



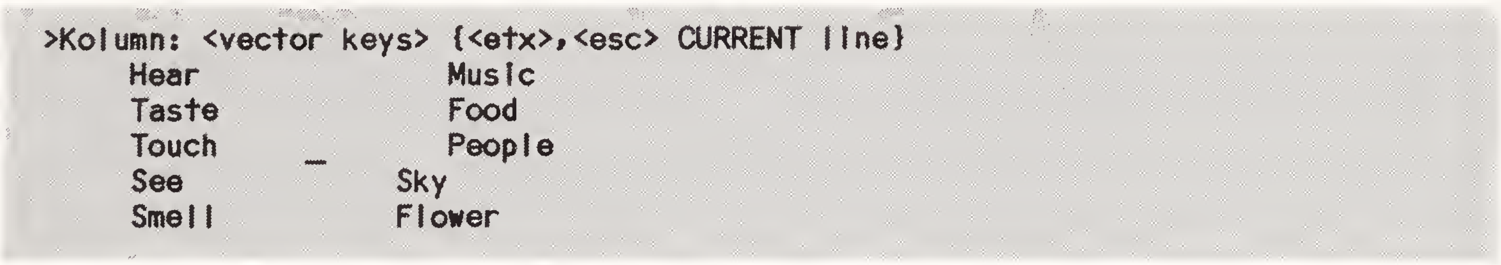
```
>Kolumn: <vector keys> {<etx>,<esc> CURRENT line}
     Hear      _   Music
     Taste         Food
     Touch         People
     See           Sky
     Smell         Flower
```

and use K(olumn with [[right]] to move "Music" to the right:



```
>Kolumn: <vector keys> {<etx>,<esc> CURRENT line}
     Hear      _      Music
     Taste         Food
     Touch         People
     See           Sky
     Smell         Flower
```

you can then use [[down]] to change succeeding lines below in the same manner:



```
>Kolumn: <vector keys> {<etx>,<esc> CURRENT line}
     Hear             Music
     Taste            Food
     Touch     _      People
     See           Sky
     Smell         Flower
```

M(argin

M(argin rearranges the text in a paragraph so that it conforms as closely as possible to the margins defined within S(et E(nvironment.

How to use it:

Place the cursor within a paragraph and select M(argin. Your text briefly disappears from the screen. It is then redisplayed and the paragraph is appropriately rearranged.

To use M(argin, several options within S(et E(nvironment must be appropriately set. A(uto indent must be false. F(illing must be true. And the L(eft, R(ight, and P(aragraph margins must be set sensibly. These margins should correspond to the columns that you wish to use as margins for your paragraphs.

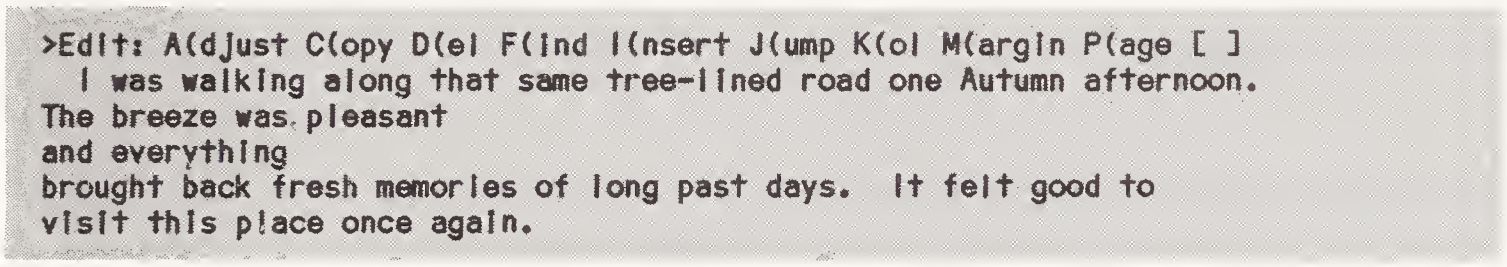
M(argin removes all extra spaces from a paragraph. Only one space is left between words. A maximum of two spaces is left after a period.

NOTE: Text that is not separated from a paragraph by a blank line or a line that starts with the command character is considered to be part of that paragraph (see Section 5.7, page 195). You should be sure that your paragraphs are correctly separated from each other and from other text.

NOTE: Single-spaced, line-structured text (such as columns or tables) will be rearranged into a paragraph by M(argin. Since it is easy to accidentally type "M", you should be sure F(illing is set to false within S(et E(nvironment when you are editing line-structured text.

Example:

If you have created a paragraph that looks like this:

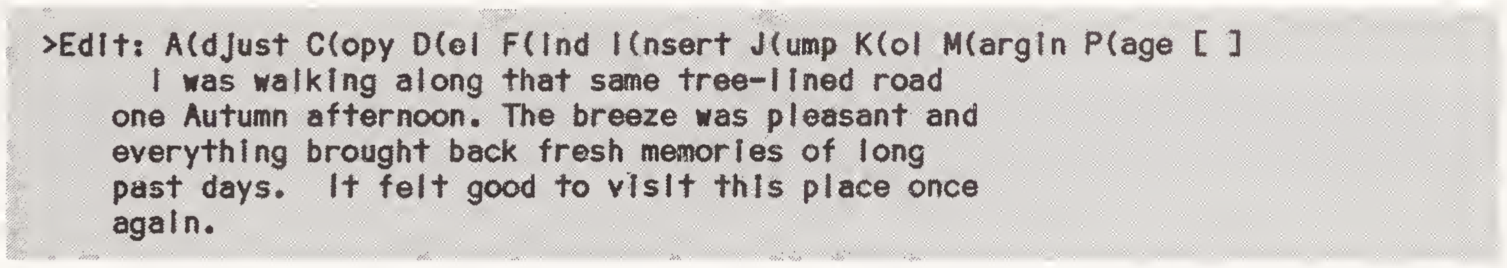


```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age [ ]
  I was walking along that same tree-lined road one Autumn afternoon.
The breeze was pleasant
and everything
brought back fresh memories of long past days.  It felt good to
visit this place once again.
```

and the margins are set as follows:

L(eft margin	5
R(ight margin	55
P(ara margin	7

you could use the M(argin command and obtain the following rearranged paragraph:



```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age [ ]
     I was walking along that same tree-lined road
   one Autumn afternoon. The breeze was pleasant and
   everything brought back fresh memories of long
   past days.  It felt good to visit this place once
   again.
```

P(age

P(age causes the next screen full of text to replace what is currently displayed in the window (see Figure 3.1).

How to use it:

Select P(age from the main Editor menu and the next screen full of text appears in the window.

A repeat factor may be used to indicate how many pages the window is to be moved. The direction indicator determines whether the paging proceeds forward or backward.

Example:

P(age is useful for browsing through the text in your workspace. If you are trying to locate a particular area, you can page through the entire workspace in a short length of time.

If you happen to know that the area you are looking for is a certain number of pages from the beginning of the workspace, you can J(ump B(eginning, enter the appropriate repeat factor, and select P(age. This same technique can be used from the end of the workspace with a reversed direction indicator.

R(eplace

R(eplace locates occurrences of a sequence of characters that you select (called the target) and replaces them with another sequence of characters (called the substitution string).

How to use it:

Select R(eplace and one of these two prompts is displayed:

```
>Replace [n]: L(it V(fy <targ> <sub> => _
```

```
>Replace [n]: T(ok V(fy <targ> <sub> => _
```

Enter a delimiter (which is a special character such as ".", "/", or "$"); then enter the target string followed by a matching delimeter. After that, enter another delimiter followed by the substitution string and a matching delimiter.

The delimiters for the target string may be the same as the delimiters for the substitution string. However, you should be sure that a delimiter does not appear within the string being delimited. For example, if the target contains a comma, you should not use a comma as the delimiter.

If you have used R(eplace at least once since entering the Editor, you can indicate the most recently used target and/or substitution string by simply typing "S" for "same." In fact, if you have used F(ind during the current editing session, you can type "S" to indicate the most recent target that has been used by F(ind or R(eplace.

A repeat factor may be used to replace several occurrences of the target. It is shown within the square brackets where the "n" appears in the prompts above. (Note that the repeat factor does not mean to replace the n'th occurrence of the target; it means to replace n occurrences of it.) The direction indicator determines whether targets in the forward or backward direction will be replaced.

Target and substitution strings are treated as either tokens or as literal strings (see Section 5.10, page 199). R(eplace works with tokens when T(oken default within S(et E(nvironment is true. It works with literal strings when T(oken default is false. You may override the default by selecting L(it or T(ok from the R(eplace prompt. (The prompt displays the opposite of the default.) L(it or T(ok must be selected before entering the target or between entering the target and substitution.

The V(erify option, abbreviated V(fy, allows you to select the occurrences of the target which are to be replaced. If you use a repeat factor without V(erify, all occurrences of the target that are found are replaced automatically. If you would rather watch the progress and determine whether or not a given occurrence of the target should be replaced, select V(erify before entering the target or substitution string. When you do this, each time the R(eplace activity encounters an occurrence of the target, it prompts you:

```
>Replace: <esc> aborts, 'R' replaces, ' ' doesn't
```

When this occurs, the cursor indicates which instance of the target has just been found. Type "R" to replace it, [[space]] to leave it unchanged, or [[esc]] to leave it unchanged and cancel the R(eplace operation.

When the V(fy option is used, this prompt is redisplayed until you have replaced as many occurrences of the target as you indicated with the repeat factor, or until the last occurrence of the target is found, or until you use [[esc]].

Example:

You might want to replace all occurrences of the word "January" with "February". From the beginning of your workspace, type slash, "/", to indicate the infinite repeat factor. Then select R(eplace and respond:

```
>Replace [/]: L(it V(fy <targ> <sub> => /January/ /February/
```

The replacements are done and the cursor is left at the end of the last "February" placed in the workspace.

If you want to replace the string "2000.00 / 2" with "1,000" you could do it like this:

```
>Replace [1]: L(it V(fy <targ> <sub> => ,2000.00 / 2, /1,000/
```

Since a period and a slash occur in the target, neither of them can serve as the delimiter; comma is a good choice. In the substitution string, however, a comma occurs; slash is chosen as the delimiter.

If you want to change most occurrences of "Section 3" with "Section 2", you could type "and use R(eplace with L(iteral and V(erify in this manner:

```
>Replace [/]: L(it V(fy <targ> <sub> => LV /Section 3/ /Section 2/
```

For each literal string "Section 3", you are asked to verify if you want to make the replacement. You might decide to replace it in the case of "Section 3" or "Section 3a". However, you might decide not to replace it if "Section 30" is found.

S(et E(nvironment

S(et E(nvironment displays useful information about the status of your workspace. It also enables you to set several options which determine how the Editor behaves.

How to use it:

Select S(et and this prompt is displayed:

```
  >Set: E(nvironment M(arker <esc>
```

Select E(nvironment and a display similar to this appears:

```
>Environment: {Options} <spacebar> to leave _
    A(uto indent  True
    F(illing      False
    L(eft margin  1
    R(ight margin 80
    P(ara margin  6
    C(ommand ch   ^
    S(et tabstops
    T(oken def    True

    1987 bytes used, 16445 available.

    Patterns:
      <target>= 'Your target' <subst>= 'Your substitution string'

    Markers:
      MARKER1   MARKER2   SO_FORTH

Editing: YOUR.FILE
Created January 1, 1983; Last updated January 1, 1983 (Revision 1)
Editor Version [ ]
```

Several options are shown: A(uto indent, F(illing, and so forth. Most of these options have a value associated with them. (The values shown above are typical of what you might see.) In most cases, these values are a number or a true/false indication. Below the options and their values is additional information that reflects the state of your workspace. (Not all of this information is present every time you enter S(et E(nvironment.)

To alter the value associated with an option, select the option by typing the corresponding letter. The cursor is moved to the line where the old value is displayed. To enter a numeric value, type the number followed by [[ret]]. To enter a true/false indication, type "T" or "F". To enter a character value, type the character.

A(uto indent

A(uto indent stands for "automatic indentation." Its default value is true.

When A(uto indent is true, typing [[ret]] in I(nsert causes the next line to start at the indentation of the current line. When A(uto indent is false, typing [[ret]] in I(nsert starts the next line at the left margin.

F(illing

F(illing stands for "line filling." Its default value is false.

When F(illing is false, you are editing in the line-oriented mode (as described under I(nsert). M(argin cannot do anything in this mode.

When F(illing is true and A(uto indent is false, you are editing in the paragraph-oriented mode (again, described under I(nsert). M(argin does function in this mode.

L(eft, R(ight, and P(ara Margins

The L(eft margin, R(ight margin, and P(ara margin options allow you to define the Editor's margins. These margins affect I(nsert and M(argin when you are editing in paragraph mode.

The left margin's initial value is 1 (which is the first column on the screen). The right margin's initial value is 80 (which is the last column on most screens). The paragraph margin indicates the indentation that you want the first line of a paragraph to have; it has an initial value of 6.

C(ommand ch

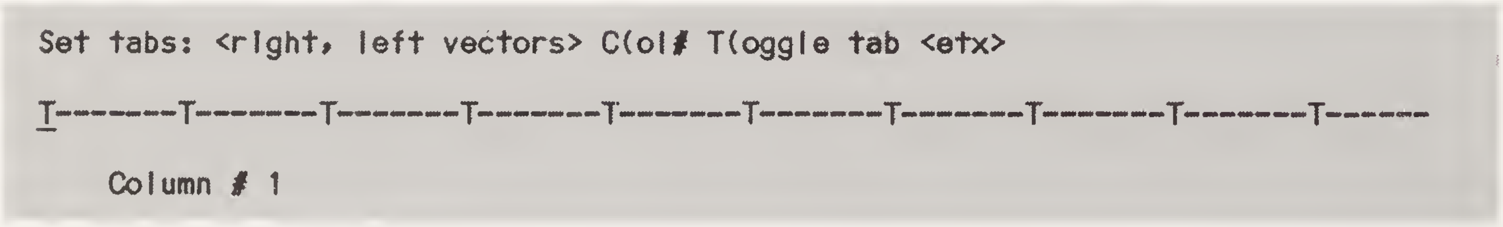
C(ommand ch stands for command character. Its initial value is carat, "^".

The command character (see Section 5.7, page 195) may be used to indicate the beginning or ending of a paragraph by placing it as the first character on a line. It is recognized by M(argin and I(nsert when you are editing in paragraph-oriented mode.

S(et tabstops

S(et tabstops allows you to change the positions of the tab stops. By default, tab stops are placed at every eighth position across the screen.

Select S(et tabstops and the following display appears:



```
Set tabs: <right, left vectors> C(ol# T(oggle tab <etx>

T-------T-------T-------T-------T-------T-------T-------T-------T-------T------

    Column # 1
```

The dashed line represents the 80 columns on the screen. Each "T" indicates a tab stop.

In order to add or delete a tab stop, you must first place the cursor at the desired location along the dashed line. To move the cursor, use the [[left]] or [[right]] keys. Alternatively, you can select C(ol # and enter a column number followed by [[ret]]. The cursor is moved there.

Once you have positioned the cursor, you may select T(oggle tab. This creates a tab stop there if one does not currently exist. It removes a tab stop if one does currently exist.

When you have the tab stops setup to your satisfaction, type [[etx]] to return to the S(et E(nvironment display. When you continue editing, the new tab stops are in effect.

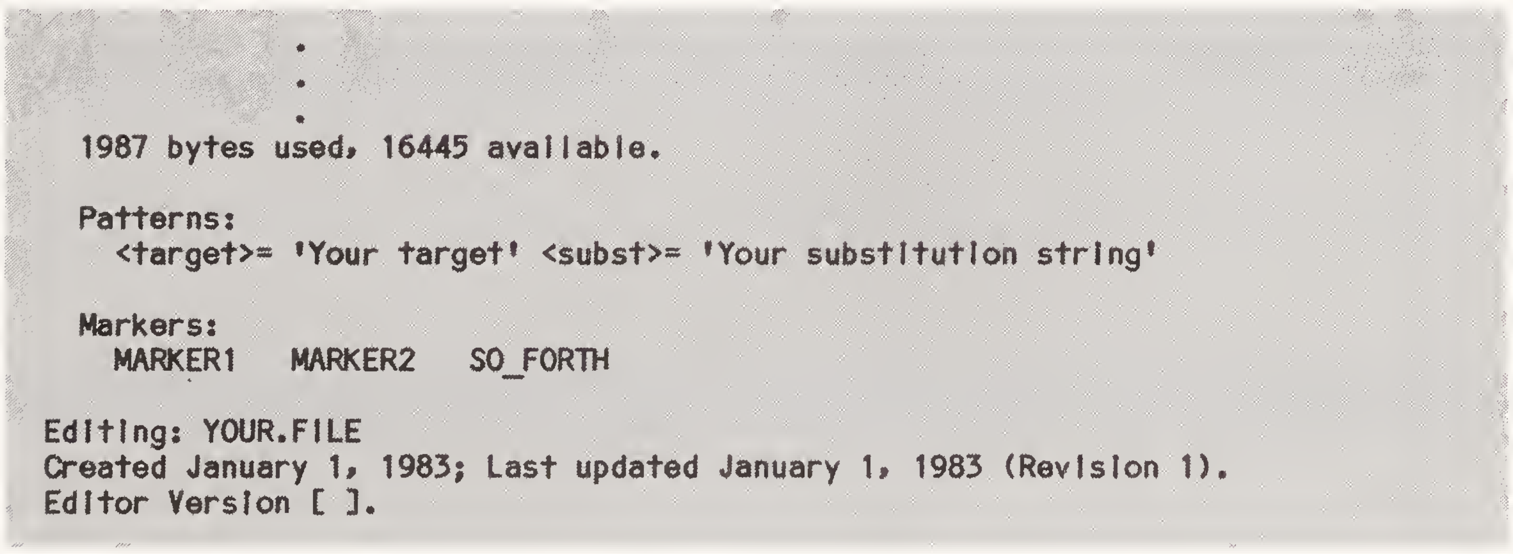
T(oken def

T(oken def stands for token default. Its default value is true.

F(ind and R(eplace are able to specifically work with either tokens or literal strings. If you do not specify which one, however, they work with tokens if T(oken default is true and literal strings if T(oken default is false.

The Rest of S(et E(nvironment

Below all of the options on the S(et E(nvironment display, there is some more information. It looks similar to this:



```
           .
           .
           .
  1987 bytes used, 16445 available.

  Patterns:
    <target>= 'Your target' <subst>= 'Your substitution string'

  Markers:
    MARKER1   MARKER2   SO_FORTH

 Editing: YOUR.FILE
 Created January 1, 1983; Last updated January 1, 1983 (Revision 1).
 Editor Version [ ].
```

Not all of this information is present all the time. The

"Patterns" and "Markers" are displayed only when applicable.

The first line indicates how many bytes (or characters) are used and how many are still available within your workspace. The sum of these two numbers is the maximum size your workspace can be. This maximum size varies among computers and depends upon the amount of main memory that your particular computer has.

The next line shows the target string and substitution string patterns (if they exist). If you used either F(ind or R(eplace in the current editing session, you introduced a target string. If you used R(eplace, you introduced a substitution string.

Next, the names of any markers that you have set are displayed. The markers are displayed by S(et E(nvironment so that you can easily check to see what markers exist.

The next line shows the date the workspace was first created, the date it was last updated to disk, and the number of times it has been revised on the disk.

The final line shows the version number of the UCSD p-System Editor that you are using.

S(et M(arker

S(et M(arker places markers in your workspace.

How to use it:

Position the cursor where you want the marker to be located and select S(et M(arker. You are prompted for a marker name:

```
Set what marker ? MARKER [ret]
```

The name should consist of eight or fewer characters. You may set as many as 20 markers. (If you attempt to set more, you are asked if you want to remove one of the existing markers in order to set another one.)

Example:

There may be a section of text within your workspace, called "Section 3", that you need to J(ump to frequently. You could place the cursor there and use S(et M(arker:

```
Set what marker ? SECT3 [ret]
```

Later, you can find this location by using J(ump M(arker like this:

```
Jump to what marker ? SECT3 [ret]
```

V(erify

V(erify assures that the screen reflects the actual contents of your workspace.

How to use it:

There are some rare circumstances under which text can be inappropriately left on the screen. It is usually obvious when this happens.

Selecting V(erify causes the text on the screen to briefly disappear and then be redisplayed. If there was anything extraneous on the screen, it is no longer present.

V(erify also tends to move the window so that the cursor is near the middle of the screen.

X(change

X(change enters new text by overwriting existing text within your workspace.

How to use it:

Select X(change and the following line is displayed:

```
>eXchange: Text <vector keys> {<etx>,<esc> CURRENT line}
```

Type in the text you want. The original text at the location of the cursor is replaced by what you enter.

It is possible to move the cursor without affecting the existing text. In order to do this, you can use any cursor movement key except ⟦space⟧. If you use ⟦space⟧, a blank character replaces what was originally there.

To accept the changes that you have made, use ⟦etx⟧. You can use ⟦esc⟧ to exit X(change, but if you have moved to more than one line, only the most recent changes to the current line are discarded.

While in X(change, you can insert an extra blank character by typing ⟦exch-ins⟧. And, you can delete a character by typing ⟦exch-del⟧. These keys are convenient since you do not have to exit X(change and use I(nsert or D(elete; you can remain in X(change and simply type a key.

Example:

If you want to change:

```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age [ ]
One for the money
```

to "Two for the show", select X(change and enter the new line:

```
>eXchange: Text <vector keys> {<etx>,<esc> CURRENT line}
Two for the showy
```

Now, you need to delete the last "y". One way to do this is to accept the changes you have made with X(change, and to use D(elete. However, it is easier to simply type [[exch-del]] once:

```
>eXchange: Text <vector keys> {<etx>,<esc> CURRENT line}
Two for the show_
```

Now use [[etx]] and the changes are accepted.

Z(ap

Z(ap deletes all text between the current cursor position and the first character associated with the most recent F(ind, R(eplace, or I(nsert.

How to use it:

Before using Z(ap, you should be sure you know the location of the first character associated with the most recent F(ind, R(eplace, or I(nsert. Place the cursor at some other location and select Z(ap to remove the material that lies between those two positions.

If you are removing more than 80 characters, this prompt appears:

```
WARNING: You are about to zap more than 80 chars, do you wish to zap? (y/n)
```

Type "Y" if you wish to proceed and "N" otherwise.

Example:

If you insert and accept a sentence which you then want to delete, you can remove it by simply typing "Z" (since the cursor is already at the end of the sentence).

If you F(ind or R(eplace a sequence of characters, the cursor ends up at the end of the sequence. You can, if you want, remove the sequence by selecting Z(ap.

If you want to remove a large section of text from your workspace, you could place the cursor where that text begins:

```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age [ ]
This is the beginning of a large portion of
text to be discarded ...
```

Select I(nsert and then immediately exit it with [[esc]] or [[etx]]. Next, move the cursor to the end of the text to be deleted:

```
>Edit: A(djust C(opy D(el F(ind I(nsert J(ump K(ol M(argin P(age [ ]
... Here is the end of the large portion of
text to be discarded._
```

Now, select Z(ap and you receive the warning:

```
WARNING! You are about to zap more than 80 chars, do you wish to zap? (y/n) Y
```

If you type "Y" as shown, the text is deleted. This is often easier than using D(elete to remove the text.

When you perform Z(ap on a large portion of text, you may also receive a message indicating that there is "no room to copy the deletion." This is described in Appendix A, "Error Messages for Major Activities."

THE FILER 6

6.1 INTRODUCTION

The Filer is responsible for managing files on your disks. It allows you to see what files are there, move them around, change their names, and so forth. It also allows you to change the name of a storage volume, initialize its directory, and check its magnetic recording surface for physical problems.

In addition, the Filer allows you to interact with communication volumes. For example, files may be printed or displayed on the console.

Chapter 4, "The Operating System," covers files and volumes in some detail. The Filer is principally concerned with them and so most of that material is especially relevant to this chapter.

The next few sections summarize what the Filer can do. Next, the activities on the Filer menu are described in alphabetical order. At the end of this chapter, there are sections covering some more advanced topics: subsidiary volumes, wild cards, and utility programs for recovering lost files or directories.

6.2 VIEWING FILES AND VOLUMES

As we just mentioned, files and volumes are covered in Chapter 4. Briefly, storage volumes (which are usually disks) contain information in the form of files. Several files may reside on a disk. At the beginning of a storage volume, the p-System maintains a file directory. The name of every file on the volume is kept there. Other information, such as the location of each file, its size, and the date it was created, is also stored in the directory.

When you want to view the files on a disk, you can either use the L(ist directory or E(xtended list directory activities.

L(ist directory informs you what files are on a disk and gives you their sizes and dates of creation.

E(xtended list directory works just like L(ist directory except that more information is displayed. This extra information includes the location of each file and its type (such as code or text file). Also, the unused areas on the disk are shown.

If you want to see what volumes are accessible to the p-System, you should use V(olumes. V(olumes displays the names of all storage volumes and communication volumes which are on-line.

6.3 CREATING AND REMOVING FILES

The editors and compilers can create files. An editor creates text files and a compiler creates code files. The Filer can be used to create files, as well. It also has the ability to remove files (no matter how they were created).

M(ake creates a disk file. The content of the new file is whatever happened to be on the disk in the area where the file was created.

R(emove deletes a file (or several files) from a disk.

Z(ero can also be used to remove files. If there are files on a disk to begin with, Z(ero removes all of them.

6.4 MOVING FILES AROUND

Often, you may need to move a file from one disk to another. Perhaps you will want to move all of the files on a master disk to a back up disk. Or you may want to move a file from one place on a disk to another location on that same disk.

T(ransfer can do all of these things. If you use T(ransfer to move a file to the same volume that it was originally on, and you give it the same name, the old copy of the file is removed. However, if you give the file a new name, or if you transfer it to a different disk, the original copy of the file remains.

You may find it convenient to use wild cards in conjunction with T(ransfer. Wild cards allow you to transfer several files at a time very easily. (They are discribed in the "Wild Cards" section later in this chapter.)

K(runch is a special tool for "crunching" a disk. It moves all the files together so that the free space on a disk is consolidated into one large area. K(runch is especially useful when a disk has become "fragmented," that is, when its files are spread out. In this situation, disk space may only be available in relatively small portions. For example, a fragmented disk might have enough free space to store a large file. However, if no single unused area is big enough to hold that file, it can't be stored on the disk. After you use K(runch in this situation, the large file can fit onto the disk.

6.5 PRINTING AND DISPLAYING FILES

You can also use the Filer's T(ransfer activity to print or display files. When a file is transferred to PRINTER:, it is printed. Similarly, when a file is transferred to CONSOLE:, it is displayed on the screen. In either case, if it is a text file, it appears exactly as it does in the Editor.

You can T(ransfer other kinds of files to the printer or the console. However, some files are not intended for this. Code files, for example, contain material that is not meant to be viewed directly. If you try to print or display a code file, you receive "garbage" as your output. On the other hand, some kinds of data files consist of readable material that can be printed or displayed using T(ransfer without any difficulties.

6.6 THE DISK SURFACE

The recording surface of a magnetic disk can be damaged in several ways. Physical damage may occur from long or rough use. A surge of voltage when the disk is in the drive can hurt the recording surface. A poorly functioning disk drive can also damage a disk.

Sometimes the damage caused by these problems is permanent, but often it is not. The Filer has facilities for finding any problems that might exist on a disk's surface and correcting them if possible.

The B(ad blocks activity discovers these kinds of problems. (A block on a disk is an area that is 512 bytes long.) B(ad blocks informs you which blocks, if any, on a particular disk are having problems.

X(amine allows you to test the blocks that you suspect are bad to see if they are permanently bad, or if they can be fixed. If the troublesome areas on your disk's surface can be returned to normal, X(amine does this for you. Otherwise, you can mark the bad blocks so that valuable material is not written, and perhaps lost, there. You might choose to discard disks with bad blocks, however.

There are three utility programs that may assist you in recovering from disk problems. They are Recover, Copydupdir, and Markdupdir. These utilities are covered at the end of this chapter.

6.7 ENTERING AND EXITING THE FILER

To use the Filer, SYSTEM.FILER must reside on a volume which is on-line.

In order to enter the Filer, select F(ile from the Command menu. The Filer menu is displayed and looks like this:

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate,?  [ ]
```

If you type "?" twice, the remaining portions of this menu are displayed:

```
Filer: Q(uit, B(ad-blks, E(xt-dir, K(rnch, M(ake, P(refix, V(ols,? [ ]
```

```
Filer: X(amine, Z(ero, O(n/off-line, F(lip-swap/lock [ ]
```

To exit the Filer, select Q(uit and you are returned to the main p-System menu.

6.8 DISK SWAPPING

When you enter the Filer, code is read into main memory from the disk file SYSTEM.FILER. Some of the code may remain on disk, however. Each time you select an activity, it is possible that a disk access will be required to read a portion of SYSTEM.FILER into main memory. If you have removed the disk which contains SYSTEM.FILER from its drive, you are prompted to replace it and type ⟦space⟧ to continue. This can be an inconvenience if you only have two disk drives (since the Filer performs many disk-to-disk operations and removing the disk containing SYSTEM.FILER is often required).

The F(lip-Swap/Lock activity addresses this problem. If your computer has enough main memory, the entire Filer can be "locked" into memory. This means that no further disk accesses will be required to read the Filer's code. (If your computer doesn't have enough memory, you will not be able to take advantage of F(lip-Swap/Lock.)

6.9 THE FILER MENU

In this section, the activities on the Filer's menu are covered alphabetically. Most of these activities display error messages under certain circumstances. The errors are covered in Appendix A, "Error Messages for Major Activities." The file and volume notational conventions (see Section 4.16, page 161) are especially applicable to these descriptions.

B(ad Blocks

B(ad blocks, abbreviated B(ad-blks, scans a disk's surface for physical problems which can cause I/O errors.

How to use it:

Select B(ad blocks and one or more of the following prompts appear:

```
Bad block scan of what vol ? VOLUME-ID [ret]
Scan for ### blocks ? (Y/N) Y or N
Scan for how many blocks ? ### [ret]
```

The first prompt asks for the volume that you want to check.

The second prompt only appears if there is a valid directory on the volume. This prompt displays the total number of blocks on that volume and asks if you want to check all of them.

If you indicate that you don't want to check the entire volume, or if no valid directory exists, the third prompt asks how many blocks you want to check.

After this, the checking proceeds. The bad block scan can take several seconds to a minute (or more) depending upon the speed and storage capacity of your disk hardware. If no problems are found, you are simply informed:

```
0 bad blocks
```

If errors are found, they are reported like this:

```
Block ## Is bad
Block ## Is bad
Block ## Is bad
3 bad blocks
File(s) endangered:
FILE-NAME-1      ##  ##
FILE-NAME-2      ##  ##
```

The block numbers for any bad blocks are given. (You can use the X(amine activity to attempt to fix them.) The endangered files (in which those blocks occur) are listed. The numbers which follow an endangered file indicate the first and last block of that file.

Example:

If you are encountering I/O errors with a disk, it is reasonable to suspect that there are bad blocks on it. To check the disk surface, you would use B(ad blocks in a fashion similar to this:

```
Bad block scan of what vol ? MYDISK: [ret]
Scan for 320 blocks ? (Y/N) Y
Block 32 Is bad
1 bad block
File(s) endangered:
MY.FILE.TEXT    30  38
```

The next step is to use the X(amine activity to attempt to fix block 32.

C(hange

C(hange, abbreviated C(hng, alters the name of a file or storage volume.

How to use it:

Select C(hange and one or more of the following prompts appear:

```
Change what file ? FILE-SPEC [ret]
Change to what ? NEW-FILE-NAME [ret]
Remove old VOLUME-NAME:NEW-FILE-NAME ? Y or N
VOLUME-NAME:FILE-NAME  -->  NEW-FILE-NAME
```

The first prompt asks you to indicate the file that is to have its name changed.

The second prompt asks for the new name to be given to that file.

If there is already a file on the disk with the new name, the third prompt asks if you want to remove it. (You can't have two files with the same name on the same disk.)

If you type "Y", or if there wasn't already a file with that name, the change takes place and the final line is displayed.

In order to change a volume name, the process is similar:

```
Change what file ? VOLUME-ID [ret]
Change to what ? NEW-VOLUME-NAME: [ret]
VOLUME-NAME:  -->  NEW-VOLUME-NAME:
```

The first two prompts ask for the volume name to change and for the new volume name. The third line indicates that the change was made successfully. If an existing volume with the new name is on-line, the change operation will not go through.

It is possible to specify the old name and the new name in response to C(hange's first prompt by using a comma, like this:

```
Change what file ? FILE-SPEC , NEW-FILE-NAME [ret]
```

This is convenient since it is usually easier to type.

Wild cards may be used with C(hange. They allow you to change the names of several files at once. See the "Wild Cards" section at the end of this chapter for more information about this.

Example:

To change the name of a file on MYDISK: from FILE.TEXT to OLD.FILE.TEXT, use C(hange like this:

```
Change what file ? MYDISK:FILE.TEXT [ret]
Change to what ? OLD.FILE.TEXT [ret]
MYDISK:FILE.TEXT  -->  OLD.FILE.TEXT
```

To change the name of a disk from SYSTEM2: to MYDISK: you can use C(hange like this:

```
Change what file ? SYSTEM2: [ret]
Change to what ? MYDISK: [ret]
SYSTEM2:  -->  MYDISK:
```

D(ate

D(ate displays the p-System's current date and allows you to alter that date if you wish.

How to use it:

Select D(ate and the p-System's current date is displayed along with a prompt asking for the new date:

```
Date set: <1..31>-<Jan..Dec>-00..99
Today is 1-Jan-83
New date ? _
```

You can respond to the prompt by entering a new date. In order to do this, type the number of the day, hyphen, the first three letters of the month, hyphen, and the last two numbers of the year. For example:

```
New date ? 2-JAN-83 [ret]
```

You don't always have to type all of this. If you only want to change the day, you can simply type that number followed by [ret]. In this case, the month and the year remain the same. You can also change just the day and the month if you wish. Given that the date is currently set to 1-Jan-83, all of the following responses change it to 2-Jan-83:

```
  New date ? 2 [ret]
  New date ? 2-JAN [ret]
  New date ? 2-JAN-83 [ret]
```

If you simply type [ret] in response to the D(ate prompt, the date remains the same.

E(xtended List

E(xtended list directory, abbreviated E(xt-dir, displays a disk directory in the same way that L(ist directory does, except that more information about the files is provided.

How to use it:

Select E(xt-dir and this prompt is displayed:

```
Dir listing of what vol? VOLUME-ID [ret]
                         FILE-SPEC [ret]
                         VOLUME-ID , FILE-SPEC [ret]
```

The first response lists the directory of the specified volume on the console.

The second response only lists the directory entry for the particular file indicated. If that file is specified using wild cards, a subset of the directory (such as all the text files) can be listed. (See "Wild Cards" later in this chapter.)

The third response creates a listing of the volume and sends that listing to the file specified. If that file is a disk file, the listing is saved on disk. (Normally, you would specify a text file to do this.) If the file specification indicates a communication volume, the listing is sent there. For example, if the file specification is PRINTER:, the directory listing is printed.

Example:

Select E(xt-dir and respond as follows:

```
Dir listing of what vol? #4: [ret]
```

The directory listing of the disk in drive #4: then appears on the console and looks similar to this:

```
MY_VOL:
SYSTEM.PASCAL    113  1-Jan-83      6   512   Codefile
SYSTEM.MISCINFO    2  1-Jan-83    119   512   Datafile
SYSTEM.FILER      32  1-Jan-83    121   512   Codefile
SYSTEM.EDITOR     49  1-Jan-83    153   512   Codefile
SYSTEM.LIBRARY    21  1-Jan-83    202   512   Codefile
SYSTEM.INTERP     30  1-Jan-83    223   512   Datafile
< UNUSED >         9              253
TEST.TEXT          4  1-Jan-83    262   512   Textfile
TEST.CODE          9  1-Jan-83    266   512   Codefile
< UNUSED >         4              275
SCRIPT.TEXT        4  1-Jan-83    279   512   Textfile
< UNUSED >        37              283
9/9 files<listed/in-dir>, 270 blocks used, 50 unused, 37 in largest
```

Each file name is followed by the length of the file in blocks. The next column contains the date the file was created or last modified. The fourth column shows the starting block of each file. The fifth column indicates the number of bytes in the last block of the file. The last column shows the file type. The unused areas can be clearly seen.

The last line indicates: 9 files have been listed out of 9 total; there are 270 blocks in use on the volume; there are 50 blocks still available; and the largest single unused area is 37 blocks long.

F(lip Swap/Lock

F(lip Swap/Lock determines whether or not portions of the Filer's code are allowed to be swapped between main memory and disk (see Section 6.8, page 243).

How to use it:

Select F(lip Swap/Lock and this message is displayed indicating that the Filer's segments are locked into main memory:

```
Filer segments memlocked. [#### words]
```

If you type "F" again, the situation is reversed:

```
Filer segments swappable. [#### words]
```

The number of 16-bit words available in main memory is displayed in both cases. Often there is less memory space available when the Filer is locked into memory. If the amount of remaining main memory is too small, some of the Filer's activities will work more slowly. (On some computers, there isn't even enough main memory to lock the entire Filer into memory.)

Example:

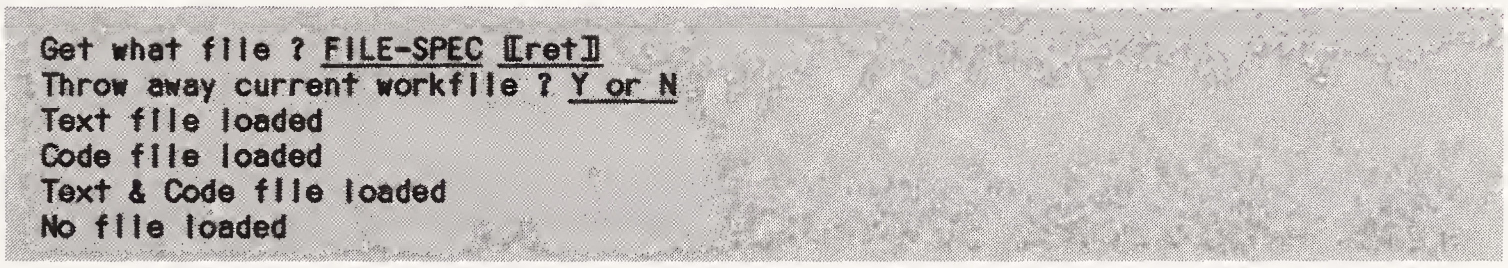
You may have a computer with only two disk drives. If you need to use the Filer to do several disk-to-disk operations, it is likely that you will need to remove the disk containing SYSTEM.FILER (which is probably the system disk). Before doing this, you should lock the Filer into memory by selecting F(lip swap/lock.

G(et

G(et designates a text file and/or code file as the workfile.

How to use it:

Select G(et and one or more of the following lines appear:



```
Get what file ? FILE-SPEC [ret]
Throw away current workfile ? Y or N
Text file loaded
Code file loaded
Text & Code file loaded
No file loaded
```

Respond to the first prompt by indicating the file to be designated as your workfile. The suffixes .TEXT and .CODE are automatically appended to the name you enter.

The second prompt only appears if SYSTEM.WRK.TEXT or SYSTEM.WRK.CODE (the temporary workfiles) are on your system disk. If you respond with "Y", the SYSTEM.WRK files are removed from the disk. If you type "N", G(et is cancelled. If you want to use G(et but do not want to lose the existing temporary workfiles, you should use S(ave first.

One of the last four messages is displayed when G(et is finished. The first message indicates that a text file was found which has the name you entered. That text file is now your work file. If the second message appears, a code file was found. The third message indicates that a text file and a code file match the name you gave. And the final message indicates that no file was found with that name. In the last case, you do not have a workfile after using G(et.

Example:

If you have the file PROGRAM.TEXT on your disk, you can select G(et and respond:

```
Get what file ? PROGRAM [ret]
Text file loaded
```

If you now Q(uit the Filer and select E(dit, PROGRAM.TEXT is automatically loaded into the workspace. If you select C(omp, PROGRAM.TEXT is automatically compiled.

K(runch

K(runch consolidates all of the unused space on a disk into one contiguous area. It does this by moving the files as far forward (or backward) as possible.

How to use it:

Select K(runch and one or more of the following lines are displayed:

```
Crunch what vol ? VOLUME-ID [ret]
From end of disk, block ### ? (Y/N) Y or N
Starting at block # ? ### [ret]
Moving forward FILE-NAME-1
Moving forward FILE-NAME-2
Moving backward FILE-NAME-3
VOLUME-NAME: crunched
```

The first prompt asks for the volume that you want to K(runch.

The second prompt asks if you want K(runch to start from the end of the disk and move all of the files forward. If you type "Y", the crunching proceeds. If you type "N", the third prompt appears and asks where you would like the crunching to begin.

In response to the third prompt, enter the number of the block where you want K(runch to start. Files in front of that block are moved toward the beginning of the disk; files behind it are moved toward the end.

As the crunching proceeds, a "Moving forward" or "Moving backward" message is displayed for each file which is moved.

The final message indicates that K(runch has successfully completed its operation.

If SYSTEM.FILER or SYSTEM.PASCAL are moved during the K(runch operation, you are prompted to reboot (because the p-System cannot gracefully recover under these circumstances).

NOTE: K(runch is dangerous to use on a disk that has bad blocks that are not marked as .BAD files. K(runch can move good files on top of these areas, destroying valuable data. It is a good habit to do a B(ad block scan before you K(runch a disk.

Example:

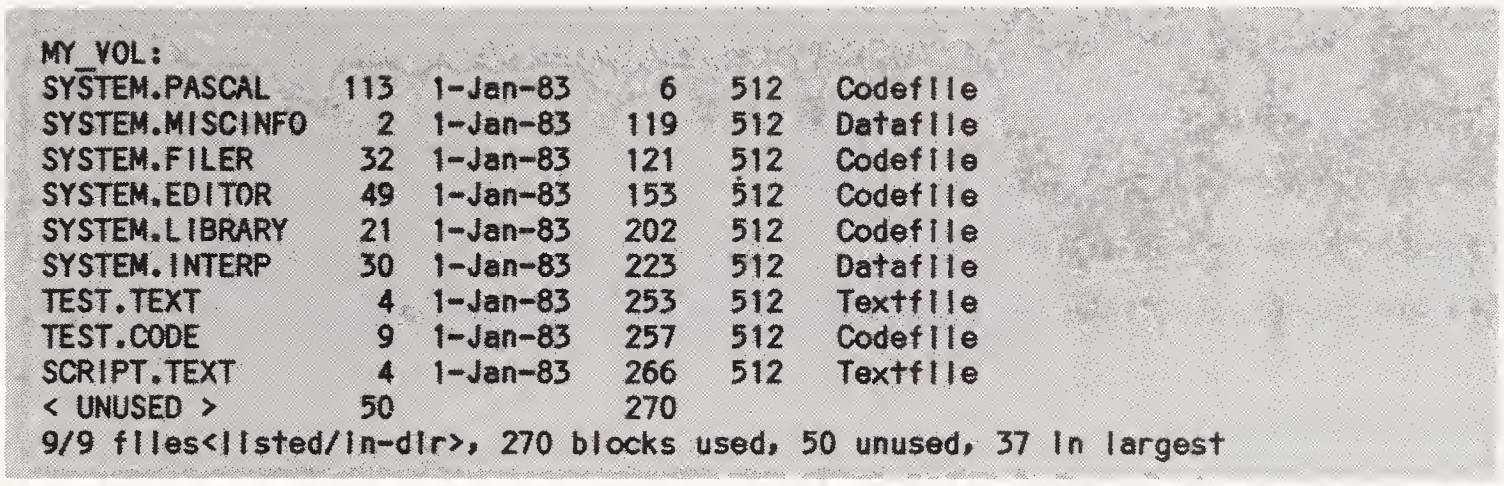
Consider the volume described by this extended listing:

```
MY_VOL:
SYSTEM.PASCAL    113  1-Jan-83     6   512   Codefile
SYSTEM.MISCINFO    2  1-Jan-83   119   512   Datafile
SYSTEM.FILER      32  1-Jan-83   121   512   Codefile
SYSTEM.EDITOR     49  1-Jan-83   153   512   Codefile
SYSTEM.LIBRARY    21  1-Jan-83   202   512   Codefile
SYSTEM.INTERP     30  1-Jan-83   223   512   Datafile
< UNUSED  >        9                 253
TEST.TEXT          4  1-Jan-83   262   512   Textfile
TEST.CODE          9  1-Jan-83   266   512   Codefile
< UNUSED >         4                 275
SCRIPT.TEXT        4  1-Jan-83   279   512   Textfile
< UNUSED >        37                 283
9/9 files<listed/in-dir>, 270 blocks used, 50 unused, 37 in largest
```

If you want to place a forty block file on the following disk, it won't fit. The reason is that this disk doesn't contain 40 blocks in one unused area. However, there are more than 40 available blocks throughout the disk. In order to consolidate that unused disk space, you can select K(runch and respond:

```
Crunch what vol ? MY VOL: [ret]
From end of disk, block 320 ? (Y/N) Y
Moving forward TEST.TEXT
Moving forward TEST.CODE
Moving forward SCRIPT.TEXT
MYVOL: crunched
```

If you do another extended listing, you can see that the unused disk space has been consolidated at the end of MY_VOL:



```
MY_VOL:
SYSTEM.PASCAL    113  1-Jan-83    6   512   Codefile
SYSTEM.MISCINFO    2  1-Jan-83  119   512   Datafile
SYSTEM.FILER      32  1-Jan-83  121   512   Codefile
SYSTEM.EDITOR     49  1-Jan-83  153   512   Codefile
SYSTEM.LIBRARY    21  1-Jan-83  202   512   Codefile
SYSTEM.INTERP     30  1-Jan-83  223   512   Datafile
TEST.TEXT          4  1-Jan-83  253   512   Textfile
TEST.CODE          9  1-Jan-83  257   512   Codefile
SCRIPT.TEXT        4  1-Jan-83  266   512   Textfile
< UNUSED >        50            270
9/9 files<listed/in-dir>, 270 blocks used, 50 unused, 37 in largest
```

Now there is enough room to place the forty block file on MY_VOL:.

L(ist Directory

L(ist directory, abbreviated L(dir, displays the names (and other pertinent information) of all the files on a disk.

How to use it:

Select L(ist directory and this prompt is displayed:

```
Dir listing of what vol? VOLUME-ID [ret]
                         FILE-SPEC [ret]
                         VOLUME-ID , FILE-SPEC [ret]
```

The first response lists the directory of the specified volume on the console.

The second response lists the directory entry only for the indicated file. If that file is specified using wild cards, a subset of the directory (such as all of the code files) can be listed. (See the "Wild Cards" section later in this chapter.)

The third response creates a listing of the indicated volume and sends that listing to the file specified. If the file specification indicates a disk file, the listing is placed in that file. However, the file specification might be a communication volume such as PRINTER:. In this case, the directory listing is printed.

Example:

In order to view the directory of the disk in #4, use L(ist directory like this:

```
Dir listing of what vol? #4: [ret]
```

The directory listing then appears on the console and looks similar to the following example:

```
MY_VOL:
SYSTEM.PASCAL    113  1-Jan-83
SYSTEM.MISCINFO    2  1-Jan-83
SYSTEM.FILER      32  1-Jan-83
SYSTEM.EDITOR     49  1-Jan-83
SYSTEM.LIBRARY    21  1-Jan-83
SYSTEM.INTERP     30  1-Jan-83
TEST.TEXT          4  1-Jan-83
TEST.CODE          9  1-Jan-83
SCRIPT.TEXT        4  1-Jan-83
9/9 files<listed/in-dir>, 270 blocks used, 50 unused, 37 in largest
```

Each file name is followed by the length, in blocks, of the file, and the date it was created or last modified. The final line indicates that there are 9 files listed out of 9 files total; there are 270 blocks of disk space used and 50 available; and out of those 50, the largest contiguous area is 37 blocks long.

If you want to print this listing for future reference, you could do it like this:

```
Dir listing of what vol? #4: , PRINTER: [ret]
```

Alternatively you could send the listing to a disk file:

```
Dir listing of what vol? #4: , LIST.TEXT [ret]
```

Later, you could use T(ransfer to send LIST.TEXT to PRINTER:. This prints the directory listing in the same way that the first response did. It may be useful to have a copy of the directory saved in a disk file, however.

M(ake

M(ake creates a disk file. The initial information in such a file is whatever happens to be on the disk in the area where the file is created.

How to use it:

Select M(ake and this prompt is displayed:

```
Make what file ? FILE-NAME [ret]
                 FILE-NAME SIZE-SPEC  [ret]
                 VOLUME-ID:FILE-NAME [ret]
                 VOLUME-ID:FILE-NAME SIZE-SPEC  [ret]
```

You should enter the name of the file you want to make. As these four responses indicate, you may include a size specification and/or a volume ID.

If your file name ends with .TEXT, a text file is created. Similarly, if it ends with .CODE, .FOTO, .BACK, .BAD, or .SVOL, the corresponding type of file is created. (The .BACK and .FOTO files aren't covered in this book.) If none of these suffixes are used, a data file is created.

You can choose the size of a file you make by using a size specification (see Section 4.5, page 144). For instance, the following response makes a 10 block file:

```
Make what file ? FILE-NAME[10] [ret]
```

When a file length is given like this, the file is created in the first unused area on the disk that is large enough to hold it. In this example, the file occupies the first available area that is at least 10 blocks long.

If you do not specify a length, the file is made as large as it can be and occupies the largest available area on the volume.

M(ake can be used to create .SVOL files (which contain subsidiary volumes). When you use M(ake to create an .SVOL file, it displays some extra prompts which are covered in the "Subsidiary Volumes" section, later in this chapter.

Example:

Select M(ake and respond:

```
Make what file ? #5:MY.FILE.TEXT[22] [ret]
```

A 22-block text file is created on the volume in drive #5. It is created in the first unused area which is at least 22 blocks long.

N(ew

N(ew cancels the workfile status of the current workfile. Temporary (unsaved) workfiles are removed by N(ew.

How to use it:

Select N(ew and, if your workfile is saved, you are informed:

```
Workfile cleared
```

The file still exists on the disk but is no longer the workfile. This is essentially the opposite action that G(et performs. If you have a temporary workfile, you are prompted:

```
Throw away current workfile ? Y or N
```

If you type "N", N(ew is cancelled and nothing changes. If you type "Y", the temporary workfile(s) are removed.

Example:

You may have been using a workfile for a while and are now ready to use a new one. Enter the Filer and, if you want to save the work that you have been doing, use S(ave. Then select N(ew and you are informed:

```
Workfile cleared
```

At this point you can G(et another workfile if you want.

O(n/Off-Line

O(n/Off-line **mounts** and **dismounts** subsidiary volumes. (Subsidiary volumes are covered earlier in this chapter.)

How to use it:

Select O(n/Off-line and the following menu is displayed:

```
Subsidiary Volume: M(ount, D(ismount, C(lear
```

If you select M(ount, these lines are displayed:

```
Mount what vol ? FILE-SPEC [ret]
VOLUME-ID: FILE-NAME  --> Mounted
```

The response must indicate an .SVOL file. If you select D(ismount, these lines are displayed:

```
Dismount what vol ? VOLUME-ID [ret]
VOLUME-NAME:  --> Dismounted
```

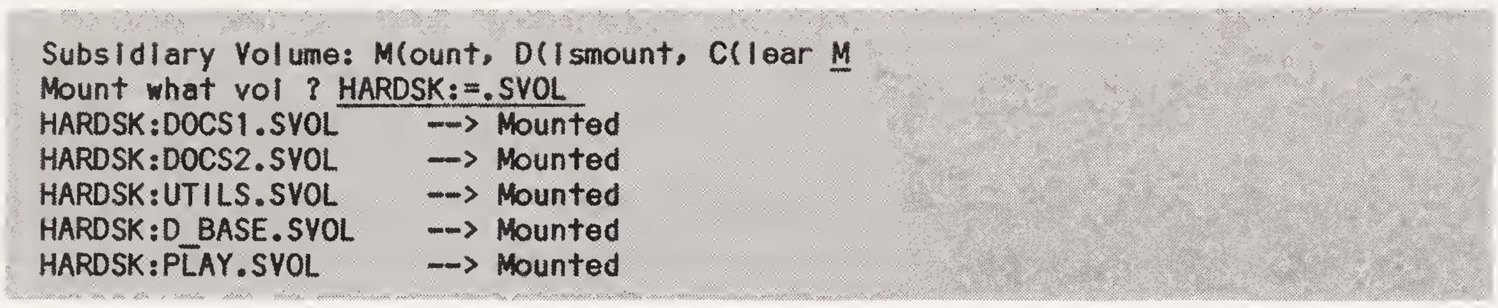
The response must indicate a volume ID for a subsidiary volume. That volume is dismounted.

Notice the difference between the response that is expected for mounting and the one that is expected for dismounting. In the first case you specify the .SVOL file, and in the second case you specify the subsidiary volume ID.

If you select C(lear, all mounted subsidiary volumes are dismounted.

Example:

If you have a disk on which you have 5 subsidiary volumes, you can mount all of them using the equal sign wild card:



```
Subsidiary Volume: M(ount, D(ismount, C(lear M
Mount what vol ? HARDSK:=.SVOL
HARDSK:DOCS1.SVOL      --> Mounted
HARDSK:DOCS2.SVOL      --> Mounted
HARDSK:UTILS.SVOL      --> Mounted
HARDSK:D_BASE.SVOL     --> Mounted
HARDSK:PLAY.SVOL       --> Mounted
```

After this operation DOCS1:, DOCS2:, UTILS:, D_BASE:, and PLAY: are all on-line. The V(olumes activity can be used to see which device numbers these volumes are assigned. (The equal wild card is discussed in the "Wild Cards" section later in this chapter.)

P(refix

P(refix designates a given storage volume as the default disk (see Section 4.7, page 147).

How to use it:

Select P(refix and these lines are displayed:

```
Prefix titles by what vol ? VOLUME-ID [ret]
Prefix is VOLUME-ID
```

The response to the prompt indicates the volume you wish to designate as the default disk.

If you P(refix to a device number, the disk in the drive (if one is present) becomes the prefixed volume. If there is no disk in the drive, the device itself (e.g. #5:) is used as the prefix. This means that whatever disk you place in the prefixed drive is the prefixed volume.

Example:

If you are doing a lot of work with files on a disk called DISK2:, you can respond to p-System prompts in this fashion:

```
Transfer what file ? DISK2:MY.FILE , DISK2:MY.FILE.BACK [ret]
Remove what file ? DISK2:ANOTHER.FILE [ret]
```

However, if you use P(refix like this:

```
Prefix titles by what vol ? DISK2: [ret]
```

you can then answer these prompts with less thought and effort:

```
Transfer what file ? MY.FILE , MY.FILE.BACK [ret]
Remove what file ? ANOTHER.FILE [ret]
```

R(emove

R(emove deletes one or more files from the directory of a storage volume.

How to use it:

Select R(emove and these lines are displayed:

```
Remove what file ? FILE-SPEC [ret]
VOLUME-NAME: FILE-NAME    -->  removed
Update directory ? Y or N
```

The response to the first prompt should indicate the file that you want removed.

The second line indicates the action that is taking place.

The third line asks if you are certain that you want to remove the indicated file. (This is a double check.) If you type "Y", the file is removed; otherwise it is not.

You should not use R(emove to delete temporary workfiles. Always use N(ew for this.

Wild cards may be used with R(emove. They allow you to remove several files at once. See the "Wild Cards" section, later in this chapter, for more information about this.

Example:

To remove OLD.FILE.TEXT from the volume in #5, use R(emove as follows:

```
Remove what file ? #5:OLD.FILE.TEXT [ret]
MYDISK:OLD.FILE.TEXT  --> removed
Update directory ? Y
```

S(ave

S(ave changes the temporary workfiles (SYSTEM.WRK.TEXT and SYSTEM.WRK.CODE) into permanent workfiles (sometimes called named workfiles).

How to use it:

Select S(ave and, if you have any temporary workfiles, one or more of the following lines are displayed:

```
Save as VOLUME-NAME:OLD-FILE-NAME ? Y or N
Save as what file ? FILE-SPEC [ret]
Text file saved
Code file saved
Text & Code file saved
```

The first prompt is only displayed if you initially used G(et to designate the workfile. This prompt is asking you if you want to save the workfile under its original name. If you do, the original workfile is removed.

If you type "N" for the first prompt, or if you didn't designate the workfile with G(et, the second prompt is displayed. It asks you for the name to give the saved workfile. Respond with any proper file name that you want, but do not include a suffix (.TEXT or .CODE).

One of the last three lines is then displayed. This indicates that a text file, a code file, or both have been saved as the permanent workfile.

If you don't have any temporary workfiles when you select S(ave, you are simply notified:

```
Workfile is already saved
```

If you don't have any workfile at all, you are informed:

```
No workfile to save
```

After a file is saved, it remains your workfile. In order to cancel its workfile status, you should use N(ew.

You can save your workfiles on the system disk (where the temporary versions reside) or on some other disk. If you save them on the system disk, the names of the SYSTEM.WRK files are actually changed to the names that you want. If you save your temporary workfiles on another disk, the SYSTEM.WRK files still remain as they were (although permanent versions of them now exist elsewhere).

Example:

You may be developing a program using workfiles. If your program is working well so far, you might want to save it in its current state before adding more material that could cause it to fail. To do this, enter the Filer, select S(ave, and indicate the program's file name:

```
Save as what file ? PROGRAM [ret]
Text & Code file saved
```

The files PROGRAM.TEXT and PROGRAM.CODE are now your permanent workfiles. If you enter the Editor, PROGRAM.TEXT is loaded into the workspace. You can then use Q(uit U(pdate and a new SYSTEM.WRK.TEXT is created. You can use the compiler to create a new SYSTEM.WRK.CODE. However, the old text and code versions remain unaltered as PROGRAM.TEXT and PROGRAM.CODE.

T(ransfer

T(ransfer moves files from one place to another. It can also move a volume onto another volume. In addition, T(ransfer can print or display files by sending them to the printer or to the console.

How to use it:

To transfer a file, select T(ransfer and one or more of these prompts are displayed:

```
Transfer what file ? FILE-SPEC [ret]
To where ? NEW-FILE-SPEC [ret]
Remove NEW-VOLUME-NAME:NEW-FILE-NAME ? Y or N
VOLUME-NAME:FILE-NAME  -->  NEW-VOLUME-NAME:NEW-FILE-NAME
```

The first prompt requests a file to be transferred.

The second prompt asks where to transfer that file.

If you indicate a destination file which already exists, the third prompt appears and asks if you want to remove the existing file. If you type "Y", the Filer removes it before placing the new copy on the disk. If you type "N", the T(ransfer activity is cancelled because two files with the same name can't exist on the same volume.

The fourth line indicates that the transfer was successful.

Usually, the source file remains undisturbed. It is only removed when the destination file is placed on the same disk as the source file and given the same name. Even then, you are asked if you want to remove the source file (since it conflicts with the destination file name).

Wild cards can be used in conjunction with T(ransfer. With wild cards, you can easily transfer several files from one disk to another. This is a very convenient method of maintaining back up disks. (See the "Wild Cards" section later in this chapter.)

T(ransfer can also copy an entire storage volume onto another storage volume. To do this, respond to the T(ransfer prompts with volume ID's instead of file names. When you do volume-to-volume (or disk-to-disk) transfers, one or more of these prompts are displayed:

```
Transfer what file ? VOLUME-ID [ret]
To where ? NEW-VOLUME-ID [ret]
Transfer ### blocks ? Y or N
# of blocks to transfer ? ###  [ret]
Destroy EXISTING-VOLUME-NAME: ? Y or N
```

The first and second prompts ask for the source and destination volumes.

The third prompt asks if you want to transfer the total number of blocks on the source volume. (This prompt only appears if a valid directory exists on the source volume.)

If you don't elect to transfer the entire source volume, the fourth prompt asks how many blocks you do want to transfer.

The final prompt verifies that you want to go through with the transfer. If you do, any existing information on the destination volume is overwritten. (This prompt only appears if a valid directory already exists on the destination volume.)

NOTE: When doing a volume-to-volume T(ransfer, make sure that the two volumes do not have the same name. The p-System cannot distinguish between them if they do. When you T(ransfer a master disk onto a back up disk, the back up disk ends up with the same name as the master. You should C(hange the back up disk's name before performing *the operation again.*

NOTE: You should only do a volume-to-volume T(ransfer between disks of the same storage capacity. This is because the disk directory (which indicates the storage capacity of the volume and the locations of the files) is directly copied from the source disk to the destination disk. If the destination disk does not have enough room to contain the rest of the disk image, the directory will be incorrect.

It is possible to indicate the source and destination files in response to the first T(ransfer prompt by using a comma, like this:

```
Transfer what file ? FILE-SPEC , NEW-FILE-SPEC [[ret]]
```

This can be convenient because it is easier to type. Also, you can use [[bs]] to erase any mistake that you make while typing the source file (because you haven't typed [[ret]] yet).

In order to print a file, you can T(ransfer it to PRINTER: or #6:. In order to display a file on your computer's screen, T(ransfer it to CONSOLE: or #1:. In general, only text files should be transferred to the printer or console. Most other types of files are not intended to be viewed in this way.

It is possible to T(ransfer your input at the keyboard to a communication device or to a disk file. To do this, T(ransfer CONSOLE:, or #1:, to the desired destination. When you have finished typing your input, type [[eof]]. If, for example, you T(ransfer CONSOLE: to PRINTER:, the p-System waits for you to enter something at the keyboard. When you have finished and you type [[eof]], your input is printed.

Example:

To T(ransfer a file called MY.FILE.CODE from your system disk to the disk in drive #5:, use T(ransfer like this:

```
Transfer what file ? *MY.FILE.CODE [ret]
To where ? #5:MY.FILE.CODE [ret]
SYSDISK:MY.FILE.CODE   -->  DISK2:MY.FILE.CODE
```

In order to print a file called LISTING.TEXT, use T(ransfer like this:

```
Transfer what file ? LISTING.TEXT [ret]
To where ? PRINTER: [ret]
```

If you want to test your printer to see that it is correctly interfacing with your computer, you can use T(ransfer like this:

```
Transfer what file ? CONSOLE: [ret]
To where ? PRINTER: [ret]
THIS IS A TEST [ret] [eof]
```

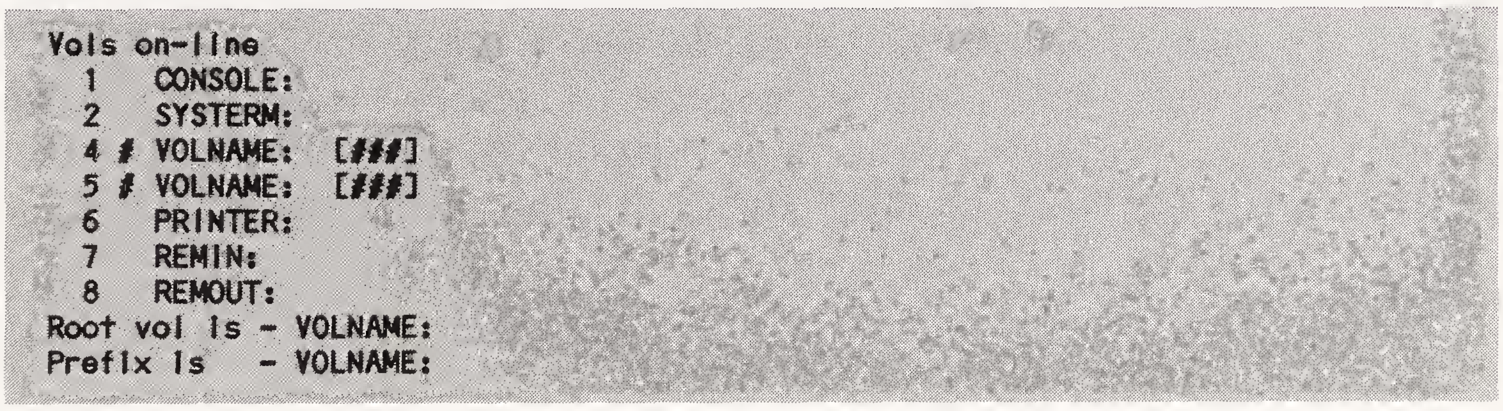
If all goes well, "THIS IS A TEST" is printed.

V(olumes

V(olumes, abbreviated V(ols, displays the volumes that are on-line. A storage volume is on-line if the disk is correctly placed in a drive. A communication volume is on-line if it is properly connected and the p-System is able to access it.

How to use it:

Select V(olumes and this display appears:



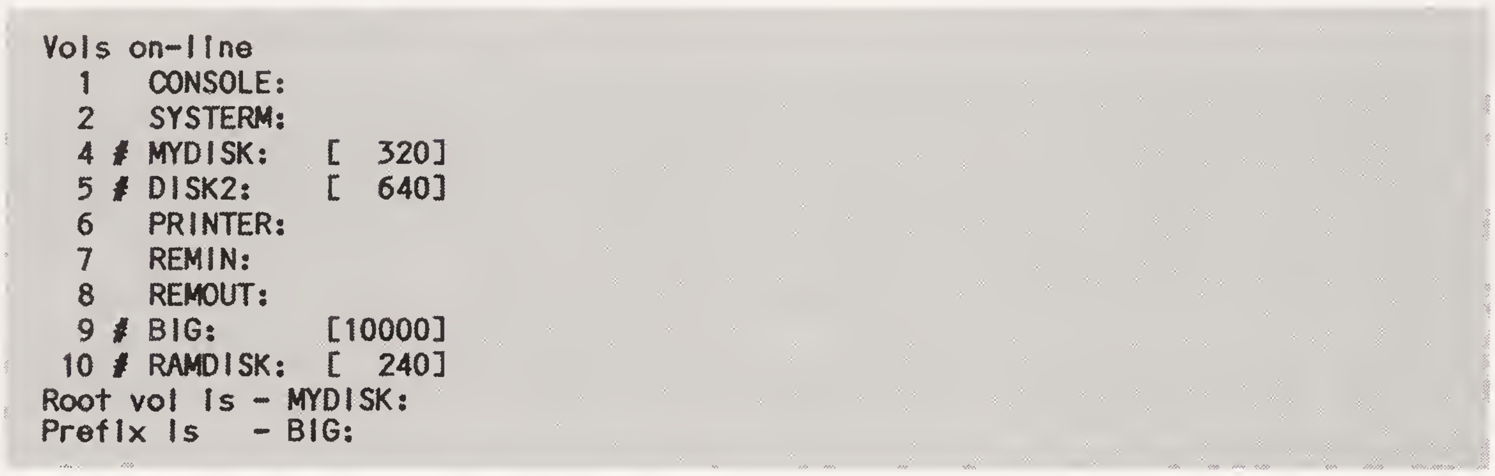
```
Vols on-line
  1    CONSOLE:
  2    SYSTERM:
  4 #  VOLNAME:  [###]
  5 #  VOLNAME:  [###]
  6    PRINTER:
  7    REMIN:
  8    REMOUT:
Root vol is - VOLNAME:
Prefix is   - VOLNAME:
```

The first column shows the device numbers of the on-line volumes. In the next column, the volume names are listed. Storage volumes show a number sign ("#") between the device number and the volume name. In this example display, devices #4: and #5: are the only storage volumes on-line. Following a storage volume name, its maximum storage capacity in blocks is displayed between square brackets, "[" and "]". The other devices shown are the standard communication volumes (see Section 4.11, page 155).

The "root vol" is the system disk (the disk that you booted with). The prefix volume is the default volume (see Section 4.7, page 147).

Example:

If you select V(olumes, this display might appear:



```
Vols on-line
  1   CONSOLE:
  2   SYSTERM:
  4 # MYDISK:    [  320]
  5 # DISK2:     [  640]
  6   PRINTER:
  7   REMIN:
  8   REMOUT:
  9 # BIG:       [10000]
 10 # RAMDISK:   [  240]
Root vol is - MYDISK:
Prefix is   - BIG:
```

This shows all of the standard communication devices on-line. It also shows four storage devices. There are two floppy disks: a 320 block disk in #4 and a 640 block disk in #5. Device #9 contains a hard disk, called BIG:, which has a 10,000 block storage capacity. And, #10 is a RAM disk (a virtual disk which exists in main memory). The system disk (called "root vol" here) is MYDISK:. The default disk (called "prefix" here) is BIG:.

W(hat

W(hat tells you the status of your workfile, if you have one.

How to use it:

Select W(hat, and one of these messages appear:

```
Workfile is VOLUME-NAME:FILE-NAME
Workfile is VOLUME-NAME:FILE-NAME (not saved)
Not named (not saved)
No workfile
```

The first and second messages indicate your current workfile. There may be a text and/or code version of this file. In the second case, the phrase "not saved" indicates that there is a temporary version of the workfile.

The third message indicates that your workfile is a temporary workfile (SYSTEM.WRK.TEXT and/or SYSTEM.WRK.CODE).

The fourth message simply indicates that you do not currently have a workfile.

Example:

If you G(et a file called MY.PROG.TEXT and then select W(hat, you are informed:

```
Workfile is VOLNAME:MY.PROG
```

If you edit that file and use Q(uit U(pdate to leave the Editor, the temporary version of MY.PROG.TEXT is created. Now, if you enter the Filer and select W(hat, you are informed:

```
Workfile is VOLNAME:MY.PROG (not saved)
```

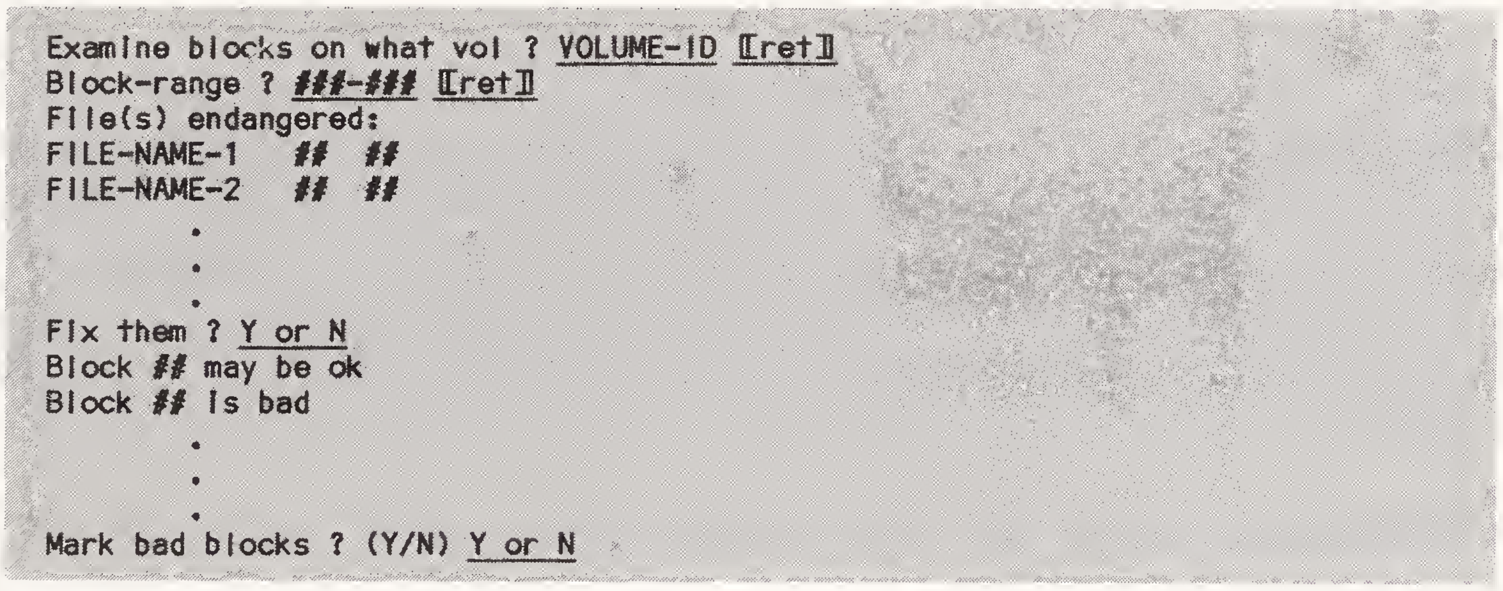
This reminds you that the most current version of MY.PROG is not S(aved under an explicit name.

X(amine

X(amine attempts to fix bad blocks on a disk.

How to use it:

Select X(amine, and the following prompts appear:



```
Examine blocks on what vol ? VOLUME-ID [ret]
Block-range ? ###-### [ret]
File(s) endangered:
FILE-NAME-1    ##  ##
FILE-NAME-2    ##  ##
          .
          .
          .
Fix them ? Y or N
Block ## may be ok
Block ## is bad
          .
          .
          .
Mark bad blocks ? (Y/N) Y or N
```

The first prompt asks you to designate the volume that you want to examine.

The second prompt asks which blocks on that volume are to be checked. In response to this prompt you can enter a single number or two numbers separated by a hyphen. If you enter a single number, that block is examined. If you enter two numbers with a hyphen, those two blocks and all blocks between them are examined.

If any files overlap the block range, they are listed as "File(s) endangered." In this case you are asked if you want to "Fix them." These files are endangered because X(amine may destroy information contained in any of the blocks that are examined. (Because of this danger, you should only examine blocks that are apparently bad, according to the B(ad blocks activity.)

If you elect to proceed (or if no files were endangered) X(amine attempts to fix any problems by reading and writing to each block in the block range several times. The block numbers are displayed followed by "may be ok" or "is bad." If the message "may be ok" is displayed, it is likely that the block is fine. You should check to be sure by using B(ad blocks again.

If any blocks are bad, the final prompt, above, asks if you want to mark them. If you do, the bad blocks are marked by placing a .BAD file over them. (You are warned if existing files must be removed in order to mark the bad blocks.) A bad file created by X(amine has the name:

BAD.#####.BAD

where "#####" is the block number. The p-System does not move such a file when K(runch is used. This means that it is safe to K(runch a disk with bad blocks as long as they are marked. You may decide to discard disks with bad blocks just to be safe, however. You might also try formatting the disk again in an attempt to fix the bad blocks.

Example:

If the B(ad blocks activity indicates that blocks 25 and 27 are bad, you could use X(amine like this:

```
Examine blocks on what vol ? MY DISK: [ret]
Block-range ? 25-27 [ret]
File(s) endangered:
PROGRAM.CODE  24  32
Fix them ? Y
Block 25 may be ok
Block 26 may be ok
Block 27 is bad
Mark bad blocks (files will be removed!) ? (Y/N) Y
```

In this example, PROGRAM.CODE (which occupies blocks 24 through 32) overlaps the bad blocks. Even though X(amine was able to fix block 25, block 27 was beyond repair. In order to mark block 27, PROGRAM.CODE must be removed. (Hopefully, there is a back up copy of PROGRAM.CODE on another disk!)

Z(ero

Z(ero places a new directory on a storage volume. This new directory is empty, indicating that no files currently exist on the disk.

How to use it:

Select Z(ero and these prompts are displayed:

```
Zero dir of what vol ? VOLUME-ID [ret]
Destroy VOLUME-NAME: ? Y or N
Duplicate dir ? Y or N
Are there ### blks on the disk ? (Y/N) Y or N
# of blocks on the disk ? ### [ret]
New vol name ? NEW-VOLUME-NAME: [ret]
NEW-VOLUME-NAME: correct ? Y or N
NEW-VOLUME-NAME: zeroed
```

The first prompt asks which volume is to be Z(eroed.

The second prompt only appears if the volume already has a directory (that is, if it is not blank). This prompt asks if you want to overwrite the current directory. If you do, the old files on that disk are no longer going to appear in the directory and are essentially lost. It is usually possible to recover them, but this can be a tedious task.

The third prompt asks if you want a duplicate directory (see Section 4.8, page 148) to be maintained on the Z(eroed volume. If you do, two copies of the disk directory are kept on the new volume for safety.

The fourth prompt only appears if the volume already has a directory. It displays the current size of the volume, in blocks, and asks if you want the new directory to indicate the same size.

If you don't want the disk to show that number of blocks (or if there is no current directory) the fifth prompt asks for the size that you would like. Usually, you should respond to this prompt with the maximum capacity of your disks. (Refer to the inside front cover of this book.)

The sixth prompt asks for the new volume name.

The second-to-last prompt verifies that you want the name you entered. This is your last chance to cancel the Z(ero activity without actually affecting the disk in question.

The final message indicates that the volume has been successfully Z(eroed.

NOTE: Most computers require that a blank diskette be "formatted" by a disk formatting utility before it can be Z(eroed by the Filer (and subsequently used by the p-System in general). In some cases, the disk formatting utility performs the initial Z(ero operation on the disk for you.

Example:

If you are initializing a blank disk, you might use Z(ero like this:

```
Zero dir of what vol ? #5: [ret]
Duplicate dir ? N
# of blocks on the disk ? 320
New vol name ? MYDISK: [ret]
MYDISK: correct ? Y
MYDISK: zeroed
```

6.10 SUBSIDIARY VOLUMES

This section covers a more advanced topic known as **subsidiary volumes.** A subsidiary volume is a file that can be used as if it were a separate disk altogether. It has its own directory and may contain its own files. The disk that contains the subsidiary volume is called the **principal volume.**

Subsidiary volumes are especially useful when dealing with large capacity disks. Using subsidiary volumes, you can divide such disks into logical portions. For example, you can have one subsidiary volume for personal programs, one for professional use, and so forth.

Also, the p-System is able to store many more files than it otherwise could. A volume is able to hold, at most, 77 files with the current p-System. This is far too few files for a large capacity disk. However, each subsidiary volume is able to hold 77 files of its own. This means that you could conceivably have as many as 77 subsidiary volumes with as many as 77 files on each.

The files that contain subsidiary volumes use the the name of the subsidiary volume and must contain 7 or fewer characters. Here are some valid file names and corresponding subsidiary volume names:

File Name	Subsidiary Volume It Contains
WORK.SVOL	WORK:
PLAY.SVOL	PLAY:
MEMOS_1.SVOL	MEMOS_1:
THESIS.SVOL	THESIS:

Figure 6.1 gives you an idea of the structure of subsidiary volumes. It shows a directory on the principal volume which includes an .SVOL file. The directory within the .SVOL file is shown along with the files contained within the subsidiary volume.

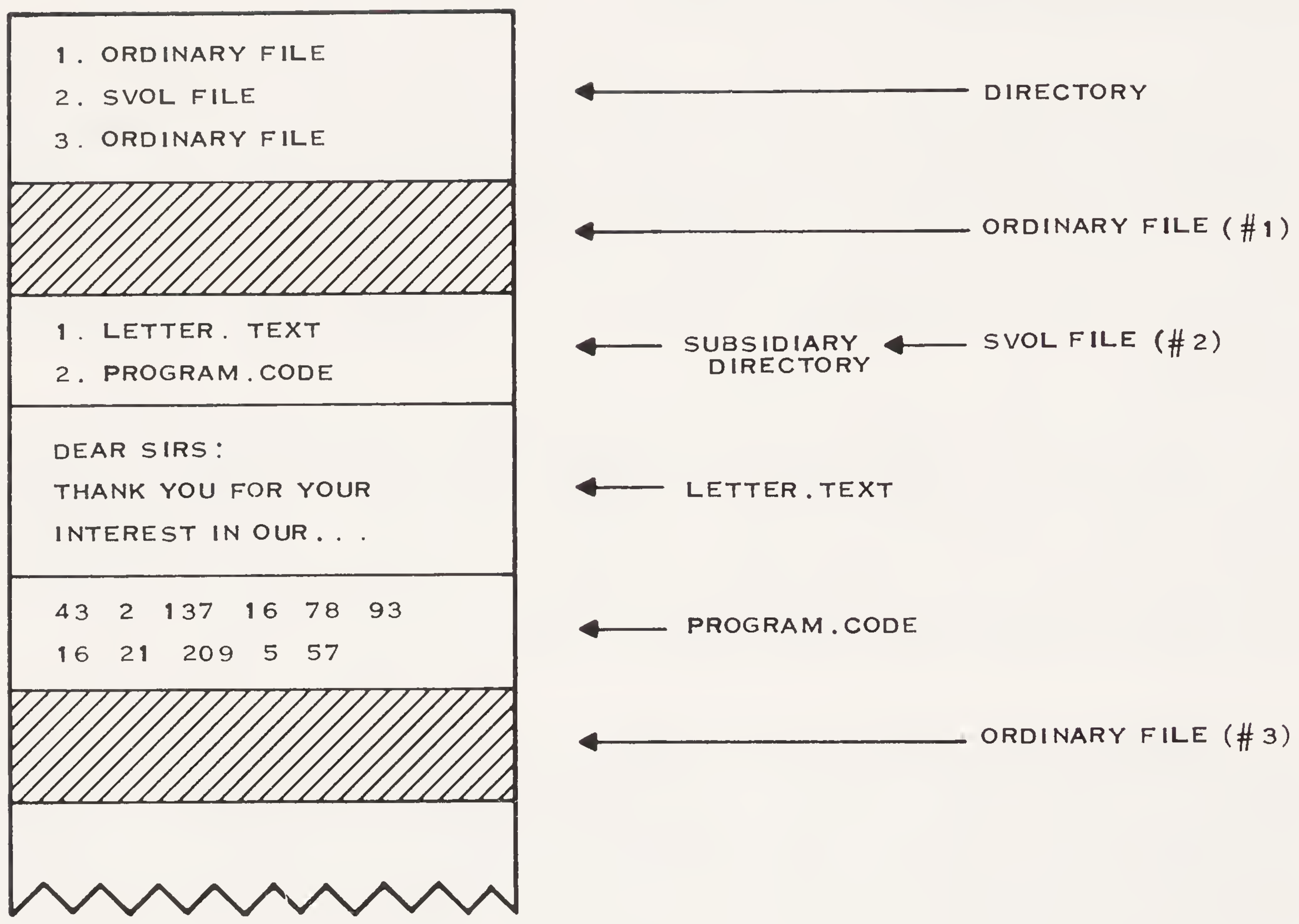


Figure 6.1

In order for a subsidiary volume to be used, it must be **mounted.** Mounting a subsidiary volume is similar to bringing an ordinary disk volume on-line. A subsidiary volume is not necessarily mounted just because the corresponding .SVOL file resides on an on-line volume.

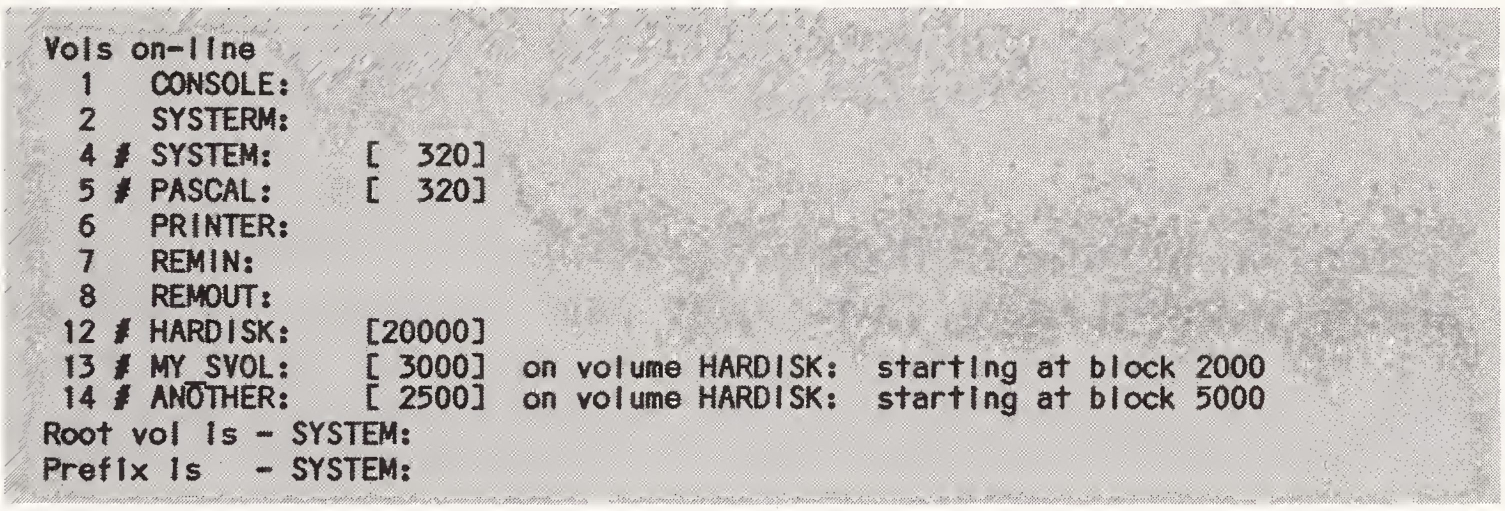
There are two ways that you can mount a subsidiary volume. The first way is to simply have the principal volume on-line when the p-System is booted or reinitialized. The initialization process mounts, as far as it is able to, all of the subsidiary volumes that are found on all of the on-line principal volumes.

You can use the O(n/Off-Line activity (described with the other Filer activities) to manually mount subsidiary volumes. You can also use this activity to dismount subsidiary volumes.

NOTE: There is a limit to the number of subsidiary volumes that you can have mounted at one time. This limit can be set by you and is subject to memory constraints and tradeoffs. It is beyond the scope of this book to go into this, however. See Chapter 9 for further reading about subsidiary volumes and the Setup utility.

You should attempt to keep a principal volume on-line as long as you are using a subsidiary volume that resides on it. This is a safety precaution since, under certain circumstances, it is possible to confuse the p-System about a subsidiary volume if you remove the principal volume and replace it with some other disk.

The V(olumes activity (described with the other Filer activities) has some special provisions for subsidiary volumes. It displays additional information for subsidiary volumes. The name of the principal volume is given. Also, the location of the subsidiary volume is shown. The following is an example:



```
Vols on-line
  1   CONSOLE:
  2   SYSTERM:
  4 # SYSTEM:      [  320]
  5 # PASCAL:      [  320]
  6   PRINTER:
  7   REMIN:
  8   REMOUT:
 12 # HARDISK:     [20000]
 13 # MY_SVOL:     [ 3000]  on volume HARDISK:  starting at block 2000
 14 # ANOTHER:     [ 2500]  on volume HARDISK:  starting at block 5000
Root vol is - SYSTEM:
Prefix is   - SYSTEM:
```

In this example, a 20,000 block disk, called HARDISK:, is on-line as device #12. The two subsidiary volumes, MY_SVOL: and ANOTHER:, are located on HARDISK: at the indicated starting blocks. The size of each subsidiary volume, in blocks, is shown (e.g., 3000 for MY_SVOL) just as it is for any other storage volume. The device numbers are also shown as they are for the rest of the volumes; in this example, MY_SVOL: is device #13.

In order to create an .SVOL file, you should use M(ake (which is described with the other Filer menu items). Whenever you M(ake an .SVOL file, the Filer realizes that you want to create a subsidiary volume. In order to do this, it asks you one or two extra questions:

```
Make what file ? VOLNAME.SVOL [###] [ret]
Zero subsidiary volume directory ? Y or N
Duplicate dir ? Y or N
```

The response to the first prompt should be the name of the subsidiary volume and may include the size specification.

If a subsidiary volume directory previously existed where you are now creating the .SVOL file, you are asked if you want to Z(ero the old directory. If you do, the new subsidiary volume will contain no files. If you don't, the new subsidiary volume will contain the same files that the old subsidiary volume did.

The third prompt asks if you want a duplicate directory to be maintained on the subsidiary volume. Duplicate directories are a safety precaution that you may use if you wish.

When a subsidiary volume is created with M(ake, it is mounted automatically unless you have already mounted as many subsidiary volumes as your system configuration allows.

6.11 WILD CARDS

Wild cards allow you to refer to more that one file in a shorthand fashion. They are convenient to use in conjunction with many of the Filer activities. Wild cards can help you to avoid excessive typing and the errors that may result.

There are three wild card symbols: equal sign (=), question mark (?), and dollar sign ($). They can be used as part of a file name when you are responding to Filer prompts.

The equal sign matches any sequence of characters. For instance:

```
A.PROG=
```

matches all of the following:

```
A.PROG.TEXT
A.PROG.CODE
A.PROGRAM
A.PROG
```

The R(emove activity, for example, removes all of those files (if they exist to begin with) if you enter this response:

```
Remove what file ? A.PROG= [ret]
```

The equal sign, by itself, designates all of the files on a disk. For instance, if you respond to the R(emove prompt like this:

```
Remove what file ? = [ret]
```

or

```
Remove what file ? MYDISK:= [ret]
```

all files are removed from the prefix disk or from MYDISK:, respectively.

The question mark behaves just like the equal sign except that you are asked, for each matching file, whether you want that file included in the operation. For example, you can use R(emove like this:

```
Remove what file ? A.PROG? [ret]
Remove A.PROG.TEXT ? Y, N, or [esc]
Remove A.PROG.CODE ? Y, N, or [esc]
Remove A.PROGRAM ? Y, N, or [esc]
Remove A.PROG ? Y, N, or [esc]
Update directory ? Y or N
```

For each match, you are asked if you want to remove that particular file. You should respond to each prompt with "Y" for yes, "N" for no, or [esc] to discontinue this series of prompts at any point. Typing [esc] exits the R(emove activity altogether if you have not indicated that you want to remove any files so far. If you have indicated that one or more files are to be removed, typing [esc], skips to the "Update directory?" prompt. If you don't update the directory, none of the files are removed.

The dollar sign wild card indicates "the same file name as before." It is only used with T(ransfer (although the compilers and assemblers can use this wild card as well). T(ransfer prompts you for a source file and a destination for that file. If you indicate dollar sign as the destination, the original file name is given to the transferred file. It is not necessarily transferred to the same volume as the source file, however. The volume ID is independent of the dollar sign wild card. As an example, you might use T(ransfer like this:

```
Transfer what file ? VOL1:FILE.NAME [ret]
To what file ? VOL2:$ [ret]
VOL1:FILE.NAME  -->  VOL2:FILE.NAME
```

This saves you from having to retype the destination file name. You could also use T(ransfer like this:

```
Transfer what file ? VOL1:A.PROG= [ret]
To what file ? VOL2:$ [ret]
VOL1:A.PROG.TEXT  -->  VOL2:A.PROG.TEXT
VOL1:A.PROG.CODE  -->  VOL2:A.PROG.CODE
VOL1:A.PROGRAM    -->  VOL2:A.PROGRAM
```

This transfers all files on VOL2: that match A.PROG= to VOL2:. It gives them the same name that they originally had.

If there is a source and destination, as in the case with T(ransfer and C(hange, wild cards must be used on both sides, or not at all. The following T(ransfer operation is not correct because several files cannot be transferred to one file:

```
Transfer what file ? A.PROG= [ret]
To what file ? MYDISK:A.PROG.TEXT [ret]
```

The single exception to this rule is that a dollar sign may be used as the destination in T(ransfer for a file which is specified without wild cards (as shown above).

The Filer activities that can use wild cards are:

C(hange
E(xtended list directory
L(ist directory
O(n/off line
R(emove
T(ransfer

The next two sections demonstrate useful operations that can be performed by using wild cards in conjunction with R(emove and T(ransfer.

Removing Several Files from a Volume

If you want to remove every file from a volume, you can use R(emove like this:

```
Remove what file ? VOLNAME:= [ret]
VOLNAME:A.FILE.TEXT     --> removed
VOLNAME:A.FILE.CODE     --> removed
VOLNAME:ANOTHER.FILE    --> removed
VOLNAME:YET.ANOTHER     --> removed
VOLNAME:LAST.FILE.TEXT --> removed
Update directory ? Y or N
```

The prompt at the end is a double check. If you type "Y", all of the files are removed. If you type "N", nothing is removed.

You can remove all of the text files, or all of the code files on a disk like this:

```
Remove what file ? VOLNAME:=.TEXT [ret]
```

```
Remove what file ? =.CODE [ret]
```

The first response removes all text files on VOLNAME:. The second response removes all code files on the prefix disk.

You can also use the question mark wild card so that you are prompted, for each file, whether or not it should be removed. This is demonstrated in the discussion about the question mark wild card above.

Backing Up Disks Using T(ransfer

There are two convenient ways to use T(ransfer to back up the files on a disk. The first is to do a disk-to-disk transfer. This amounts to transferring one volume to another and is described under T(ransfer.

The other way is to do a file-by-file T(ransfer using wild cards. For example, you could use T(ransfer like this:

```
Transfer what file ? MASTER:= [ret]
To where ? BACKUP:$ [ret]
MASTER:FILE.NAME.1  --> BACKUP:FILE.NAME.1
MASTER:FILE.NAME.2  --> BACKUP:FILE.NAME.2
MASTER:FILE.NAME.3  --> BACKUP:FILE.NAME.3
                   etc.
```

If an existing file on the destination disk has the same name as a file being transferred, you are asked if you want to remove the existing file. If you decide not to remove it, the corresponding file from the source disk is not transferred. Otherwise, the transfer goes through. In either case, the Filer then goes on to the next file on the source disk. (This practice of asking you if you want to remove a file that has the same name is a standard safety precaution used by T(ransfer. In order to save time and effort, you may want to remove any matching files on the backup disk before you do this sort of T(ransfer operation.)

6.12 FILE AND DIRECTORY RECOVERING

There are several ways that files and directories can be lost. Files can be lost, for example, if you accidentally remove them. A directory can be lost if you unintentionally Z(ero a disk, or if you somehow overwrite the directory.

There are three utility programs which can assist you in recovering lost files or directories. They are the Copydupdir, Markdupdir, and Recover utilities. This section describes how to use these utilities.

The Copydupdir and Markdupdir Utilities

Copydupdir and Markdupdir are used in conjunction with duplicate directories (see Section 4.8, page 148). If you are maintaining a duplicate directory on a disk, Copydupdir can copy it into the main directory if necessary. If you aren't maintaining a duplicate directory, Markdupdir can create one for you.

When you X(ecute Copydupdir, the following prompts are displayed:

```
Duplicate Directory Copier [ ]
Enter drive # of user's disk (4,5,9,10,11) ? DEVICE-NUMBER [ret]
Are you sure you want to zap directory of VOLNAME: {blocks 2-5} ? Y or N
Directory copy is complete.  Type <ret> to exit.
```

The first line identifies the Copydupdir utility.

The second prompt asks for the disk's device number. This is the disk that will have the duplicate directory copied into the main directory. Do not include the number sign or colon when you enter the device number.

The third prompt asks you to verify that you want to "zap" that volume's directory. You should be aware that when the duplicate directory is copied, the current main directory will be destroyed.

The final line indicates that the copying is complete. When you type ⟦ret⟧, Copydupdir is exited.

If a duplicate directory is not currently being maintained on the disk, you are warned that this is the case. If you go ahead with the copying, the contents of blocks 6 through 9 are written into the main directory. It is important that a correct duplicate directory exists in that location because, otherwise, the newly copied directory will be invalid.

When you X(ecute Markdupdir, the following prompts are displayed:

```
Duplicate Directory Marker [ ]
Enter drive # of user's disk (4,5,9,10,11) ? DEVICE-NUMBER ⟦ret⟧
A duplicate directory is not being maintained on VOLNAME:
WARNING! It appears that blocks 6-9 are not free for use.
  Are you sure they are free ? Y or N
Do you want the directories to be marked ? Y or N
Directories are now marked as duplicate.  Type <ret> to exit. _
```

The first line identifies the Markdupdir utility.

The second prompt asks for the disk's device number. This is the disk that will be marked as having a duplicate directory.

The third line indicates that a duplicate directory is not currently being maintained on the disk. (If one is, you are notified of that, and the Markdupdir utility is exited.)

The next two lines are a warning. They indicate that an existing file may be overlapping blocks 6 through 9. If this is the case, that file will be overwritten when you create a duplicate directory. If the disk does contain a file there, you should move it before marking the directory. This warning always appears, even if there is no file in that area.

The second to last prompt verifies that you want to mark the directory as duplicate.

The final prompt notifies you that a duplicate directory will now be maintained.

The Recover Utility

Recover is useful for recovering files that have been lost. This utility looks at the directory and informs you of the files that currently appear there. It then looks through the disk and locates areas that resemble text files or code files. (Other sorts of files cannot be recovered since they do not have a distinguishable format.) The files that are found are entered into the directory, if you want.

When you execute Recover, these prompts appear:

```
Recover [ ]
USER'S DISK IN DRIVE # (0 exits): DEVICE-NUMBER [ret]
USER'S VOLUME-ID: VOLUME-NAME [ret]
FILE.NAME.1 found
FILE.NAME.2 found
     .
     .
     .
Are there still IMPORTANT files missing (Y/N) ? Y or N
File DUMMY01X.TEXT inserted at blocks ###-###
File DUMMY02X.TEXT inserted at blocks ###-###
File FILE.NAME.CODE inserted at blocks ###-###
     .
     .
     .
GO AHEAD AND UPDATE DIRECTORY (Y/N) ? Y or N
```

The first line identifies the Recover utility.

The second line asks for the device number of the disk to be recovered.

The third line requests a volume name. This name will be recorded on the disk when its directory is updated.

Next, the names of all files currently listed in the directory are displayed.

Following these names is a prompt asking you if there are still some important files missing. If you indicate that there are, Recover begins to look for lost files. The file names are displayed followed by a block range indicating where the files are located. Text files are named DUMMY01X, DUMMY02X, and so forth. This is because there is no way to tell what name they originally had. You need to examine the contents of these files (perhaps using the Editor) to identify them. You will also have to determine which copy of a particular file is the most recent version. Code files are given names that correspond to the program contained within them.

The final prompt asks if you want to update the directory. If you elect to do so, the recovered files are entered into the directory. If you don't, the directory remains as it was before Recover was executed.

MODULES: A THEME OF THE P-SYSTEM 7

7.1 INTRODUCTION

The old saying, "divide and conquer," is just as true for modern software engineering as it was for the ancient battles fought by the man who is said to have first used the phrase (Julius Caesar). In software work, instead of dividing enemy armies, we divide large programs into **modules.** But "conquering" of one sort or another is still the intended result.

This chapter discusses the ways in which this well-known principle is applicable to the p-System. We aren't trying to provide a "cookbook" for using modules in the p-System. Instead, we concentrate on strategies—the strategies that guided the original design of the p-System and the strategies that you can take advantage of in your use of it.

This chapter should be most valuable if you intend to make serious use of the p-System, particularly in developing programs. No matter how you intend to use your p-System, we hope you find this discussion interesting and valuable.

Since you're probably not much interested in "conquering" in the military sense, here are some more directly useful restatements of the principle:

- "Divide and isolate." The p-System is divided into modules. One result is the isolation of the small portion of the System that must be changed when it is moved among dissimilar computers. This means that most of the components of the p-System, and most p-System application programs, can be run without change on almost any kind of personal computer.
- "Divide and understand." The p-System makes it easy for you to break large programs into smaller modules. Understanding all the modules individually is generally easier than dealing with the single large program.
- "Divide and reuse." The modules of a program are not only easier to understand; if they are carefully designed, they may even be usable in other programs! This leads to a pleasant prospect for you as a p-System programmer: major parts of a large program may already exist (as previously written modules) before you start work!
- "Divide and manage." Ready-to-run p-System programs are composed of modules called **segments.** When a program is executed, only segments that are actively directing the computer need to be in main memory. Thus the p-System can handle programs that are bigger than the available main memory space.

In the remainder of this chapter, we explore these four variations of "conquer" in each of three general areas of the use of modules in the p-System. The first topic is the p-System portability strategy.

7.2 USING MODULES TO ACHIEVE PORTABILITY

We must first address some basic questions: "Why is portability hard to achieve?" "Why can't all software run on any computer?" The reason is that most brands of computers are quite different in the details of their construction and operation, even though they may look similar and serve similar functions.

For instance, two personal computers may contain different kinds of **microprocessors**—the tiny silicon chips that direct a small computer's activities. Each kind of microprocessor has a distinct vocabulary of instructions that it obeys. These **instruction sets** may be as different as French is from English. It shouldn't be surprising, therefore, that you have to choose the right set of instructions in order to communicate properly with a microprocessor.

Even when two computers contain the same kind of microprocessor, there can still be portability barriers, because their style of interaction with input/output peripherals (such as diskette drives or the console display and keyboard) may be different. In other words, the "languages" of input/output interaction may differ, even if the central processor languages are compatible.

Examples of these two kinds of differences among personal computers are shown in Figure 7.1, in which several computers made by one company (Texas Instruments) are shown. The two computers on the left use the same kind of microprocessor instruction set, but different kinds of peripherals, so their edge patterns are different. The third computer, the TI Professional Computer, is different from the other two in the processor language it uses, as well as in the peripheral conventions it expects.

The figure also shows the p-System with an application program for each computer. Since the same p-System can be used in all three configurations, the edge patterns on the System are the same. The figure is not complete, however, since no direct connection exists between the p-System and the host computer hardware.

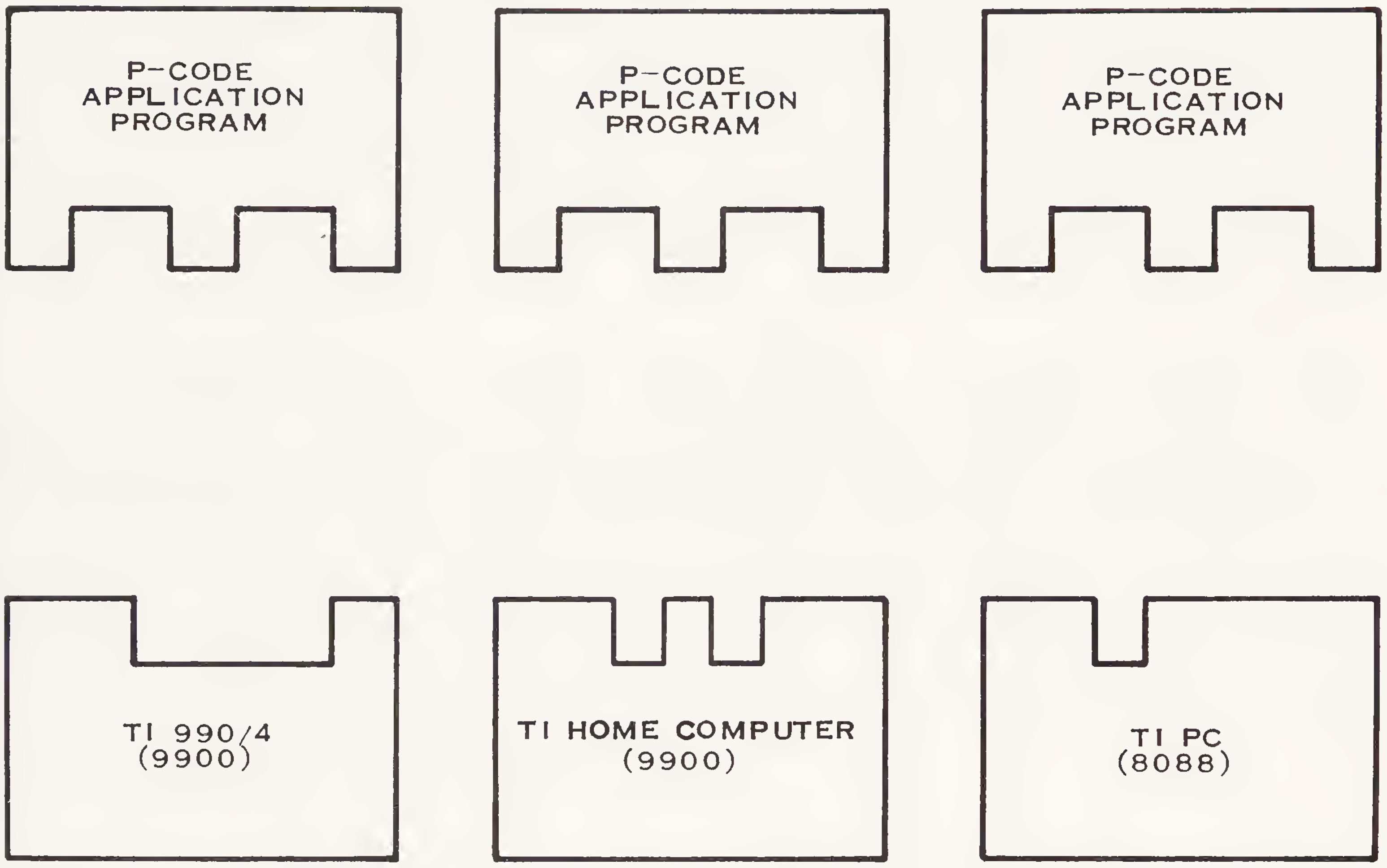

P-CODE APPLICATION PROGRAM
P-CODE APPLICATION PROGRAM
P-CODE APPLICATION PROGRAM
TI 990/4 (9900)
TI HOME COMPUTER (9900)
TI PC (8088)

Figure 7.1

The secret of the portability of the p-System is the use of a foundation software module which deals with the host computer microprocessor and its peripherals, while isolating the rest of the p-System from the details of this hardware. Figure 7.2 shows this module in place. Notice that it adapts to the various peculiar interface patterns, while presenting the same edge pattern to the p-System.

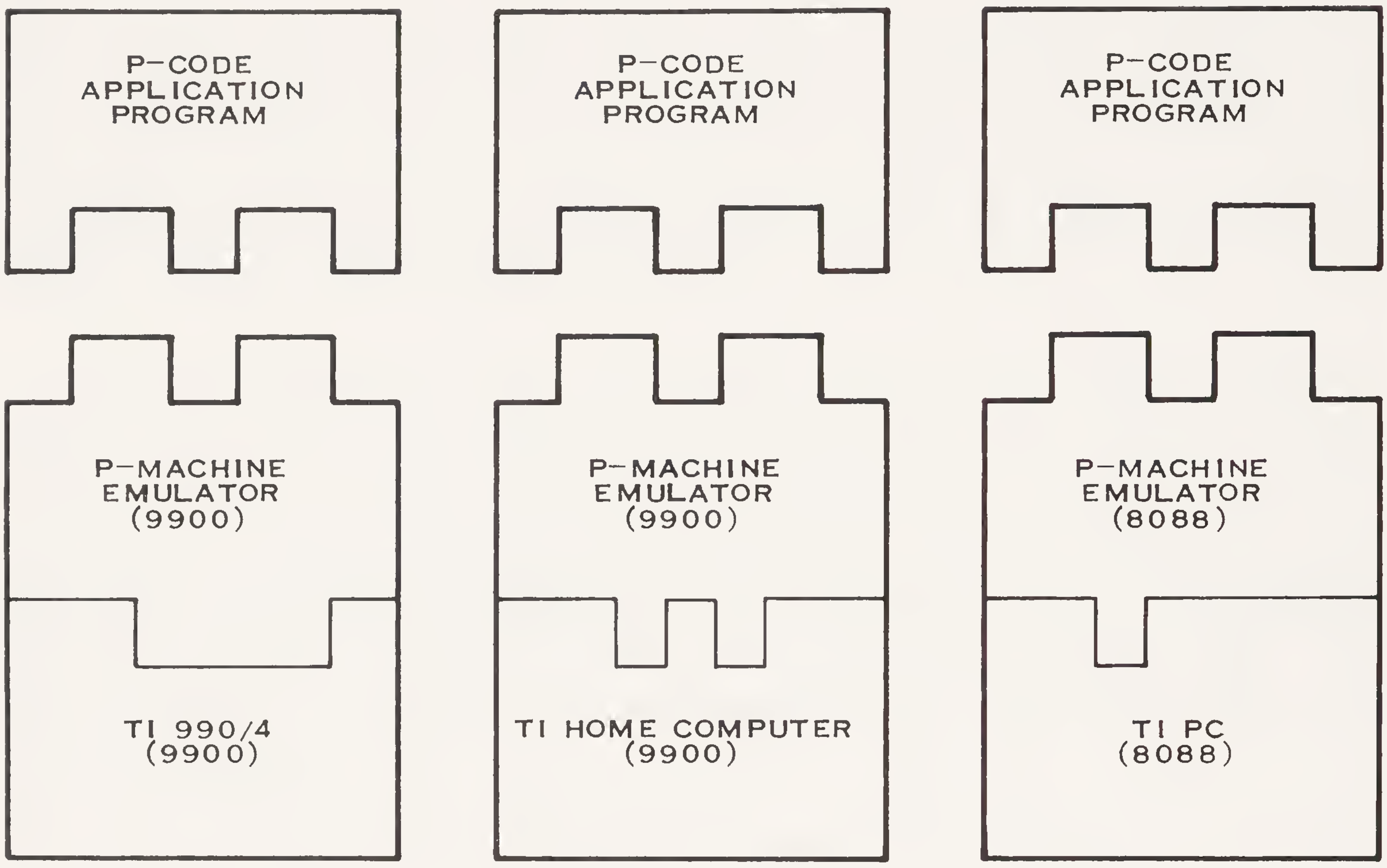

P-CODE APPLICATION PROGRAM
P-CODE APPLICATION PROGRAM
P-CODE APPLICATION PROGRAM
P-MACHINE EMULATOR (9900)
P-MACHINE EMULATOR (9900)
P-MACHINE EMULATOR (8088)
TI 990/4 (9900)
TI HOME COMPUTER (9900)
TI PC (8088)

Figure 7.2

This foundation module is the **p-machine emulator** (PME). This emulator turns the host computer into a **p-machine.** All p-machines work alike, regardless of differences in the host computers on which they run.

The p-machine is an idealized computer architecture that was designed as a foundation for the p-System. Instructions for the p-machine are called **p-code.** The compilation process that we dealt with in Chapter 3 translates high level language source statements (written in UCSD Pascal or FORTRAN-77) into p-code. The resulting p-code program can then be executed to accomplish some useful task such as producing a series of payroll checks ("p-checks?").

The p-machine contains a smaller module, called the Basic I/O Subsystem (BIOS). This module handles the peripherals of the host computer and serves to isolate the bulk of the PME from dependence on those peripherals.

When the p-System in installed on a particular type of computer, an appropriate PME and BIOS must be configured. This task involves some sophisticated programming. Fortunately, it has already been done for most of the popular personal computers. If you are interested in an adaptation for a particular model of computer, but don't know a source, check the *UCSD p-System Implementations Catalog*.

Because the PME and BIOS modules hide the peculiarities of the various personal computer types, an application program represented in p-code can be used on a wide variety of computers. Figure 7.3 shows this wide range. Microprocessor types are listed along the left (in "8-bit" and "16-bit" groups). Next to each processor name is one or two personal computers that incorporate that microprocessor. The p-System has been implemented on all the personal computers shown.

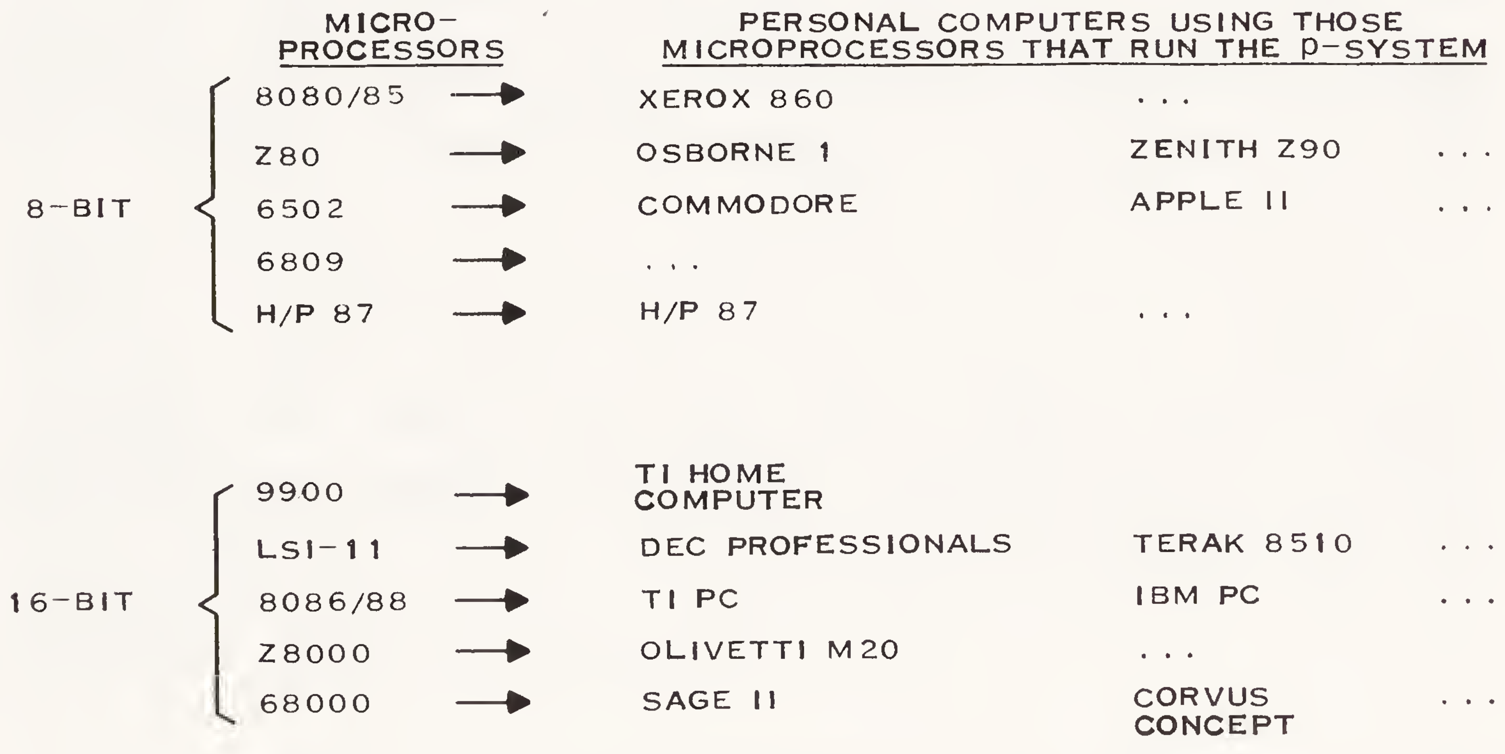


Figure 7.3

What are the implications of the p-System's wide portability for you? One implication is that the number of p-System applications for your computer is not nearly so dependent on the kind of computer you have, as it would be if you weren't using the p-System. Particularly, if you can use the Universal Medium, you should benefit from the fact that application suppliers don't have to invest a lot of effort customizing their applications to your particular model of computer. You may even become an applications supplier yourself!

You also gain freedom of hardware choice with the p-System. If you replace your current computer or add additional computers in your organization, they can be selected on the basis of hardware capabilities and cost-effectiveness, with confidence that the p-System can (almost certainly) be installed on the equipment you finally select.

Furthermore, your investment in acquiring or building p-System software for your current environment is conserved, when you use the same software in new hardware environments.

Finally, there is a subtle but important benefit from the fact that tens of thousands of personal computer users are pounding on the same software you're using. In the world of software, "used" goods are often more valuable than "new" goods, because the feedback from thousands of users can be crucial to making software more reliable.

The use of modules to achieve portability is primarily an example of the "divide and isolate" principle. In the next section, we discuss the use of modules during p-System program development, where all four senses of "conquer" (isolation, understanding, reuse, and management) can be important objectives.

7.3 USING MODULES IN PROGRAM DEVELOPMENT

Some psychologists believe that there are fundamental limits on the number of distinct ideas that a human mind can productively deal with at one time. They claim that the magic number is seven (plus or minus two). For example, consider the task of memorizing the following list of numbers:

5 7 4 2 2 7 8 3 2 8 0 0 5 5 5 1 6 8 9

Unless you have special gifts of memory, you're probably intimidated by the thought of juggling all those digits in your head. What if, however, we group them like this:

574-22-7832 (800) 555-1689

Now the task is much less intimidating, because the numbers can be recognized as Social Security and telephone numbers. The stream of digits can be considered in **groups** (six of them). The first two groups in the phone number are particularly easy to remember, because they have special meanings. This is "divide and comprehend" in action!

One way you can divide a program is to use a **procedure**, a named group of language statements that usually serves a coherent purpose. (The formal name of the "procedure" construct in a particular language may be something else. The name "subroutine" is used in FORTRAN-77, for example.)

A procedure could, for instance, have responsibility for requesting and accepting a calendar date from a user at the console keyboard. A program containing this procedure could invoke it (in many places, if necessary) by using the procedure's name.

Consider the program on the next page, which produces verses of a well-known song. The program is written in Pascal, but its operation should be clear, even if your expertise is in some other language. The comments (enclosed in braces "{}") should help.

```
program NinetyNineBottlesofBeer;

{This "variable" maintains a record of the bottle count.}
var Count: integer;

Procedure OneVerse;
begin

{Write the lines of a verse, inserting the appropriate bottle count.}
writeln(Count,' bottles of beer on the wall,');
writeln(Count,' bottles of beer;');
writeln('If one of those bottles should happen to fall:');

{Reduce the bottle count by one, and write the last line.}
Count := Count - 1;
writeln('There'd be ',Count,' bottles of beer on the wall.');
writeln;

end;

begin

{Start with 99 bottles.}
Count := 99;

{Produce some verses by invoking the procedure once for each verse.}
OneVerse;
OneVerse;
OneVerse;
OneVerse;
end.
```

Using procedure modules can contribute to program development in all of the ways identified in our introduction. For example, OneVerse captures, in one place, the structure of a verse. This makes it easy, for instance, to make different choices for the punctuation of each line, while maintaining consistency over the entire song.

OneVerse is also easy to reuse. If we hadn't used procedures in this program, it would have been very long, because each of the occurrences of "OneVerse" would have been replaced by the details of a particular verse. Getting those details right (over and over again!) would not have been easy.

In spite of all their benefits, procedures do have some drawbacks. One of these is that it is not very convenient to reuse a procedure in several different programs. First, you must copy the text of the procedure into each program that needs it. If you want to change the procedure, you have to find all the copies and fix them individually.

Another difficulty is that in many situations the author of a procedure may not want you to know its internal details. The details may be a trade secret!

Enter the UCSD Pascal **unit** construct. It addresses these difficulties with procedures, and has other benefits, as well. (The other two p-System languages, BASIC and FORTRAN-77, have comparable, though somewhat less powerful, constructs. We describe the UCSD Pascal version, here.)

A unit is a group of procedures and data structures, usually related to a common task area. A program or another unit can access these facilities by naming the unit in a simple **uses** statement. The using program or unit is called the **client.**

A unit has two parts. The first is the **interface part**, which describes the procedures and data items that are "public" (that is, made available to clients). The second part of a unit is the **implementation part**, which contains the detailed definitions of the public procedures, plus any other "private" procedures or data that are needed in the unit.

A unit can be compiled by itself, with no knowledge of potential clients. This means that when you work on a program containing many units, you can save a significant amount of program development time by recompiling only the modified units when the program is changed. Units that are not changed, do not generally have to be recompiled. The exception is that when the interface section of a unit is changed, all clients of that unit must be recompiled.

In its compiled (p-code) form, a unit still includes textual source definitions for the interface section. These definitions become available to clients. Note, however, that no details on the implementation section are available to clients.

A sample unit, called SimpleGraphics, is shown below. It provides three public services: putting a dot at a particular (x,y) coordinate on the graphics screen of a host computer; choosing the color for subsequent dots; and clearing the entire graphics screen. Here is the unit:

```
Unit SimpleGraphics;
Interface

Procedure PutDot (xCoordinate, yCoordinate: Integer);
Procedure ChangeColor (NewColor: Integer);
Procedure ClearScreen;

Implementation
Var CurrentColor: Integer;

Procedure PutDot; begin ... end;
Procedure ChangeColor; begin CurrentColor := NewColor end;
Procedure Clearscreen; begin ... end;

end.
```

Only one of the procedure definitions is shown (ChangeColor). The variable CurrentColor stores the color selected most recently by the client. CurrentColor is updated whenever ChangeColor is called.

A program or another unit that needs the facilities offered by SimpleGraphics need only include the statement "USES SIMPLEGRAPHICS".

SimpleGraphics is a good example of the way in which units can contribute to useful isolation in programs. As a user of SimpleGraphics, you need only know the functional effects of the three interface procedures, so the implementation can be changed to cater to different kinds of graphic devices (screens, plotters, or a graphics printer, for example) without impacting your programs.

The full-fledged graphics package called Turtlegraphics (which is described in the next chapter) is another example of the isolation benefits of units. It has been implemented on several different computers that have different display hardware details, but Turtlegraphics' interface to client programs is preserved in each of these adaptations.

Units don't just "divide and isolate." They address all four of the variations on "divide and conquer" that we listed in the introduction. Here are brief comments on the others:

- o "Divide and understand." Since you only need to understand the services a unit provides, and not how it implements those services, it is easier to deal with a large program that is composed of many units than it would be if you had to wade through all that implementation detail.
- o "Divide and reuse." A carefully designed unit can often be used in many different programs, not just in the original context that justified its creation. As you work in the p-System environment, you can accumulate a growing arsenal of program building blocks that can be applied to new projects. Reusability of units can result in enormous savings of your program development energy.
- o "Divide and manage." Splitting a large program into units can make it easier for a group of programmers to work cooperatively on the program. Once the group decides on interface definitions for the units of the program, individual programmers can proceed on their own with the writing and testing of the implementation sections.

In this section, we have stressed the aspects of units that affect program development. In the next section we turn our emphasis to the execution of programs; we first examine the handling of units during program execution.

7.4 USING MODULES DURING PROGRAM EXECUTION

The independence that characterizes units during program development also applies during program execution. The compiled p-code for the units that a program needs can be spread across several code files. When you execute a program, the operating system searches in these files for all the needed units.

In most other operating systems, the modules of a program must be stitched together by a link editor utility and stored in a single file before the program can be executed. In the p-System, this "stitching" step is unnecessary. This results in two important benefits.

The first benefit occurs when you make a change to a unit of a program and want to re-execute it to test the impact of the change. Because the p-System doesn't require a link editing step, you can immediately re-execute the modified program after recompiling the unit or units that you changed. The result: fast progress in the program development process.

The second benefit is that a collection of related programs can share a single copy of a unit. This sharing can produce dramatic savings in disk storage space, which is often a scarce resource when large application programs are used on small personal computers.

For very large programs with many units, the dynamic "stitching" that takes place when a p-System program is executed can take some time. This is not ideal when your only interest is in routine execution of a previously developed program. The most recent versions of the p-System include a way (called the Quickstart utility) to do most of the stitching once, when a program is readied for production use. Sharing of units among related programs can still occur under this scheme.

While the p-code of a program is being executed, it must be in main memory. Large programs frequently require more space than is available in main memory, so the p-System allows p-code to be broken into **segments.** Each segment only needs to be in main memory when p-code within it is being executed; otherwise, the segment can wait on disk until it is called upon.

These segment modules in the p-System allow you to run very large programs. If you want to develop such a program, all you need to do is designate the segment boundaries in your source program and recompile it. The compiler produces a code file that contains the segments you indicated. The details of marking segments vary with the language. In UCSD Pascal, for instance, the main program and every unit are independent segments by default. You can divide any of these modules into more than one segment by declaring **segment procedures.**

The strategies for deciding how a large program should be segmented are beyond the scope of this book. We can, however, mention one excellent candidate for segment treatment: the parts of a program that are used only when the program is starting or completing execution. When these "initialization" or "termination" parts of a program are independent segments, they are out of the way when not being used. Therefore, the main part of the program has more space for its work.

When a segment is in memory, it is stored in a **code pool**, along with other segments that have been used recently. When the amount of available main memory is 64,000 bytes or less, the code pool is maintained between two dynamically changing data areas called the "stack" and the "heap." This arrangement is shown in Figure 7.4(a). These data areas are used for variables that you declare in your program or for other storage it needs. The p-System operating system also uses some of this data space.

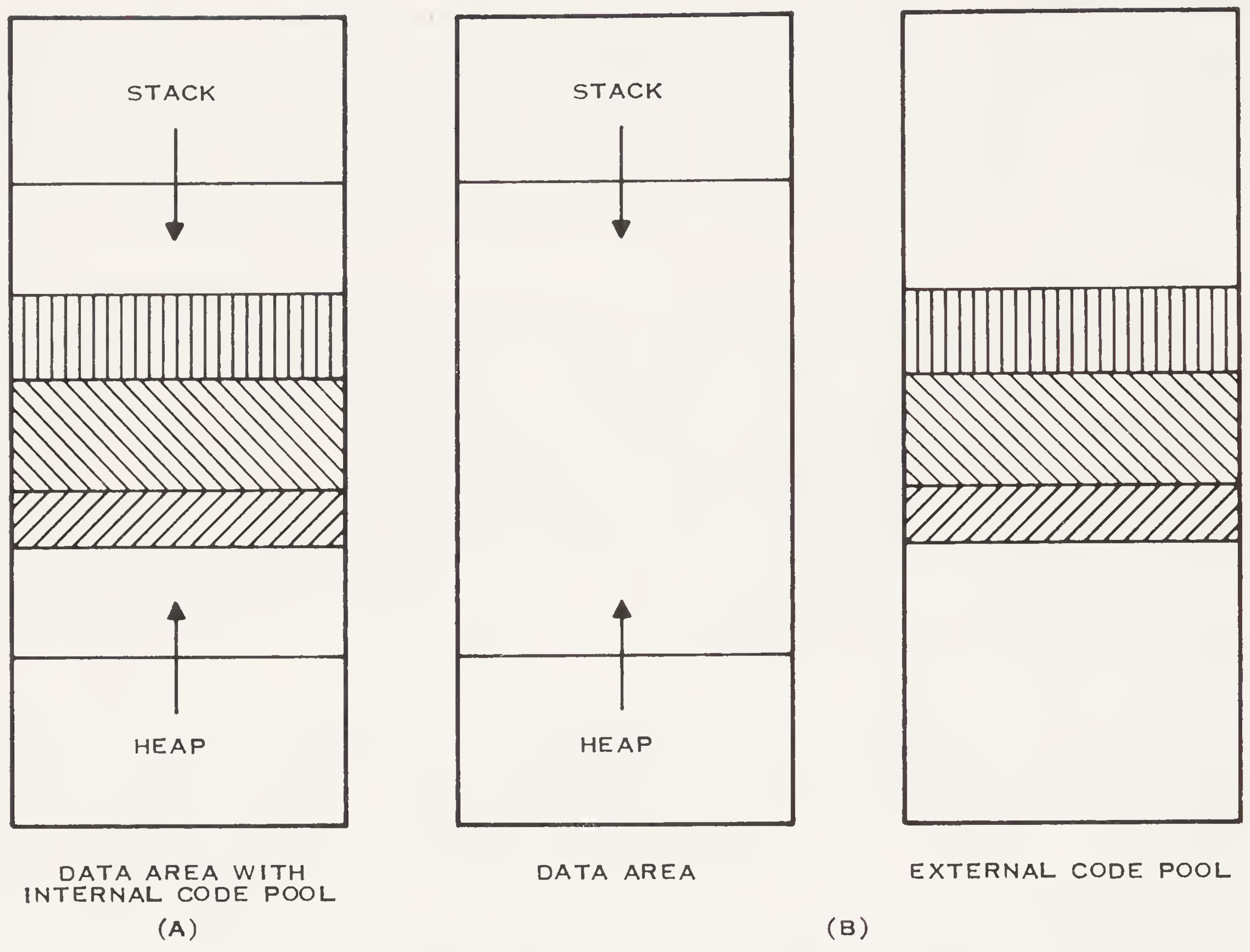


Figure 7.4

As the need for data space varies, the code pool can expand, contract, or shift to accommodate these changes.

As we mentioned above, a segment that is being actively executed must be in main memory. In addition, when one segment turns over control to another segment, both must be resident. Usually there is much more space available within the code pool than is required to meet these minimums. In this case, the p-System retains in the code pool as many of the most recently used segments as possible.

When more than 64,000 bytes of main memory are available, another arrangement for code and data storage is possible. In this **extended memory** configuration, shown in Figure 7.4(b), the code pool is stored outside the data area. This eliminates competition between code and data for memory space, and allows more room for both.

What are the implications of these code pool approaches to managing code segments? They are primarily of the "divide and manage" variety.

First, a program that runs on a computer with a small memory (say 64,000 bytes) can also run, without change, when the available main memory is doubled. When more memory is available, the program will probably run faster, because the segments needed by the program are frequently already in the code pool when required. This adjustment for different memory sizes is managed automatically by the p-System, without special programmer planning.

Second, and perhaps more important, this sophisticated handling of code segments allows much larger programs to be run in the p-System than would otherwise be possible on a given size of memory. No other microcomputer operating system that we know of provides as much assistance for running programs that are larger than the available main memory.

P-SYSTEM TOOLS AND PROGRAM BUILDING BLOCKS 8

The UCSD p-System was created to provide an excellent software environment for the development and execution of applications programs. The portability and modularity of this environment, as discussed in the previous chapter, make the p-System powerful and flexible toward this end. That chapter gave you some insight into the conceptual structure of the p-System. Here, we are more concerned with its components. These components fall into two general categories: tools and program building blocks.

A software tool is like a carpenter's tool; it allows you to build something—better and more easily—than you could without it. The Editor is an example of such a tool. With it you can create textual end products such as letters or books. A compiler is another tool. It allows you to create executable programs.

A program building block is a prefabricated module that you can use as an integral part of your programs. The p-System offers several general-purpose program building blocks that may greatly assist you in writing applications programs. They perform functions in such areas as screen control and file management.

We have divided this chapter into three sections:

- o Editing and Printing Tools
- o Program Development Tools
- o Applications Building Blocks

8.1 EDITING AND PRINTING TOOLS

The need for text editing is wide-spread and has many facets. You may want to write letters, memos, manuscripts, computer programs, poems, books, or other sorts of material. Within such text there may be paragraphs, columns, double-spaced lines, tables, or even special "pictures" made of ordinary characters placed all over the screen. You may want to save your text on disk so that it can be printed. Later you might want to change what you have created.

Once you have prepared your text, you may want to print it. Perhaps you would like it to appear on paper exactly as it does on the screen. Or, you might want to do some more elaborate things. For example, you may want to do page breaks at arbitrary places, use special form lengths, add running heads or page numbers, and so forth. Perhaps you will want to go beyond this and include proportional spacing, right margin justification, bold face printing, and so forth.

There are tools available with the p-System to perform all of these tasks. The first job, editing, is done with one of the p-System's three editors. These are the Screen-oriented Editor, the advanced editor (EDVANCE), and the line-oriented editor (YALOE).

Editing Text

The **Screen-oriented Editor** provides the standard facilities for creating, altering, and examining text files. All of the various kinds of line-oriented and paragraph-oriented material can be created with it. It is described in Chapter 5 so we won't go into any detail about it here.

EDVANCE is similar in many ways to the Screen-oriented Editor. It includes all of the standard Editor's activities and is used in about the same way. However, EDVANCE has additional capabilities which provide you with some more sophisticated editing techniques.

Perhaps the most important feature of EDVANCE is that it can work with much larger text files than the standard editor. This is because EDVANCE does not necessarily read an entire text file into main memory as the standard editor does. Part of the file being edited can remain on disk while the portion you are working on is in main memory. The memory buffer may "slide" forward or backward allowing you to move to any location within the file.

Another important feature of EDVANCE is that it allows you to give special "macro" definitions to as many as eight function keys. If your computer has keys that you can use for this, you may find this very convenient. You are able to assign a string of characters to any function key. Whenever a function key is typed, it reproduces those characters. If you are using I(nsert, for example, pressing a function key inserts the characters into your workspace. This might be convenient if you need to insert the same thing several times. The characters produced by a function key may also invoke editor activities. You can use this facility to perform all sorts of repetitive operations.

EDVANCE also has several additional activities. Many of these help to move the cursor easily. For example, you can, by pressing a single key, move the cursor from word to word, to the end of a line, to the top left corner of the screen, and so forth.

YALOE (Yet Another Line-oriented Editor) is designed for computers that have a printer console device rather than a screen. It is not nearly as sophisticated as the other two editors, but it is essential if you want to edit text on such a computer.

All of the editors store your text on disk in the form of text files. There are a variety of ways that these files may be printed as we describe next.

Printing Files

The simplest way to print a text file is to use T(ransfer (as described in Chapter 6). When you T(ransfer a file to the printer, it is printed exactly as it appears on the screen when you edit it. In most situations, this is not the best way to produce a final copy of your text because no special form lengths or page breaks are taken into consideration. However, when you want to quickly and easily print something, T(ransfer is a good mechanism. (Files containing compiled or assembled listings can be printed quite well using T(ransfer since they have their own pagination.)

The **Print** utility, provided with the p-System, is a very useful tool for producing many sorts of final copy output. It allows you to control page breaks, form length, headings (which can include the date, page number, and text file name), and more. You can even connect several text files together so that they are printed consecutively (and without a page break between them, if you want).

Print is especially good for items that need a professional appearance but don't require the same level of sophistication as large documents and books. Print works very well with letters, memos, small contracts, and so forth.

At the upper end of the printing spectrum are **text formatters.** Text formatters allow much more control over the printing process then the other methods we have mentioned. The printed page that you are now reading was, in fact, taken from the output of the Sprinter (tm) text formatter on a letter quality printer.

With text formatters you can <u>underline</u> text or cause it to appear in **bold face** on many printers. Several printers are able to do proportional spacing and many text formatters are able to handle this. Proportional spacing means that thinner letters, like "i," take up less horizontal space than wider ones, like "W." This causes the output to look as though it were typeset. If proportional spacing is not used, the output looks similar to what most typewriters produce.

Text formatters are also able to do right (as well as left) margin justification. Paragraphs that are right-justified line up exactly with the right-hand margin. This, of course, is how most books are printed.

There are many other things that text formatters can do. Pages can be numbered. Special headings and footings can be used. Some text formatters are able to automatically generate an index and table of contents. Sprinter even has an associated spelling checker which can help you to eliminate spelling errors in your text.

In order to use a text formatter you need to place special directives in your text files. These directives may indicate that you want to turn bold face on, indent the next line, do a page break if the next three lines don't fit on the current page, and so forth. The exact directives that are used depend upon the particular formatter.

When you have mastered the use of a good text formatter (along with the p-System's editing and file managing facilities), you are in a good position to do very powerful word processing!

Several text formatters are available to run with the UCSD p-System. See the *UCSD p-System Applications Catalog* or the USUS *Vendor Catalog* (described in Chapter 9) for further information.

There is another p-System tool that falls into the printing category: the **Print Spooler.** The Print Spooler is a facility that allows you to print text files at the same time that you are using the p-System for other activities. You can, for example, print a file while you are using the Screen-oriented Editor or the Filer.

It is possible to print a document using the Print Spooler with the level of sophistication that the Print utility offers. This is done by running the text through the print utility first, and sending the output to a disk file (instead of directly to the printer). Later, the Print Spooler can send that file (or several such files) to the printer.

To use the Print Spooler, you need to execute SPOOLER.CODE. This utility allows you to place the names of the text files to be printed in a first-in-first-out queue (called SYSTEM.SPOOLER). The utility also allows you to suspend, restart, or quit the printing at any point.

The printing process is performed by the operating system. If there are text file names in SYSTEM.SPOOLER, those files are printed in the order that they were placed there.

For many p-System activities, such as editing with the Screen-oriented Editor, the printing process goes on at a very reasonable rate and p-System response is normal. (At this writing, however, editing with EDVANCE should not be done in conjunction with print spooling.)

8.2 PROGRAM DEVELOPMENT

The p-System provides a wide array of tools to assist you in developing programs. This development process includes editing, compiling, debugging, and optimizing.

The editing phase involves using one of the p-System's editors to produce the program text. The compilers translate the program text into code which can be executed by the computer. The problem of debugging comes in when a program doesn't do what you intended. Optimization involves making correct programs run better (i.e., more quickly, consuming less memory space, and so forth). The next three sections discuss compiling, debugging, and optimizing programs with the p-System.

Compiling Programs

The p-System currently offers three compilers: UCSD Pascal, BASIC, and FORTRAN-77. Each compiler translates program text into p-code which can be executed within the p-System environment.

The **UCSD Pascal** language (the most popular with the p-System) is a somewhat extended version of standard Pascal. It is modularly structured for clarity and has many powerful features. These include programmer-defined variable types, powerful string and array operations, random access to files, 36 decimal digit arithmetic, 32 and 64 bit real arithmetic, separate compilation, and more.

The **FORTRAN-77** language is an ANSI (American National Standards Institute) subset of FORTRAN-77. Known for its scientific and arithmetic capabilities, the p-System's FORTRAN-77 language includes the If-Then-Else construct, a built-in character type, and all FORTRAN numeric intrinsic functions.

The **BASIC** available with the p-System is a compiled (rather then interpreted) language with an expanded syntax. It includes the If-Then-Else construct, optional line numbers, and virtual disk arrays.

These compilers can create programs or program modules. The **Library** utility can combine two or more compiled modules together. As we pointed out in Chapter 7, compiled modules, called units, can reside in separate code files known as libraries. When the host program is executed, the necessary units are found in the libraries. This provides a useful way of sharing the separately compiled modules among several programs.

The Library utility offers another approach. With it you can place the units directly into a host program's code file. Although this uses up more disk space if two or more program code files on a disk contain the same unit, it is convenient in many circumstances. For example, if all of the code for a particular program is in one file, that program can be easily moved from disk to disk, or from computer to computer. If, on the other hand, some of a program's code resides in libraries, you need to be certain that the correct libraries are always around when you move the program to another environment. Beyond this, the library utility is useful for placing several units into one file which can then be designated as a library.

Another p-System tool that you can use to create executable code is an **assembler.** Assembly language programming, while more tedious than higher-level programming, may be attractive to you in certain situations. The assembled machine code is directly executed by your computer's microprocessor. This means it is faster (although usually more bulky) than the p-code which the compilers produce. Also, low-level machine-specific programming can be done in assembly language. This is not possible from the higher-level languages. The p-System currently offers assemblers for all of these processors: 8080, Z80, LSI-11 / PDP-11, 6502, 6809, 9900, 8086/8088/8087, and 68000.

Assembly language routines can be called from Pascal, BASIC, or FORTRAN. The **Linker** (introduced in Chapter 4) is used to bind the assembled routines into the host (which may be a compiled module or another assembled module).

So, the compilers and assemblers, along with the Library utility and the Linker, allow you to create and combine executable programs and program modules.

Debugging Programs

To help you determine what might be going wrong with a program, the p-System provides several tools.

The **Debugger** is a very useful tool for interactively finding errors in programs written in UCSD Pascal, FORTRAN, or BASIC. In order to use the Debugger effectively, however, you need to have a good understanding of the internal details of the p-System.

Interactive debugging means that while your program is running, you can "interact" with it. You can stop it, look at what values are being assigned to variables, step through the code very slowly, and so forth. These kinds of things are often helpful in determining what might be going wrong with a program that you are developing.

With Pascal, the debugger can be used symbolically. This means that variables can be accessed by name (rather than by a numerical offset as they otherwise are). And break points can be specified by procedure name and line number (rather than by procedure number and p-code offset).

It is often essential to have a compiled listing of the code being debugged. This helps you keep track of where you are when you use the Debugger. A compiled listing also shows p-code offsets, procedure numbers, and other useful information that you need to successfully take advantage of the Debugger's capabilities.

Sometimes it is useful to have detailed information about the internal contents of a code file. However, to ordinary humans, the raw content of a code file is practically incomprehensible. Fortunately, the **Decode** utility can be used to "decode" this content so that it is quite a bit easier to understand. Probably, you will only want to view a code file at this level of detail if you are debugging a very complex piece of code and are very knowledgeable about the internal details of the p-System.

One thing the Decoder can show you is the executable p-code within a file. If you look directly at p-code with the Patch utility (which is described next), it appears to be a very strange collection of hexadecimal (base 16) digits. The Decoder displays the p-code in a more meaningful way called mnemonic form. In this form you can see the name of each individual p-code. The following two columns show the same piece of code in both formats:

Mnemonic Form	Hexadecimal Form
LDCB 50	8032
SRO 1	A501
CXG 3 1	940301
SLDO 1	30
LDC1 400	819001
EQUI	B0
FJP 4	D4F6
CXG 4 2	940402
RPU 0	9600

At first glance, mnemonic form may seem almost as difficult to comprehend as plain hexadecimal digits. Admittedly, it is not a trivial task to understand p-code in either format. However, when you know what each p-code operator does, mnemonic form is certainly easier to understand. (See Chapter 9 for further reading about the p-code operators.)

The Debugger has a simple decoder built into it for your convenience. It can display p-code in mnemonic form. But the Decoder utility, besides giving you a more informative listing, can print the mnemonic output so that you can easily reference it while you are debugging.

There is more to a code file than just the p-code itself. Sometimes there is an **interface section** which contains text. Also, since code files may be divided up into one or more **code segments**, the code segment names, sizes, and so forth, are stored in the code file. Sometimes a code file requires additional code from another file in order to run. In this case, very specific information about that separately compiled (or assembled) code is stored in the code file. All of this information may be of value to you and the Decoder can display it in an easily readable format.

The **Patch** utility offers another view of the internal structure of files. Although Patch can be used for purposes other than program development (for example, recovering lost files) it is often as useful here as the Debugger or Decoder. For example, if your program creates some sort of data file, and you suspect that something is incorrect within that file, Patch can be used to view its internal details.

Patch reads a block from the file and displays it on the console. This display can either be in hexadecimal notation (base 16, 0 through F), or in printable characters. You can move the cursor around this display and alter any values if you want. And, you can write the (presumably altered) block back out to disk. This sort of "patch" accounts for the utility's name.

Optimizing Programs

The p-System offers several tools and facilities to assist you in making programs efficient with respect to both execution speed and memory space requirements.

The modular design of the p-System is an important factor in memory space management. As discussed in the previous chapter, you can divide programs into segments. Large programs, which might not otherwise fit into a small computer's main memory, can be run if they are segmented. Also, the unit feature can be used for effectively managing disk space, since sharable code doesn't have to be duplicated.

The time/space tradeoffs between p-code and machine-level code can also be optimized. P-code (the compilers' output) is generally more compact than machine code. However, it is also slower.

A common rule of thumb is that 20% of the code is executed 80% of the time. In many programs, it is the case that some small portion of a program is significantly more time-critical then the rest. It makes sense, therefore, to translate that portion to machine-level code sacrificing some memory space in favor of noticeable execution speed improvements.

There are two ways that you can do this with the p-System. One is to write the time critical code by hand in assembly language. The other, much easier approach, is to use the **Native Code Generator.**

The code generator is a very powerful tool that translates portions of the p-code within a code file into machine-level code, more commonly called **native code.** It is easy to experiment with the code generator (translating different routines into native code and so forth) to determine the most optimal ways to use it on a particular application.

The code generator's output always contains a hybrid mixture of p-code and native code. This means that the resulting code file can only be executed within the p-System environment. (The assemblers can be used to create code that runs outside of the p-System environment, if that is desired.)

The **Quickstart** utility can be useful for making programs start more quickly. If a program is divided into a fairly large number of units, it may take several seconds, or tens of seconds, for it to start running. This is because of the **associate time** requirements. During associate time, tables of information concerning the program's units are set up. This information is needed so that the various pieces of code can be located when they are needed during the program's execution. With the Quickstart utility, these tables can be created for a program and stored in the code file so that association time is no longer a significant factor. As long as the libraries that contain the program's units remain unaltered and on the same disks, the tables are valid.

Another utility, called **Real Convert**, is useful for increasing the execution speed of certain programs which use floating point constants. Real Convert is helpful when a program contains code segments which are frequently swapped into and out of memory and which also have a large number of real constants. Normally, every time a code segment is read into memory, any real constants it contains must be converted from the machine-portable **canonical form** to the machine-specific **native form.** If there is a large number of real constants, this conversion process can slow down the program's execution speed. Real Convert changes the real constants in the code file to the native form for the processor in use when the utility is run. The resulting code file can only be run on that processor. For example, if you execute Real Convert while using a four word 8086 system, the real constants in the program's code file are converted from canonical form to four word 8086 form. This means that the code file will now only run on a four word 8086 system. (It should run more quickly, however.)

Another useful tool for helping to optimize (or even debug) Pascal programs is the cross referencer, **Xref.** Xref takes as input the text for a Pascal program. It produces a listing which contains several tables that may be an aid in program analysis. These tables give you information about which procedures call which other procedures, where variables are referenced, and so forth.

8.3 APPLICATION BUILDING BLOCKS

Although you could write your applications programs entirely from scratch, it is likely that you would be duplicating existing and available code in some areas. Furthermore, as the p-System continues to evolve, it is possible that you would have to upgrade some of that code whereas the standard applications building blocks are maintained by the p-System developers. So, it may be greatly to your advantage to use some of the applications building blocks that are covered here.

These building blocks are available in the form of pre-compiled units. They provide such services as controlling the screen in a portable fashion, managing disk files from programs, manipulating color graphics images, and more.

A few of these units reside within the operating system. The others must be placed in a library or your program code file (using the Library utility).

Operating System Units

The operating system, SYSTEM.PASCAL, has been discussed throughout this book. It is, of course, the core of the UCSD p-System and it contains a lot of code to perform its various tasks. Some of this code can be useful to applications programs and so it has been made generally accessible. In particular, there are portions of the operating system which facilitate screen handling, allow you to chain programs together, and help you to intercept certain kinds of p-System error messages and change them to fit your particular application.

One important thing that most applications programs must do is display information on the screen and retrieve user responses. When you write applications using the UCSD p-System, you will probably want to take this a step further and insure that your user interface is portable (as well as clean). This issue of portability could be a problem since there are so many types of computer terminals and displays, most of which have their own way of doing things.

Fortunately, the operating system's screen handling unit, **Screenops**, provides some very useful routines which are independent of the particular brand of hardware that an end user might have. Screenops includes routines which blank out a single line or clear the entire screen. There are routines to move the cursor in any direction or to place it at a specific location on the screen. If you intend to use the kind of menus and prompts that the p-System uses, there are routines that display them and help you to read the user's input (including the special control keys which vary from computer to computer). There is also some miscellaneous information which you can get at using Screenops (for example, the current date).

Another thing that you may want to do, as an applications developer, is create your own user-friendly environment. If you do this, it is convenient to be able to start up one or more programs from a central menu and later return. (SYSTEM.MENU, which is briefly introduced in Chapter 4, can be very useful in this context.) The **Commandio** unit within the operating system has some facilities that allow you to chain programs together. Chaining means that when one program finishes executing, another is started automatically (without the user having to enter something at the keyboard). For example, from a simple menu program, you can chain to other programs which the user selects. The routine that does this is called CHAIN.

Another routine within Commandio, called REDIRECT, allows you to redirect input and output in the same manner as execution option strings (see Section 4.17, page 180). This may come in handy in various situations. For example, you may want to save the user from needless troubles by automating a series of tasks. This might be done by redirecting your program's input (or the p-System's input) to a script file.

When you are creating your own user-friendly environment like this, there is another operating system unit which may be of some value. It is called **Errorhandler.** It allows your application programs to intercept execution errors and errors that can occur when a necessary disk has been removed from a drive. For example, if the user accidentally removes a needed disk from its drive, normally a message like this is displayed:

```
Need segment SEGNAME: Put volume VOLNAME in unit U then type <space>
```

But, your particular application could arrange for a more specific message to be used, for instance:

```
Please place the DB Manager disk back in its drive.  Then type space.
```

In order to compile a program which uses any of these units, you need to have available the code files Screenops, Commandio, or Errorhandler. This is because those files have the interface sections which are needed by the compiler. When you run such a program, however, only SYSTEM.PASCAL needs to be available since the code for these units resides there (without the interface sections).

File Management Units

You have seen how the Filer handles disk files in this book. You may want to do the same sort of file managing directly from your applications programs. The Filer is an ordinary program, and your programs can do the same things that it does. However, it is not a trivial programming task to implement the Filer activities. So, there are four units that have been made available and are known as the **File Management Units.**

One of these units, called DIR.INFO, helps your programs to access disk directories. It allows you to list directories, change file names, change the date of a file or volume, remove a file, and several other tasks.

Another unit, FILE.INFO, can be used to gain information about particular files. With it you can see if a file is open or not, find its length, determine what volume it is on, and so forth.

The third unit, SYS.INFO, allows you to access information which is stored globally in the p-System. For example, you can determine what the name of the work file is, find out the name of the system disk, change the internal p-System date, and more.

Finally, a unit called WILD provides some wild card facilities that can be used with the other File Management Units. These wild cards are similar to those used by the Filer. For example, using the equal wild card like this:

```
    =.TEXT
```

you can use DIR.INFO to get a list of all text files on a certain volume.

Xenofile

Xenofile is a facility which allows users of the UCSD p-System to access CP/M disk files. It consists of three units (one for Pascal, BASIC, and FORTRAN). Each unit provides several CP/M functions to p-System programs.

For example, your p-System programs can open, close, delete, create, and rename CP/M files. They can read and write records to and from such files. They can handle the CP/M file control blocks. They can write-protect CP/M disks. And, there are several other such functions which you can use from your p-System programs.

Xenofile also includes a utility program which acts as a simple CP/M "filer." With it you can display a CP/M directory and transfer text files between a p-System disk and a CP/M disk.

KSAM

KSAM is a file management system which allows programs to store and retrieve data in a keyed or sequential fashion. It is especially useful for developing such applications as data base managers, reservation systems, inventory control programs, and so forth.

For example, using KSAM, you can create a file of names, addresses, and zip codes. This file can be maintained so that all of the entries are in alphabetical order according to last name. You can then access individual entries sequentially (going from the names that start with "A" to the ones that start with "Z"). Or you can access any entry randomly by using a specific key (in this case, a particular last name).

Furthermore, you could sort this same example file in zip code order. You might do both if you want to insert and delete random entries according to last name, and then print out all entries on mailing labels according to zip code.

KSAM is designed to access files efficiently so that it is practical for you to maintain large files if necessary.

The main part of KSAM consists of two units. The main unit performs various functions with respect to a primary key. The second unit allows you to have as many alternate keys as you need. There are two additional units which allow KSAM to interface with BASIC or FORTRAN. These last two units are not necessary if you are using Pascal.

Turtlegraphics

Many computers are able to display graphic images on their screens. This means that all sorts of figures, charts and graphs can be created. The Turtlegraphics unit can help your programs to display these sorts of things if your computer hardware supports graphics.

Turtlegraphics is so named because it uses the concept of a turtle which moves across your screen leaving a trail as it goes. You can tell the turtle to move a given distance in a given direction. Or, you can tell it to move to some specific location. In either case, as it moves, it leaves its trail if you want it to. The trail may be in various colors if your hardware allows. The trail can appear to be over, under, or on the same level as other portions of the figure being created. Although the trail is always a straight line, circles and other curves can be "drawn" by programmatically moving the turtle very short distances and slightly changing the direction each time.

Once a figure has been created, the turtle can rest. The resulting work of art may be stored in a .FOTO file on disk. It can be loaded and displayed again at any time. Several figures may be displayed on the screen at the same time. They can be placed in various locations and can appear to be over, under, or on the same level as each other when they intersect.

On some computers, Turtlegraphics is already configured and ready to use. In other cases, you must install the

Turtlegraphics package in order to use it. This involves writing some assembly language routines that are specific to your hardware. These routines perform the basic tasks of setting a point to a particular color, drawing a line segment, and so forth. Turtlegraphics builds upon them to provide higher level services to your p-System programs.

FURTHER READING 9

This book is not a complete description of the p-System since that would have required thousands of pages of text. In this short chapter we indicate some of the other sources of p-System information that are available. Two important sources are SofTech Microsystems (SMS), and the UCSD p-System User's Society (USUS). SMS can be contacted at:

SofTech Microsystems, Inc.
16885 West Bernardo Drive
San Diego, California 92127
(619) 451-1230

USUS may be contacted at:

USUS
P.O. Box 1148
La Jolla, California 92038

9.1 p-SYSTEM REFERENCE MANUALS

SofTech Microsystems publishes a series of reference manuals which serve as the formal descriptions of the p-System. Many p-System suppliers simply provide these manuals with the p-System software. Some suppliers, however, choose to rework these manuals into their own formats.

The IV.1 documents that are currently distributed by SMS are described next (in the first subsection). There are many of the older IV.0 and IV.1 manuals already in circulation; these are described in the second subsection.

Current Version IV.1 Documents

Operating System Reference Manual

This document describes the aspects of the p-System that are of interest to all p-System users (non-programmers as well as programmers). It covers the following topics:

- Operating System
  - Menus and Prompts
  - Command menu items
  - Execution Option Strings
  - Redirection
- File Management
  - File names and types
  - Devices and volumes
  - Recovering files
  - Workfiles
  - Subsidiary volumes
  - User-defined serial devices
  - Filer menu items
- Screen-oriented Editor
- Utilities
  - Print
  - Print Spooler
  - Quickstart
  - Real Convert
  - Setup
  - Copydupdir
  - Markdupdir
  - Recover
  - Library
  - Disksize

Program Development Reference Manual

This document covers tools and general principles of p-System program development. The various programming languages are not described here. The following topics are covered:

- Pascal Compiler
  - Using the compiler
  - Compiler options
  - Selective USES
- User Interfacing From Programs
  - SYSTEM.MENU and SYSTEM.STARTUP
  - Program chaining and redirection
  - Screen handling unit
  - Error handling unit
- File Management units
- Turtlegraphics
- Native Code Generator
- Debugger
- Utilities
  - Decode
  - Patch
  - Xref

Assemblers Reference Manual

This book addresses the p-System assemblers, the Linker, and the COMPRESS utility. These specific topics are covered:

- Assembler Directives
- Macros
- Linking and Relocation
- The Compress Utility
- Using the Assembler
- Assembler Listings
- Processor Specific Information

8086 Assembler Reference Manual

This book is equivalent to the assembler manual, above, except it concentrates on the 8086/8088/8087 processors. It contains additional information concerning the 8086 family opcodes, registers, and flags.

Internal Architecture Reference Manual

This book describes various aspects of the internal workings of the p-System. The following topics are addressed:

- P-machine Architecture
  - Stack / Heap
  - Code Pool
  - Code Segments
  - Task Environments
  - P-code Operators
- Low-Level I/O
  - Runtime Support Package (RSP)
  - Basic I/O Subsystem (BIOS)
- Operating System Internal Details
- Program Execution Internal Details

Adaptable System Installation Manual

Detailed directions for installing the Adaptable System are presented in this book. The Adaptable System packaging of the p-System allows you to adapt the p-System to the input/output conventions of your computer. Sophisticated assembly language programming is required. (It is usually preferable to acquire a p-System that has already been adapted to your computer. See the **Implementations Catalog** described in Section 9.2.) The following topics are addressed:

- Bootstrapping
- Terminal Handling
- Simplified BIOS (SBIOS)
- Utilities
  - Booter
  - Diskchange
  - Screentest

FORTRAN-77 Reference Manual

This book is the reference for the the p-System implementation of FORTRAN-77.

BASIC Reference Manual

This book is the reference for the p-System implementation of BASIC.

Optional Products Reference Manual

This book is actually a collection of several independent manuals. These manuals describe tools and program building blocks that are not necessarily part of the standard p-System. Currently, the following optional products are covered:

EDVANCE
KSAM
SofTeach
XenoFile

Original Version IV.0/IV.1 Organization

Users' Manual

This is the principal reference for the the p-System, version IV.0. It covers the topics that are addressed in the current "Operating System Reference Manual", "Program Development Reference Manual", and the "Assembler Reference Manual".

Installation Guide

This book is equivalent to the current "Installation Reference Manual."

Internal Architecture Guide

The book is equivalent to the current "Internal Architecture Reference Manual."

FORTRAN-77 Reference Manual

This book is the reference for the p-System implementation of FORTRAN-77.

BASIC Reference Manual

This book is the reference for the p-System implementation of BASIC.

Users' Manual Supplement

This book describes the additional facilities available with the IV.1 release of the p-System. It augments, but does not replace, the IV.0 manuals.

9.2 p-SYSTEM CATALOGS

The first two catalogs described in this section are published by SofTech Microsystems on a periodic schedule (approximately every six months). The third catalog is part of the UCSD p-System User's Society (USUS) periodic newsletter.

UCSD p-System Applications Catalog

This book describes hundreds of software packages that are compatible with the p-System and offered by independent software distributors. For each program, the distributor, price range, and brief functional description are provided. Names and addresses of distributors are also included.

UCSD p-System Implementations Catalog

If you don't have the p-System for your computer, this book may tell you how to get it. It lists distributors of adaptations of the p-System for various manufacturers' computers (personal and otherwise).

USUS Vendor Catalog

This catalog is part of the USUS newletter and lists vendors of p-System applications and other p-System-related products.

9.3 BOOKS ON PASCAL AND UCSD PASCAL

UCSD Pascal Handbook, Randy Clark and Stephen Koehler (Prentice Hall, New York, 1982)

Indispensable if you're programming in UCSD Pascal. Includes a full reference description of the UCSD Pascal language, along with a series of tested example programs that illustrate many useful UCSD Pascal programming techniques.

A Practical Introduction to Pascal, I.R. Wilson and A.M. Addyman (Springer-Verlag, New York, 1979)

Concise and readable treatment of the entire Pascal language. Not ideal for the novice programmer. Does not address UCSD Pascal extensions.

Pascal: an Introduction to Methodical Programming, William Findlay and David Watt (Computer Science Press, Potomac, Maryland, 1978)

One of the better tutorial books on Pascal and structured programming.

Doing Business with Pascal, R. Hergert and D. Hergert (Sybex, Berkeley, 1983)

Describes the use of UCSD Pascal for business application programs. Stresses the importance of the UCSD Pascal unit construct and its modularity benefits. Case studies and ready-to-run programs illustrate advanced UCSD Pascal programming techniques.

ERROR MESSAGES FOR MAJOR ACTIVITIES

A

This appendix summarizes the error messages produced by the activities of the Operating System, the Filer, and the Editor. Each error is discussed, and potential diagnoses and recovery actions are listed.

In many cases, only the meaningful part of the error message is listed here. Often, when displayed on the screen, this is preceded by the word "ERROR:" or perhaps followed by a phrase like one of these:

```
Type <spacebar> to continue, <esc> to abort.
Do you wish to continue (Y/N) ?
```

When you understand the nature of the particular error, the remaining part of the message should be clear.

A.1 OPERATING SYSTEM ERRORS

A(ssemble

Cannot find SYSTEM.ASSMBLER: That file is not present on any on-line volume. If it is present, the file is corrupted.

xxxx.OPCODES not on any volume: The "xxxx" is a processor name (such as Z80 or 8086). This opcodes file is necessary in order to run the assembler. The file was not found on any on-line volume.

Can't find VOL:WORKFILE.TEXT: The text file that you indicated is not present. Or, if you didn't indicate a text file, at some point you had a workfile which is no longer on-line. You may have R(emoved the workfile without doing a N(ew. Or, the disk containing the workfile may not be in the proper drive.

Can't open VOL:FILE.CODE: The code file that you indicated can't be opened because the volume is not on-line, or the file name that you gave is incorrectly specified, or there is no room on the disk. If you are using a workfile, there is no room for SYSTEM.WRK.CODE on the system disk.

Syntax errors: The assembler, itself, displays errors if your text does not conform to the correct syntax of the assembly language. These errors are not covered in this book.

C(ompile

Cannot find SYSTEM.COMPILER: That file is not present on any on-line volume. If it is present, the file is corrupted.

Can't find VOL:FILE.TEXT: The text file that you indicated is not present. Or, if you didn't indicate a text file, at some point you had a workfile which is no longer on-line. You may have R(emoved the workfile without doing a N(ew. Or, the disk containing the workfile may not be in the proper drive.

Can't open VOL:FILE.CODE: The code file that you indicated can't be opened because the volume is not on-line, or the file name that you gave is incorrectly specified, or there is no room on the disk. If you are using a workfile, there is no room for SYSTEM.WRK.CODE on the system disk.

Syntax errors: The compilers display errors if your text does not conform to the correct syntax of the language being compiled. These errors are covered in Appendix C.

D(ebug

No debugger in system: The Debugger units have not been placed in SYSTEM.PASCAL. (This must be done by using the Library utility.)

E(dit

Cannot find SYSTEM.EDITOR: That file is not present on any on-line volume. If it is present, the file is corrupted.

Workfile lost: At some point you had a workfile which is no longer available. You may have R(emoved the workfile without doing a N(ew. (You can simply enter the Filer and select N(ew if this is the case.) Or, the disk containing the workfile may not be in the proper drive.

Buffer overflow: The file you are trying to load is too large to fit into your workspace in main memory. You can edit it, but only the first part of the file is available. You should **not** save the workspace under its old name; if you do, you lose the portion of the file that did not fit into memory.

Error reading file (or) Disk error: The file can't be read into the workspace. There may be a bad block or the disk may have been removed in the middle of the reading process.

Unable to allocate buffer: If your computer has a very limited amount of main memory, this error indicates that you can't use the Screen-oriented Editor because there is not enough room to hold a workspace.

Editor activity errors: There are errors that can occur while you use the Editor. These are covered later in this appendix.

Screen problems: If the Editor doesn't display material on the screen properly, or if the cursor movement keys don't work, the file SYSTEM.MISCINFO has not been properly configured using the SETUP utility, or the GOTOXY unit within the operating system is not correct for your console. You should run the Screentest utility to verify that screen handling is functioning properly on your terminal.

F(ile

Cannot find SYSTEM.FILER: That file is not present on any on-line volume. If it is present, the file is corrupted.

Filer activity errors: There are errors that can occur while you use the Filer. These are covered later in this appendix.

L(ink

Cannot find SYSTEM.LINKER: That file is not present on any on-line volume. If it is present, the file is corrupted.

No file FILENAME.CODE: The file that you indicated as a host file or lib file doesn't exist on the expected volume.

All segs linked: Your host file does not have any references to external assembly language routines. Or, if it does contain such references, those routines have already been linked into it.

Code open error: The file that you indicated as an output file can't be opened. The name may be incorrect (e.g., too long), the volume that you specified may not be on-line, or there may not be enough room on the volume for the file.

Code write error: The output file could not be created. There may not be enough contiguous disk space on the volume to hold the resulting file. Or, a bad block may exist where the file was being created.

M(onitor

No monitor open: When you leave the monitor using R(esume, this warning says that you have not designated a disk file to hold your keystrokes and therefore monitoring is not being done.

Can't open file: The script file that you indicated with B(egin can't be opened because you used an illegal file name, or the volume you specified is not on-line, or there is no room on the volume.

File already open: You attempted to use B(egin to open a new script file, but you had already used B(egin and a file is already open. You must use E(nd or A(bort on the current script file before you can use B(egin again.

Can't close file: You selected E(nd to save your script file, but that file can't be closed. You may have removed the disk that contains the file.

U(ser-restart

U not allowed: You can't restart the last program for one of several reasons: you just reinitialized (perhaps after an execution error); the last program failed to start (e.g., because it wasn't found); the last program was the C(ompiler or A(ssembler, which can't be restarted.

X(ecute

Illegal file name: The file name you entered is not a valid name. Check the actual name of the program you want to invoke, and try again.

No file FILENAME.CODE: The file that you indicated wasn't located on the indicated disk, or that disk isn't on-line. (If you didn't specify a disk, then this applies to the prefix disk even though its volume name isn't included in the message.)

No program in FILENAME.CODE: The file that you indicated doesn't contain an executable program. It may be a unit (which can't be run by itself). Or, it may not be a code file at all. If it does contain a program, the file is probably corrupted.

Redirection error: You made a mistake while using execution option strings. This may be a mistake in the syntax of the execution option string, itself. Or, an input (or output) file that doesn't exist or can't be opened may be the problem.

FILENAME.CODE is not a code file: The file you indicated is not of the CODE type, and therefore can't be executed.

Error reading (or rereading) segment dictionary (or program code file): The program file you indicated could not be read successfully. The file may contain a bad block.

Error reading library code file (or library LIB.NAME.CODE): A library file referenced by the program you invoked was not readable.

I/O Error reading library list file FILE.NAME.TEXT: The file containing the current list of libraries could not be read. Perhaps you made a mistake in specifying the file with the "L=" execution option. Try using the Editor or the Filer to check that the library text file you intend to use is valid; then use "L=" again to designate it.

Library list file FILE.NAME is not a text file: Try designating the library text file again, after confirming with E(xtended list directory that it is indeed a text file.

Warning: Library LIB.NAME.CODE not found: The named file occurs in the current library text file, but cannot be found. Processing continues, since the program being invoked may not need anything in the missing file.

Unit UNITNAME not found: The named unit is required for execution of the program you indicated. Unfortunately, this unit cannot be found by the p-System. Perhaps you didn't set up the library text file properly, or perhaps you made some other error in preparing the program for execution.

Duplicate unit UNITNAME: There is more than one instance of the named unit in the program being invoked, or perhaps there is a clash between the names of a unit in the program (or a library file) and a unit in the operating system.

Program must be linked via L(ink: The program being invoked contains unsatisfied references to assembly language routines. You must use L(ink before this program can be executed.

Segment SEGNAME is an obsolete code segment: The named segment was produced in an earlier and incompatible version of the p-System. The program that contains it must be recompiled with the current p-System version.

Too many library code files (or system units) referenced: The limits on the number of library code files (or the number of operating system units referenced) have been exceeded.

Program environment too complicated: The number of units used by the program and the complexity of their relationships mean that this program can only be executed after being processed by the Quickstart utility.

Environment construction error: An unknown error occurred while the program was being prepared for execution. The cause may be a flaw in the p-System's program invocation mechanism.

Insufficient memory to construct environment: You may be able to improve this situation by coalescing or removing libraries from the library text file list.

Insufficient memory for environment: The program is too complicated to run in the main memory available.

Insufficient memory to allocate data segment: The data storage needed for the program or one of its units is too large. This program cannot be run in the current memory configuration.

Insufficient memory to load fixed-position segment: The program contains or references an assembly language segment that must be loaded throughout execution of the program. There is not enough room to load it; therefore, this program cannot be executed in the current memory configuration.

A.2 EDITOR ERRORS

A(djust

Bell beeps when [[esc]] is typed: You can't exit A(djust with [[esc]]; you must use [[etx]].

Bell beeps when other keys are typed: You can't use any alpha-numeric keys or cursor movement keys except the ones which are indicated on the A(djust prompt.

C(opy

Buffer overflow: There is not enough room in your workspace to hold what you are attempting to copy into it (either from the copy buffer, or from a file).

File not present: The file from which you wanted to copy text is not on the indicated disk.

Marker not there: You are attempting to copy text from a disk file using markers. But, one of the markers that you indicated doesn't exist in that file.

Improper marker specification: You did not correctly indicate two markers, separated by a comma, between square brackets.

Disk error (or) Bad disk transfer: Text in the disk file can't be correctly read. There may be a bad block or the disk may have been removed.

Marker exceeds file bounds: Something is wrong with the marker in the disk file. It indicates a position that is outside of that file. The disk file is probably corrupted.

D(elete

Bell beeps when characters are typed: You can only use the cursor movement keys in D(elete.

There is no room to copy the deletion: The amount of text that you are trying to delete can't be placed in the copy buffer. You may go ahead and delete it, but if you do, you can't copy it back into your workspace later.

F(ind

Invalid delimiter: You did not use a correct delimiter (which must be a special character such as "," or "/") before starting to enter your target string.

Pattern not in the file: The sequence of characters that you entered, or the n'th occurrence of it (if you used a repeat factor) does not exist in your workspace.

No old pattern: You attempted to use the "same" option by entering "S" instead of a delimited sequence of characters. But, you have not yet used F(ind or R(eplace since starting the current editing session so there isn't an existing pattern.

I(nsert

You are about to discard more that 80 characters: You have inserted more than 80 characters and then pressed [[esc]]. This warning informs you that your insertion is going to be discarded if you go ahead and exit I(nsert with [[esc]]. You may, instead, return to I(nsert.

No insertion to back over: You have attempted to erase characters that you did not insert since starting the current I(nsert activity. Either you used [[bs]] one time too many, or you used [[delete line]] on the first line of the insertion.

Please finish up the insertion: There are less than 1000 characters of available space in your workspace and every time you start an insertion this is displayed. You should consider breaking up the file if there is very much material that you still need to add. S(et E(nvironment informs you exactly how much space is left.

No room to insert: There is no remaining space (or almost none) within your workspace and the Editor will not allow any more text to be added. **You should never push the Editor this far!**

Buffer Overflow!!!!: You added more text to your workspace than it can hold. You have now lost something off the end of your workspace.

J(ump

Not there: The marker that you indicated is not present within the workspace.

K(ol

Bell beeps when ⟦esc⟧ is typed: You can't exit K(olumn with ⟦esc⟧; you must use ⟦etx⟧.

Bell beeps when other keys are typed: You can't use any alpha-numeric keys or cursor movement keys except the ones which are indicated on the K(olumn prompt.

M(argin

Inappropriate environment: M(argin can't be used because A(uto indent is not false or F(illing is not true within S(et E(nvironment.

Q(uit

ERROR writing out the file: You used Q(uit U(pdate or Q(uit W(rite but the workspace can't be saved on disk for one of several reasons: there is not enough room on the disk; the volume where the file is to be saved isn't on-line; you indicated a syntactically incorrect file name. (This is all described in detail in Chapter 5 in the section "Leaving the Editor.")

R(eplace

Pattern not in the file: The target doesn't exist in your workspace, or the n'th occurrence of that target doesn't exist when repeat factors are used. If the target does exist, it may be that the direction indicator is not set as you thought.

No old pattern: You attempted to use the "same" option with either the target or the substitution string (by typing

"S" instead of delimited strings). But, you have not used R(eplace since starting the current editing session and there isn't any "same" pattern.

Buffer full. Aborting Replace: There are less than 200 characters remaining in your workspace and R(eplace won't allow you to make any more substitutions (since they may add to the size of the workspace).

S(et E(nvironment

T or F: If you do not respond with a "T" or "F" to a true/false option you receive this prompt. You should then enter either "T" or "F."

#: If you don't respond to a numeric S(et E(nvironment option with a number, you receive this prompt. You should then enter a numeric value.

S(et M(arker

Marker ovflw. Which one to replace?: You have already set 20 markers in your workspace. You must throw one away if you want to set another.

X(change

Buffer is filling up... watch it!: The workspace is nearly full (less than 128 characters remaining). Be very careful since X(change can add characters to your workspace. You should probably break up the workspace into two or more files before you continue editing.

Z(ap

You are about to zap more than 80 chars: This warns you that more than 80 characters are about to be deleted if you follow through with the Z(ap activity. (It is easy to accidentally type "Z" and that is why the warning is given. If you do accidentally Z(ap something, you can usually copy it back using C(opy B(uffer.)

There is no room to copy the deletion: The amount of text that you are trying to Z(ap can't be placed in the copy buffer. You may go ahead and Z(ap that text, but if you do, you can't use C(opy B(uffer to get it back into your workspace later.

Invalid ZAP: You can't do Z(ap twice in a row or this error occurs. Also, you may not have done a F(ind, R(eplace, or I(nsert in the current editing session.

A.3 FILER ERRORS

In this section, the Filer error conditions are listed and explained. In the errors that apply to files or volumes, you will often see <source> or <dest>, for example:

```
List what vol ? PRINTER: ⟦ret⟧
PRINTER: Unblkd vol, File/(blkd vol) expected <source>
```

```
Transfer what file ? #4: ⟦ret⟧
To where ? #100: ⟦ret⟧
Transfer 320 blocks ? (Y/N) Y
Put in #100:
Type <space> to continue
#100:[320] - No such vol on-line <dest>
```

"<Source>" refers to the file or volume that the activity uses as its input. (In the first example, the volume to be listed, the source, was incorrect.) "<Dest>" refers to the file or volume where the activity sends its output. (In the second example, the destination for the T(ransfer operation was incorrect.)

There are many errors which can occur in almost any Filer activity. Rather than cover them repeatedly under each activity, we summarize them here.

Bad file name: The file name that you used was not syntactically correct.

Bad form (Wild <to> Non-Wild) card: With a Filer activity that requires an input and output file, you attempted to use a wild card on only one side.

Bad I/O operation: You attempted to do an I/O transaction which can't be done. For example, it is not possible to T(ransfer something **from** the printer.

Bad unit number: You used an incorrect device number.

FILENAME..too long <file name 15-char. max>: The file name you entered contains more than the 15 character maximum that is allowed.

File not found: The file that you indicated does not exist. Perhaps you gave the wrong volume name. Or, you may have forgotten to use the file name suffix (such as .TEXT or .CODE) in a situation where it is required.

Ill file/vol name: You used a file or volume name which is syntactically incorrect. This message can occur in several error messages.

No directory on vol: The storage volume that you are trying to access does not contain a p-System directory. Perhaps it has not been Z(eroed.

No room on vol: This error indicates that you are attempting to add a file to a storage volume, but there is not enough contiguous disk space to hold it.

No such vol on-line: The volume that you indicated is not present. Perhaps you removed the disk from its drive, or used the wrong name. If you receive this error while using the Z(ero activity, you may need to format the disk before you Z(ero it.

Parity (CRC) error: This indicates that an I/O error occurred during a disk read or write or a communication volume transaction. The disk may have bad blocks or you may have removed it in the middle of the operation. The communication volume may not be functioning correctly.

Unblkd vol, File/(blkd vol) expected: This sort of error can occur in various combinations and permutations. "Unblkd vol" refers to unblocked volume (or communication volume). "Blkd vol" refers to blocked volume (or storage volume). The message indicates that you incorrectly specified a communication volume when a file or a storage volume was required. If, for example, you attempt to L(ist PRINTER: you receive this message (since communication volumes don't have directories).

VOLNAME..too long <vol name 7-char. max>: The volume name you entered contains more than the 7 character maximum that is allowed.

Vol went off-line: A volume which was on-line when the activity began is no longer present. Perhaps you removed a disk from its drive.

Wildcard not allowed: You attempted to use a wild card in a situation where the Filer does not allow it. For example, you can't designate more than one workfile, so wild cards are not allowed with G(et.

B(ad blocks

Invalid #: When responding to the "Scan for how many blocks" prompt, you entered an incorrect number (such as 0).

C(hange

Ill change (Vol <to> file) name: You attempted to change a volume name to a file name (or a file name to a volume name). You may have forgotten to include the colon after a volume name.

Vol already on-line: You attempted to change the name of a volume to the name of another volume which is currently on-line. The p-System doesn't allow this because confusion can result when two volumes with the same name are on-line at the same time. (You should always try to avoid this situation!)

Flip swap/lock

Not enough memory: Your computer does not have enough main memory to contain the entire Filer. You are unable to use this activity.

G(et

No file loaded: You incorrectly indicated the file you want to designate as the workfile. You probably specified a file that doesn't exist.

K(runch

Invalid #: You indicated an inappropriate block number (such as a negative number) in response to the "Starting at block #" prompt.

Please re-boot: The K(runch activity moved SYSTEM.PASCAL and/or SYSTEM.FILER on the system disk. The p-System can't gracefully recover from this situation and requests that you bootstrap again.

M(ake

Nested subsidiary volumes are not permitted: You attempted to create a .SVOL file within a subsidiary volume. Subsidiary volumes can't be created within other subsidiary volumes.

O(n/off-line

FILE —> NOT mounted: The file that you indicated can't be mounted. Perhaps it is not a correct .SVOL file. Or, if it is correct, you may have already mounted as many subsidiary volumes as you can on your configuration. (If this is the case, you can dismount one of the subsidiary volumes that is already mounted. Or, you may be able to use Setup to increase the maximum number of subsidiary volumes that are allowed to be mounted at one time.)

S(ave

No workfile to save: You don't presently have any workfile and so S(ave doesn't do anything.

Workfile is saved: You already have a permanent workfile and no temporary version of it exists. Therefore, S(ave does nothing.

Text file lost or **Code file lost:** Your text or code workfile can't be saved because it can't be found. You may have R(emoved SYSTEM.WRK.TEXT or SYSTEM.WRK.CODE without doing a N(ew or S(aving them first. Alternatively, the system disk may be out of its drive.

T(ransfer

Output file full: There is not enough contiguous disk space to complete the T(ransfer. This error is similar to the "No room on vol" message which can also be issued by T(ransfer.

X(amine

No room on vol: If this error occurs within X(amine, it indicates that there is not enough disk space (or there are already too many files) to create the BAD.xxxxx.BAD file.

Z(ero

Invalid #: You indicated an incorrect number of blocks for the size of the new volume.

EXECUTION ERRORS

B

This appendix describes errors that can be detected and reported by the p-System while a program is running. Two categories of errors are addressed: 1) errors that can occur in any p-System program, and 2) errors that can only occur in a program written in FORTRAN. A section of the appendix is devoted to each of these categories.

Most of these errors are reported in the manner described in Sections 1.7 and 3.7, with the error message at the bottom of your screen. For the p-System errors, a textual error message, such as "Program interrupted by user," is provided if possible. If the system disk is not available, or if there is insufficient main memory available when the error occurs, an error number replaces the textual message. Both the number and the message are given for the errors listed in this appendix.

Your direct response to any of these errors will probably be to press [[space]] (once you have absorbed the error message, and possibly written down the details for later reference). The program that was executing will then be cancelled, and the p-System will reinitialize itself (to correct any damage that might have been done as a result of the error).

Some of these errors may be detected by an application program and handled by it (possibly with your assistance). For instance, if an application program asks you to specify a disk file for it to process, it may determine that the file you specify does not exist. After informing you of the problem, the program usually gives you a chance to specify a file that does exist. This approach is used by the major p-System components. Many of the error messages listed in Appendix A result from the detection of an error described in this appendix.

For each of the p-System errors, we provide some diagnosis and recovery advice. Your response to an error will probably depend on whether it occurs in a program that you are developing yourself, or in an application program that you have acquired. In the latter case, you should make a note of the error coordinates that occur in the execution error message, and contact the supplier of the application for assistance. In some cases, however, there may be simple things you can do differently when you next use the program to avoid an execution error. If so, we have tried to anticipate and describe them. Since there are so many different circumstances in which execution errors can occur, our diagnosis and recovery advice in this appendix is not comprehensive. We believe it will be useful to you, nevertheless.

B.1 p-SYSTEM EXECUTION ERRORS

The first subsection describes the general execution errors that can occur. One of these (#10) is used whenever a program has a problem that involves input/output (I/O) activities (writing information onto a disk, for instance). Since there are so many kinds of I/O errors, these are treated separately in a second subsection.

General Execution Errors

#0—System error: The operating system has detected an internal inconsistency. There is no effective recovery action you can take. You must simply reboot the p-System.

#1—Value range error: A program attempted to use a number that is either larger or smaller than it should be. You may have made a request of the program that it isn't prepared to handle.

#2—No proc in seg table: A program attempted to call a procedure that does not exist. One possibility is that the program references external routines, but the necessary link editing step was not done to install those routines.

#3—Exit from uncalled proc: An invalid attempt was made to use the EXIT procedure in UCSD Pascal. An EXIT call names a procedure which is to be "exited." During this EXIT attempt, the named procedure could not be found, so the EXIT was impossible to perform. This is probably an error in the program.

#4—Stack overflow: The p-System has run out of main memory. Possibly this program is fundamentally too large to run in your configuration. Alternatively, you may have asked it to perform a task that requires more memory than you have. In this latter case, you may still be able to use this program, as long as you are more modest in your demands of it. You might consider changing the configuration of your p-System to make more memory available. For instance, if you have the Print Spooler installed, memory is occupied even if you aren't using the Spooler.

#5—Integer overflow: An arithmetic calculation has been attempted that would have resulted in a number larger than the p-System can handle. This is probably an error in the program.

#6—Divide by zero: An attempt has been made to divide by zero, which is an invalid operation. This is probably an error in the program.

#7—NIL pointer reference: A program has made an invalid reference to main memory. Specifically, it may have attempted to use a Pascal pointer variable that contained a value of NIL. This is illegal, and is probably a program error.

#8—Program interrupted by user: You pressed the [[break]] key (perhaps by accident). If you didn't intend to press [[break]], make sure you know what the [[break]] key is on your computer, and try to avoid this mistake in the future. If you don't know what [[break]] is (even after looking at the front inside cover of this book) check you p-System documentation or use the Setup utility.

#9—System I/O error: An I/O error has been detected during a critical operation of the operating system. No recovery from this error is possible. You should simply reboot the p-System.

#10—I/O error: This error is usually coupled with a further description indicating what type of I/O error occurred. Check the "p-System I/O Errors" subsection (which is next).

#11—Unimplemented instruction: An attempt has been made to execute an invalid p-code instruction in a program. The most likely cause is that the program code file is corrupted in some way. Try getting another copy of the program. Another possibility is that a program got out of control and inadvertently corrupted a program segment stored in main memory.

#12—Floating point error: During a computation involving real (or "floating point") numbers, an error has been detected. This is probably an error in the program.

#13—String overflow: A program attempted to use an overly long character string. This is probably an error in the program. Possibly you provided a response to a data entry prompt that had more characters than the program was intended to handle.

#14—Programmed HALT: The program has executed the UCSD Pascal procedure, HALT. This usually means the program has detected an error from which it cannot recover.

#15—Illegal heap operation: The heap is a dynamically managed storage area available to UCSD Pascal programs. Some illegal operation was attempted involving the heap. This is probably an error in the program.

#16—Breakpoint: This execution error is intended to be intercepted by the p-System Debugger. It is used as a signal to the Debugger to stop execution of the program and give you a chance to decide what to do next. If you see this error, there is probably an internal p-System problem.

#17—Incompatible real number size: The program that is running is configured for a size of real numbers that does not match the size for which the p-System has been configured. Section 1.18 provides some background on this topic. Agreement about the real number size must exist among the operating system, the p-machine emulator, and the program being executed.

#18—Set too large: An operation has been attempted involving the Pascal data type, "Set." The set was too large to be correctly handled. This is probably a program error.

#19—Segment too large: A program attempted to load a program segment that was too large to be handled on this p-System implementation. Check your computer-specific documentation to find out what this limit is.

p-System I/O Errors

The items listed in this subsection are also known as **I/O Results.** Whenever a p-System I/O operation is done, a report on its success or failure is made to the requesting program. This I/O Result is in the form of a number. If the number is zero, the operation was successful. If the number is not zero, some difficulty occurred, and the value of the number indicates the problem. If the program receives a non-zero I/O Result, it may simply pass on the number to you in a simple error message. If this happens, you need to look in this subsection to find out the details of the error.

Programs may also choose not to handle the checking of the I/O Result themselves, leaving that responsibility to the p-System, instead. In this case, when a non-zero I/O Result is detected, a standard p-System execution error is reported (with the message on the bottom line of the screen giving the error coordinate, and so on).

#1—Parity error (CRC): A read or write operation has resulted in invalid data. "Parity" and "CRC" refer to two ways in which such an error can be detected. Both involve adding extra information to the data which can be used to check the correctness of data, itself. The most likely cause of this error is a damaged area (also known as a "bad block") on a storage medium (such as a diskette). It is also possible that a diskette was not properly inserted when the I/O operation was attempted. For instance, you may have forgotten to close a drive door, or removed a diskette prematurely.

This error can also be reported in connection with I/O operations on communication devices (such as the printer).

#2—Illegal unit #: An I/O operation has been attempted using an illegal device number. (Recall that "unit" is sometimes used as a synonym for "device.") For instance, you may have referred to storage device #9: when you only have storage devices #4: and #5: on your computer.

#3—Illegal I/O request: An I/O operation has been attempted that is inappropriate for the device involved. For instance, there may have been an attempt to read data from a printer (which is ordinarily an output-only device).

#4—Data-com timeout: "Data-com" refers to "data communications." This seldom seen error can indicate that some difficulty has occurred in a communication channel (through the REMIN: and REMOUT: devices, for instance) between your computer and another computer or peripheral device.

#5—Volume went off-line: A storage or communication volume that had been on-line is no longer on-line. Perhaps you inadvertently turned off a device that was still in use, or removed a diskette prematurely.

#6—File lost in dir: A file that used to be in the directory of a storage volume is no longer there. That file has been in use, and the system now needs to confirm its status.

#7—Bad file name: The specification of a file is invalid. It may be too long, for instance. If you have just entered a file specification in response to a data entry prompt, that specification may be wrong. See the inside back cover of this book for a summary of the requirements on file specifications.

#8—No room on vol: There is insufficient room on the designated volume for the operation requested. There may have been an attempt to create a file on the volume. If so, there is insufficient space on the volume to hold the file, or the directory capacity of 77 files is exhausted.

#9—No such volume on-line: The designated volume cannot be located by the p-System. If it is a storage volume, you may have removed a diskette prematurely. If it is a communication volume, such as a printer, the device may not be turned on, or not ready for operation.

#10—No such file on volume: A file specification has designated a file on a particular volume. However, no such file exists on that volume. You may have forgotten that you need to explicitly provide a Volume ID when you designate a file that's not on the prefix, or default, volume.

#11—Dup dir entry: Somehow there are two files with the same name in the directory of a volume. This may have happened because a program was interrupted, and didn't complete execution normally. Try rebooting the p-System with the affected volume on-line; that may clean out the extra directory entry.

#12—File already open: A program has attempted to open a file variable that is already open. This is a program error.

#13—File not open: A program has attempted to access a file variable that is not open. This is a program error.

#14—Bad input format: You probably just responded incorrectly to a data entry prompt requesting that you enter a number. For instance, you may have entered letters rather than digits. Or, you may have entered a real number (such as "4.356"), when the program expected an integer number (with no fractional part).

#15—Ring buffer overflow: On some p-Systems this error is reported when you have tried to type too many characters before the p-System has a chance to process them. On other p-System's, such an attempt to enter too many "type ahead" characters is signaled by the sounding of the bell. If you continue typing after the bell, characters are discarded.

#16—Write-protect: An attempt has been made to write data on a volume that is **write-protected.** Diskettes distributed by p-System suppliers or application suppliers are often write-protected so you can't destroy them by mistake. You may have write-protected a volume, yourself, and forgotten about it.

#17—Illegal block: A program has attempted to access a block number that doesn't exist on the storage device involved.

#18—Illegal buffer: The main memory address involved in a program's low-level ("device I/O") operation is inappropriate.

B.2 FORTRAN EXECUTION ERRORS

600: Format missing final ')'
601: Sign not expected in input
602: Sign not followed by digit in input
603: Digit expected in input
604: Missing N or Z after B in format
605: Unexpected character in format
606: Zero repetition factor in format not allowed
607: Integer expected for w field in format
608: Positive integer required for w field in format
609: '.' expected in format
610: Integer expected for d field in format
611: Integer expected for e field in format
612: Positive integer required for e field in format
613: Positive integer required for w field in A format

614: Hollerith field in format must not appear
for reading
615: Hollerith field in format requires repetition factor
616: X field in format requires repetition factor
617: P field in format requires repetition factor
618: Integer appears before '+' or '-' in format
619: Integer expected after '+' or '-' in format
620: P format expected after signed repetition factor
in format
621: Maximum nesting level for formats exceeded
622: ')' has repetition factor in format
623: Integer followed by ',' illegal in format
624: '.' is illegal format control character
625: Character constant must not appear in format
for reading
626: Character constant in format must not be repeated
627: '/' in format must not be repeated
628: '\' in format must not be repeated
629: BN or BZ format control must not be repeated
630: Attempt to perform I/O on unknown unit number
631: Formatted I/O attempted on file opened as
unformatted
632: Format fails to begin with '('
633: I format expected for integer read
634: F or E format expected for real read
635: Two '.' characters in formatted real read
636: Digit expected in formatted real read
637: L format expected for logical read
639: T or F expected in logical read
640: A format expected for character read
641: I format expected for integer write
642: w field in F format not greater than d field + 1
643: Scale factor out of range of d field in E format
644: E or F format expected for real write
645: L format expected for logical write
646: A format expected for character write
647: Attempt to do unformatted I/O to a unit opened
as formatted
648: Unable to write blocked output, possibly no room on
device for file
649: Unable to read blocked input
650: Error in formatted textfile, no <cr> in last 512 bytes
651: Integer overflow on input

652: Too many bytes read out of direct access unit record
653: Incorrect number of bytes read from a direct access
unit record
654: Attempt to open direct access unit on unblocked
device
655: Attempt to do external I/O on a unit beyond end of
file record
656: Attempt to position a unit for direct access on a
nonpositive record number
657: Attempt to do direct access to a unit
opened as sequential
658: Attempt to position direct access unit on
unblocked device
659: Attempt to position direct access unit beyond end of
file for reading
660: Attempt to backspace unit connected to
unblocked device
661: Attempt to backspace sequential, unformatted unit
662: Argument to ASIN or ACOS out of bounds
(ABS(X) .GT. 1.0)
663: Argument to SIN or COS too large
(ABS(X) .GT. 10E6)
664: Attempt to do unformatted I/O to internal unit
665: Attempt to put more than one record into
internal unit
666: Attempt to write more characters to internal unit
than its length
667: EOF called on unknown unit

697: Integer variable not currently assigned
a format label
698: End of file encountered on read with no END= option
699: Integer variable not ASSIGNed a label used in
assigned goto
1000+ Compiler debug error messages - should never
appear in correct programs

SYNTAX ERRORS

C

This section lists the syntax errors that can be emitted by the UCSD Pascal and FORTRAN-77 compilers.

C.1 UCSD PASCAL SYNTAX ERRORS

1: Error in simple type
2: Identifier expected
3: Unimplemented error
4: ')' expected
5: ':' expected
6: Illegal symbol (terminator expected)
7: Error in parameter list
8: 'OF' expected
9: '(' expected
10: Error in type
11: '[' expected
12: ']' expected
13: 'END' expected
14: ';' expected
15: Integer expected

16: '=' expected
17: 'BEGIN' expected
18: Error in declaration part
19: Error in <field-list>
20: '.' expected
21: '*' expected
22: 'INTERFACE' expected
23: 'IMPLEMENTATION' expected
24: 'UNIT' expected
50: Error in constant
51: ': =' expected
52: 'THEN' expected
53: 'UNTIL' expected
54: 'DO' expected
55: 'TO' or 'DOWNTO' expected in for statement
56: 'IF' expected
57: 'FILE' expected
58: Error in <factor> (bad expression)
59: Error in variable
60: Must be of type 'SEMAPHORE'
61: Must be of type 'PROCESSID'
62: Process not allowed at this nesting level
63: Only main task may start processes
101: Identifier declared twice
102: Low bound exceeds high bound
103: Identifier is not of the appropriate class
104: Undeclared identifier
105: Sign not allowed
106: Number expected
107: Incompatible subrange types
108: File not allowed here
109: Type must not be real
110: <tagfield> type must be scalar or subrange
111: Incompatible with <tagfield> part
112: Index type must not be real
113: Index type must be a scalar or a subrange
114: Base type must not be real
115: Base type must be a scalar or a subrange
116: Error in type of standard procedure parameter
117: Unsatisified forward reference
118: Forward reference type identifier in
     variable declaration

119: Re-specified params not OK for a forward
declared procedure
120: Function result type must be scalar, subrange
or pointer
121: File value parameter not allowed
122: A forward declared function's result type can't
be re-specified
123: Missing result type in function declaration
124: F-format for reals only
125: Error in type of standard procedure parameter
126: Number of parameters does not agree with
declaration
127: Illegal parameter substitution
128: Result type does not agree with declaration
129: Type conflict of operands
130: Expression is not of set type
131: Tests on equality allowed only
132: Strict inclusion not allowed
133: File comparison not allowed
134: Illegal type of operand(s)
135: Type of operand must be Boolean
136: Set element type must be scalar or subrange
137: Set element types must be compatible
138: Type of variable is not array
139: Index type is not compatible with the declaration
140: Type of variable is not record
141: Type of variable must be file or pointer
142: Illegal parameter solution
143: Illegal type of loop control variable
144: Illegal type of expression
145: Type conflict
146: Assignment of files not allowed
147: Label type incompatible with selecting expression
148: Subrange bounds must be scalar
149: Index type must be integer
150: Assignment to standard function is not allowed
151: Assignment to formal function is not allowed
152: No such field in this record
153: Type error in read
154: Actual parameter must be a variable
155: Control variable cannot be formal or non-local
156: Multidefined case label
157: Too many cases in case statement

158: No such variant in this record
159: Real or string tagfields not allowed
160: Previous declaration was not forward
161: Again forward declared
162: Parameter size must be constant
163: Missing variant in declaration
164: Substitution of standard proc/func not allowed
165: Multidefined label
166: Multideclared label
167: Undeclared label
168: Undefined label
169: Error in base set
170: Value parameter expected
171: Standard file was re-declared
174: Pascal function or procedure expected
175: Semaphore value parameter not allowed
182: Nested UNITs not allowed
183: External declaration not allowed at this nesting level
184: External declaration not allowed in INTERFACE section
185: Segment declaration not allowed in INTERFACE section
186: Labels not allowed in INTERFACE section
187: Attempt to open library unsuccessful
188: UNIT not declared in previous uses declaration
189: 'USES' not allowed at this nesting level
190: UNIT not in library
191: Forward declaration was not segment
192: Forward declaration was segment
193: Not enough room for this operation
194: Flag must be declared at top of program
195: Unit not importable
201: Error in real number - digit expected
202: String constant must not exceed source line
203: Integer constant exceeds range
250: Too many scopes of nested identifiers
251: Too many nested procedures or functions
252: Too many forward references of procedure entries
253: Procedure too long
254: Too many long constants in this procedure
256: Too many external references
257: Too many externals
258: Too many local files
259: Expression too complicated
300: Division by zero

301: No case provided for this value
302: Index expression out of bounds
303: Value to be assigned is out of bounds
304: Element expression out of range
398: Implementation restriction
399: Implementation restriction
400: Illegal character in text
401: Unexpected end of input
402: Error in writing code file, not enough room
403: Error in reading include file
404: Error in writing list file, not enough room
405: 'PROGRAM' or 'UNIT' expected
406: Include file not legal
407: Include file nesting limit exceeded
408: INTERFACE section not contained in one file
409: Unit name reserved for system
410: Disk error

500: Assembler error

C.2 FORTRAN-77 SYNTAX ERRORS

1: Fatal error reading source block
2: Nonnumeric characters in label field
3: Too many continuation lines
4: Fatal end of file encountered
5: Labeled continuation line
6: Missing field on $ compiler directive line
7: Unable to open listing file specified on $ compiler directive line
8: Unrecognizable $ compiler directive
9: Input source file not valid textfile format
10: Maximum depth of include file nesting exceeded
11: Integer constant overflow
12: Error in real constant
13: Too many digits in constant
14: Identifier too long
15: Character constant extends to end of line
16: Character constant zero length
17: Illegal character in input
18: Integer constant expected
19: Label expected

20: Error in label
21: Type name expected (INTEGER, REAL, LOGICAL, or CHARACTER[[*n])
22: Integer constant expected
23: Extra characters at end of statement
24: '(' expected
25: Letter IMPLICIT'ed more than once
26: ')' expected
27: Letter expected
28: Identifier expected
29: Dimension(s) required in DIMENSION statement
30: Array dimensioned more than once
31: Maximum of 3 dimensions in an array
32: Incompatible arguments to EQUIVALENCE
33: Variable appears more than once in a type specification statement
34: This identifier has already been declared
35: This intrinsic function cannot be passed as an argument
36: Identifier must be a variable
37: Identifier must be a variable or the current FUNCTION
38: '/' expected
39: Named COMMON block already saved
40: Variable already appears in a COMMON block
41: Variables in two different COMMON blocks cannot be equivalenced
42: Number of subscripts in EQUIVALENCE statement does not agree with variable declaration
43: EQUIVALENCE subscript out of range
44: Two distinct cells EQUIVALENCE'd to the same location in a COMMON block
45: EQUIVALENCE statement extends a COMMON block in the negative direction
46: EQUIVALENCE statement forces a variable to two distinct locations, not in a COMMON block
47: Statement number expected
48: Mixed CHARACTER and numeric items not allowed in same COMMON block
49: CHARACTER items cannot be EQUIVALENCE'd with non-character items
50: Illegal symbol in expression
51: Can't use SUBROUTINE name in an expression

52: Type of argument must be INTEGER or REAL
53: Type of argument must be INTEGER, REAL, or CHARACTER
54: Types of comparisons must be compatible
55: Type of expression must be LOGICAL
56: Too many subscripts
57: Too few subscripts
58: Variable expected
59: '=' expected
60: Size of EQUIVALENCE'd CHARACTER items must be the same
61: Illegal assignment - types do not match
62: Can only call SUBROUTINES
63: Dummy parameters cannot appear in COMMON statements
64: Dummy parameters cannot appear in EQUIVALENCE statements
65: Assumed-size array declarations can only be used for dummy arrays
66: Adjustable-size array declarations can only be used for dummy arrays
67: Assumed-size array dimension specifier must be last dimension
68: Adjustable bound must be either parameter or in COMMON prior to appearance
69: Adjustable bound must be simple integer variable
70: Cannot have more than 1 main program
71: The size of a named COMMON must be the same in all procedures
72: Dummy arguments cannot appear in DATA statements
73: COMMON variables cannot appear in DATA statements
74: SUBROUTINE names, FUNCTION names, INTRINSIC names, etc. cannot appear in DATA statements
75: Subscript out of range in DATA statement
76: Repeat count must be >= 1
77: Constant expected
78: Type conflict in DATA statement
79: Number of variables does not match number of values in DATA statement list
80: Statement cannot have label
81: No such INTRINSIC function
82: Type declaration for INTRINSIC function does not match actual type of INTRINSIC function

83: Letter expected
84: Type of FUNCTION does not agree with a
    previous call
85: This procedure has already appeared in this compilation
86: This procedure has already been defined to exist in
    another unit via a $USES command
87: Error in type of argument to an INTRINSIC FUNCTION
88: SUBROUTINE/FUNCTION was previously used as a
    FUNCTION/SUBROUTINE
89: Unrecognizable statement
90: Functions cannot be of type CHARACTER
91: Missing END statement
92: A program unit cannot appear in a $SEPARATE
    compilation
93: Fewer actual arguments than formal arguments in
    FUNCTION/SUBROUTINE call
94: More actual arguments than formal arguments in
    FUNCTION/SUBROUTINE call
95: Type of actual argument does not agree with type of
    format argument
96: The following procedures were called but not defined:
97: This procedure was already defined by a
    $EXT directive
98: Maximum size of type CHARACTER is 255,
    minimum is 1
100: Statement out of order
101: Unrecognizable statement
102: Illegal jump into block
103: Label already used for FORMAT
104: Label already defined
105: Jump to format label
106: DO statement forbidden in this context
107: DO label must follow DO statement
108: ENDIF forbidden in this context
109: No matching IF for this ENDIF
110: Improperly nested DO block in IF block
111: ELSEIF forbidden in this context
112: No matching IF for ELSEIF
113: Improperly nested DO or ELSE block
114: '(' expected
115: ')' expected
116: THEN expected
117: Logical expression expected

118: ELSE statement forbidden in this context
119: No matching IF for ELSE
120: Unconditional GOTO forbidden in this context
121: Assigned GOTO forbidden in this context
122: Block IF statement forbidden in this context
123: Logical IF statement forbidden in this context
124: Arithmetic IF statement forbidden in this context
125: ',' expected
126: Expression of wrong type
127: RETURN forbidden in this context
128: STOP forbidden in this context
129: END forbidden in this context
131: Label referenced but not defined
132: DO or IF block not terminated
133: FORMAT statement not permitted in this context
134: FORMAT label already referenced
135: FORMAT must be labeled
136: Identifier expected
137: Integer variable expected
138: 'TO' expected
139: Integer expression expected
140: Assigned GOTO but no ASSIGN statements
141: Unrecognizable character constant as option
142: Character constant expected as option
143: Integer expression expected for unit designation
144: STATUS option expected after ',' in CLOSE statement
145: Character expression as filename in OPEN
146: FILE= option must be present in OPEN statement
147: RECL= option specified twice in OPEN statement
148: Integer expression expected for RECL= option in OPEN statement
149: Unrecognizable option in OPEN statement
150: Direct access files must specify RECL= in OPEN statement
151: Adjustable arrays not allowed as I/O list elements
152: End of statement encountered in implied DO, expressions beginning with '(' not allowed as I/O list elements
153: Variable required as control for implied DO
154: Expressions not allowed as reading I/O list elements
155: REC= option appears twice in statement
156: REC= expects integer expression
157: END= option only allowed in READ statement

158: END= option appears twice in statement
159: Unrecognizable I/O unit
160: Unrecognizable format in I/O statement
161: Options expected after ',' in I/O statement
162: Unrecognizable I/O list element
163: Label used as format but not defined in
format statement
164: Integer variable used as assigned format but no
ASSIGN statements
165: Label of an executable statement used as a format
166: Integer variable expected for assigned format
167: Label defined more than once as format
200: Error in reading $USES file
201: Syntax error in $USES file
202: SUBROUTINE/FUNCTION name in $USES file has
already been declared
203: FUNCTIONS cannot return values of type CHARACTER
204: Unable to open $USES file
205: Too many $USES statements
206: No .TEXT info for this unit in $USES file
207: Illegal segment kind in $USES file
208: There is no such unit in this $USES file
209: Missing UNIT name in $USES statement
210: Extra characters at end of $USES directive
211: Intrinsic units cannot be overlayed
212: Syntax error in $EXT directive
213: A SUBROUTINE cannot have a type
214: SUBROUTINE/FUNCTION name in $EXT directive has
already been defined
400: Code file write error
401: Too many entries in JTAB
402: Too many SUBROUTINES/FUNCTIONS in segment
403: Procedure too large (code buffer too small)
404: Insufficient room for scratch file on system disk
405: Read error on scratch file

DIFFERENCES AMONG P-SYSTEM VERSIONS D

This book is intended to be used with Version IV.1 of the UCSD p-System. You can also use it with Version IV.0, but some of the detailed directions need to be modified, and some of the screen images you see will be different from the ones we provide. These differences are summarized in this appendix.

First, however, we address a topic that you may have been wondering about: "Were there p-System Versions I, II and III?"

The short answer is: "Yes." If you want a longer answer, read the next section; otherwise, skip it and go on to section 2.

D.1 THE p-SYSTEM FAMILY TREE

Version I.3 was the first p-System version distributed outside the University of California (starting in August, 1977). This initial version evolved through Versions I.4 and then I.5, as more facilities were added and the p-System was installed on additional types of microprocessors. In 1979, when SofTech Microsystems took over distribution and support of the p-System, the principal version being distributed was Version II.0.

At about the same time, Apple Computer acquired from the University the rights to distribute the p-System on the Apple II computer. Apple's version (called Apple Pascal) was based on Version II.1 of the p-System. Apple has subsequently evolved that software through several releases.

Also in that 1979 timeframe, Version III.0 was developed for use on Western Digital's MicroEngine line of microprocessors, in which the p-machine is implemented in hardware instead of being realized by a software p-machine emulator. Version III of the p-System continues in active use on MicroEngine hardware.

Version IV.0 was an effort by SofTech Microsystems to bring together, in one system, the facilities offered in Versions II.0, II.1, and III.0. Version IV p-Systems are now offered on a number of popular personal computers.

These various versions of the p-System, while significantly different in detail, share a common approach in many areas. For instance, they share the use of menus on the top line of the screen and single keystroke selections from those menus. The screen-oriented text editor and file manager are quite similar also.

There are sufficient differences among these versions, however, that the detailed keystroke-by-keystroke procedures in Part 1 of this book only apply to Version IV systems. In addition, there are substantial differences in the internal implementations of the various versions, and many of the portability, modularity, and memory management discussions in Chapter 7 apply only to Version IV.

Now that you know roughly how the various major versions of the p-System relate to one another, the remaining topic for this appendix is specific comments on how your use of this book will be affected if you have

Version IV.0 rather than Version IV.1.

D.2 USING THIS BOOK WITH VERSION IV.0

The main focus of this section is on the differences between these two p-System versions that affect your use of this book. There are other differences (such as the availability of various add-on features), but we don't emphasize them here.

The differences listed in this section are organized by the chapter of the main book that they affect. If you are using Version IV.0, be sure to read the relevant subsection before you read each chapter.

Notes for Chapter 1

Section 1.5, page 28: When an on-line volumes list is produced by the Version IV.0 V(olumes activity, storage volume sizes (such as the "[320]" in the example) are not shown. This comment applies to all other instances of the V(olumes activity that are shown later in this chapter.

Section 1.7, page 32 : The error message shown in the screen image is

"No file system.filer.CODE", instead of

"Illegal file name system.filer.CODE".

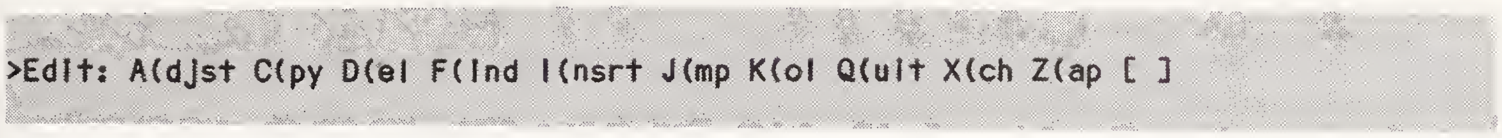
Section 1.7, page 35: The execution error message is just below the Filer menu, rather than at the bottom of the screen. It looks like this:

```
Program interrupted by user
Segment PASCALIO Proc# 17  Offset# -310
Type <space> to continue
```

Section 1.10, page 40: The file size for FILER.CODE is smaller than 37 blocks. Other directory listings later in the chapter show the smaller size, also.

Notes for Chapter 2

Section 2.2, page 62: The Editor menu is different in Version IV.0:



```
>Edit: A(djst C(py D(el F(ind I(nsrt J(mp K(ol Q(uit X(ch Z(ap [ ]
```

Notice that there is no question mark at the end of the menu, so there is no menu extension. Nevertheless, there are Editor activities not listed in the menu. One example is the M(argin activity. Despite these omissions from the IV.0 menu, the same activities are available in the Version IV.0 editor as in the Version IV.1 editor.

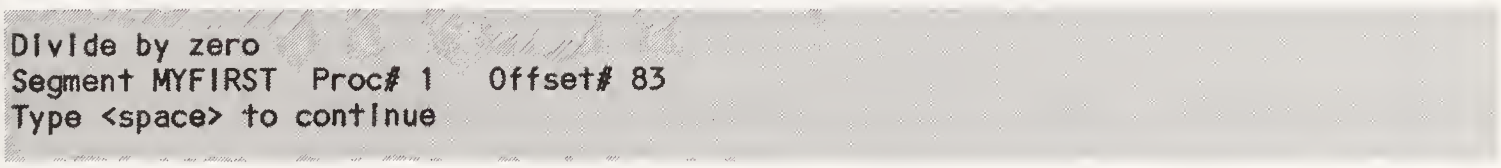
Section 2.11, page 86: The screen displayed by the Environment activity has one less item of information in Version IV.0: the line identifying the file that you are editing.

Section 2.14, page 95: The Print utility was not provided with Version IV.0 (nor even with early releases of Version IV.1). The only simple and standard means for printing text files is therefore the Filer's T(ransfer activity.

Notes for Chapter 3

Section 3.4, page 108: The prompt requesting the choice of a listing file does not appear at the beginning of a Pascal compilation. Therefore, throughout this section, the specific keystroke sequences for invoking the compiler have an extra [ret] that you don't need to type. The first of these is on this page, but there are several others

Section 3.7, page 131: The execution error message shown on the screen image looks like that on the next page, and appears whereever the cursor happens to be when the execution error occurs.



```
Divide by zero
Segment MYFIRST  Proc# 1   Offset# 83
Type <space> to continue
```

Section 3.7, page 136: You don't have the option of requesting a compiled listing when you invoke the Pascal compiler. Therefore, if you're using Pascal, you need to return to the Editor and insert the following at the beginning of the the workspace:

```
(*$L PRINTER:*)
```

This line indicates to the compiler that a compiled listing should be produced on the printer. If you don't have a printer on your computer, substitute CONSOLE: for PRINTER:. You can also put a disk file name in the $L directive (if you want the compiled listing stored on the disk).

Notes for Chapter 4

Section 4.9, page 153: No system file called SYSTEM.MENU exists in Version IV.0.

Section 4.12, page 157: None of this discussion of subsidiary volumes applies to Version IV.0, since the entire facility is missing from that version.

Section 4.15, page 160: Some of the error messages described in this section appear differently on the screen than this description indicates. The "Need segment" message would appear on the screen at the current location of the cursor and would look like this:

```
Segment MYSEG   not found:
Put volume MYDISK in unit 4
Type <space> to continue
```

The execution error message would similarly appear at the current location of the cursor, rather than on the last line of the screen. The IV.0 format of the message appears on the next page.

```
Divide by zero
Segment MYSEG  Proc# 3   Offset# 125
Type <space> to continue
```

Section 4.17, page 167: The prompt requesting the choice of a listing file does not appear during a Pascal compilation. If you want a compiled listing to be produced during a compilation, you must insert a "listing directive" in the source text file. See the comments on Chapter 3, above, or your language manual, for directions on how to get a compiled listing for your Pascal program.

Section 4.17, page 170: The main menu shown in the Screen-oriented Editor is different from that shown, but the activities available for selection are the same in both Version IV.0 and Version IV.1.

Notes for Chapter 5

Section 5.13, page 228: The Environment menu in Version IV.0 is missing the line that starts "Editing:" (which contains the name of the file being edited).

Section 5.13, page 230: The S(et tabs menu in Version IV.0 is more elaborate, and shows several types of tabs (including L(eft, R(ight, and D(ecimal). We recommend that you use only L(eft tabs.

Notes for Chapter 6

Section 6.9, page 252: The F(lip swap/lock activity is not available in Version IV.0. The result is that you may need to make sure that the diskette containing the SYSTEM.FILER file is on-line when you select a new activity in the Filer.

Section 6.9, page 263: The O(n/Off-line activity is also not available in Version IV.0. This activity is only useful in dealing with subsidiary volumes, which are not available in Version IV.0, anyway.

Section 6.9, page 275: The on-line volumes list produced in Version IV.0 does not show the size of storage volumes. So, for instance, the two occurrences of "[320]" on the example on-line volumes list would not appear.

Section 6.10, page 283: None of this section on subsidiary volumes applies to Version IV.0.

Notes for Chapter 8

The p-System facilities described in this chapter may not all be available for your Version IV.0 system. Many of them will run in the Version IV.0 environment, but were simply not available when that version was released. Others depend on specific underlying facilities in the p-System that are available only in Version IV.1. If you don't have, but would like to have, any of the facilities described in this chapter, contact your p-System supplier or SofTech Microsystems.

THE P-SYSTEM ON THE IBM PERSONAL COMPUTER

E

This appendix is a summary of those aspects of the UCSD p-System which are specific to the IBM Personal Computer (IBM PC, for short).

The first five sections are coordinated with the hands-on tutorial of Part 1. Each section corresponds to a particular point in Part 1 where you need to follow a computer-specific sequence of operations.

At the time of this writing, the p-System is available for the IBM PC from two sources. The first source is IBM, itself (through its dealers and Product Centers). The second source is Network Consulting, Inc., in Vancouver, British Columbia, CANADA. The IBM version is described in this appendix. We assume that your IBM PC hardware is installed and configured correctly. If you need to, follow the configuration instructions in IBM's *Guide to Operations*.

Two configurations of the p-System are offered by IBM for the PC. One is called the *Runtime Support* package. This package is an inexpensive way to get the capability to run p-System application programs that others have developed. The Runtime Support package includes the p-System's file manager, but not the screen-oriented editor. Therefore, the parts of this book that deal with editing text and developing programs (and other more sophisticated uses of the p-System) do not apply directly to you if you have this package. You may want to browse in those sections, anyway, to help decide whether you want to acquire the full p-System.

If you want to develop your own programs, you'll need to acquire the full UCSD p-System package, which includes the Screen-oriented Editor, many program development tools, and one or two p-System languages. The languages available are UCSD Pascal and FORTRAN-77. If you get the full p-System, essentially all of this book is relevant to you.

At the time of this writing, the p-System available from IBM is Version IV.0. Since we have written this book primarily for Version IV.1, there are a few places in the main part of the book where some details of your use of Version IV.0 will be different from the descriptions presented. Be sure to check Appendix D, "Differences Among p-System Versions," for details.

The minimum hardware requirements for running the full p-System on the IBM PC are:

o at least 64k bytes of memory,

o two disk drives (either single-sided or dual-sided), and

o a display.

For the Runtime Support package, only one disk drive is required, but it is still desirable to have two drives, and we usually assume that in this book.

E.1 STARTING THE p-SYSTEM THE FIRST TIME

This section is coordinated with the Section 1.3 in Part 1. It contains two subsections. The first subsection helps you to fill out the inside front cover of this book. The second subsection describes how to start the p-System running on the IBM PC.

Recording Your p-System Details

The first task in this appendix is to fill in the blanks in the "p-System Details for Your Computer" form. This form is located on the inside the front cover of the book. Much of this information is not yet relevant to you, but we ask you to fill it in, nevertheless. As you progress through the hands-on exercises of Part 1, you will need this information.

The information to be written in the blanks is usually **emphasized** in the text below. It isn't emphasized when a description of a key's symbol is given (as opposed to a word or letter on the key). For each symbol key, we describe the key and its location on the keyboard; you should simply draw the special symbol which appears on the key, in the appropriate blank space on the front cover.

When the Ctrl key and another key should be typed together to produce a p-System special key, we put "Ctrl-" in front of the name of the other key. Example: "Ctrl-C".

Personal computer type: **IBM Personal computer**
Major p-System version: **IV.0**

320 blocks = size of **single-sided diskette** volumes
640 blocks = size of **dual-sided diskette** volumes
#4: storage device: **left drive**
#5: storage device: **right drive**
RAM disk volume name: **RAMDISK:**
Universal Medium accessibility: **Native** format
Utility to format diskettes: **DISKFORMAT.CODE**
Need to Z(ero after formatting? **Yes**

⟦ret⟧	Marked with left bent arrow; located just left of "Home" (IBM refers to this key as the "Enter" key. You may see this term used in IBM-specific utilities or documentation.)
⟦bs⟧	Marked with left arrow; located just left of "Num Lock"
⟦delete line⟧	**Ctrl-⟦bs⟧**
⟦break⟧	**Ctrl-Break**
⟦stop/start⟧	**Ctrl-S**
⟦flush⟧	**Ctrl-F**
⟦esc⟧	**Esc**
⟦eof⟧	**Ctrl-C**
⟦tab⟧	Marked with left and right arrows; located just below Esc
⟦up⟧	Marked with up arrow and "8"; located on the numeric pad
⟦down⟧	Marked with down arrow and "2"; located on the numeric pad
⟦right⟧	Marked with right arrow and "6"; located on the numeric pad
⟦left⟧	Marked with left arrow and "4"; located on the numeric pad
⟦exch-ins⟧	**Ins** located on the numeric pad
⟦exch-del⟧	**Del** located on the numeric pad
⟦etx⟧	**Ctrl-C**

Other notes: (You can summarize the information below in the space provided.)

Pressing a Shift key (marked with an open upward pointing arrow) together with the PrtSc key causes the contents of the screen to be printed (but only with the Parallel printer adapter).

Special p-System keys on the numeric pad are only correctly produced when the numeric pad is in "cursor movement" mode (which is its initial condition). In the numeric mode, digits are produced (instead of cursor movement signals) when these keys are pressed. Repeated pressing of the Num Lock key causes the p-System to go back and forth between cursor movement mode and numeric mode.

Sometimes you may press the NumLock key by accident (when you intend to press [[bs]], for instance). If you're using the Editor when that happens, your attempts to move the cursor with the arrow keys will be unsuccessful. Digits will be produced by your keypresses instead. In a cursor movement setting, digits are interpreted by the Editor as a repeat factor. If you type more than four digits without typing a cursor movement key, the Editor complains:

```
ERROR: Repeatfactor > 10,000  Please press <spacebar> to continue.
```

To recover, type [[space]], followed by NumLock, to return the numeric keypad to cursor movement mode.

Bootstrapping the p-System

At this point we will describe how to start the UCSD p-System running on the IBM Personal Computer. This process is often called bootstrapping. If you're using the full p-System, locate the diskette labeled "SYSTEM4:". (Check the diskette holders in the *Users' Guide* binder.) If you're using the Runtime Support package, you have only one diskette, called "RUNTIME:", and you should locate it now.

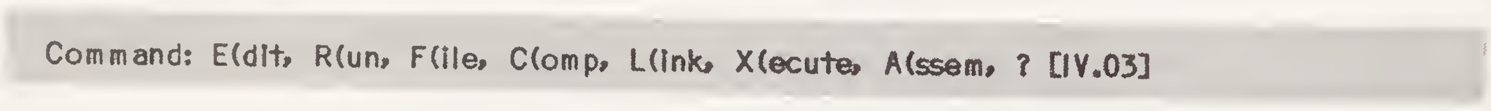
Open the drive cover of the left hand drive, insert either SYSTEM4: or RUNTIME:, and close the drive cover. The disk should be inserted with the label facing up, under your thumb.

The remainder of the start up process depends on whether your PC is already turned on. The main power switch on the Personal Computer is at the rear of the system unit on the right hand side.

If your IBM PC is turned off, turn on your printer (if you have one), and your television display or video monitor (if you use one); then switch on your computer. There should be several seconds of silence as your computer checks itself. (If you have expansion memory installed, this period could be 20 or 30 seconds.) If the check up finds no problems, a "beep" sounds; then the left drive light comes on and you hear whirring as the p-System is read into the main memory of your computer.

If your IBM PC is already turned on, press and hold down the two keys marked "Ctrl" and "Alt" on the left side of your keyboard. While holding those keys down, press the key marked "Del" on the lower right corner of the keyboard. Release all three keys together. An immediate "beep" occurs, the left drive light comes on and you hear whirring as the p-System is read into main memory.

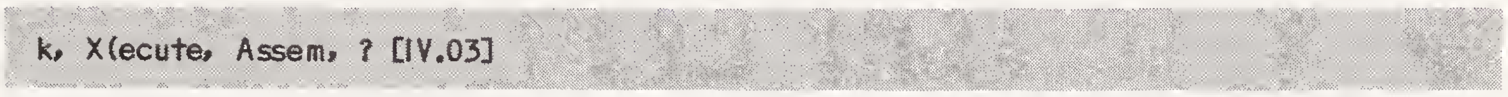
Eventually the following line (or part of it) appears on the top of your screen. There should also be an IBM logo displayed.



```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, ? [IV.03]
```

If you can see this entire line on your screen, the start up operation is complete. If you just did it for the first time, resume your reading of Chapter 1 at Section 1.3.

If your display is only capable of showing 40 characters per line (which is usually the case with an ordinary television), the appearance of your screen is quite different. The top line looks something like this:



```
k, X(ecute, Assem, ? [IV.03]
```

These are the last forty characters of the 80 character line. If your screen looks like this, read the section "Dealing With a 40 Character Screen" later in this appendix. Then, return to Chapter 1 at Section 1.3.

E.2 MAKING BACK UPS AND CREATING MYVOL:

This section describes operations that you need to do in Section 1.7 of Part 1.

There are two tasks in this section. The first task is to make a back up copy of your system diskette and begin using the back up. The second task is to make an empty p-System volume called MYVOL:. Each of these tasks requires a blank diskette, so you need two of them to go on from here.

Before you can use a new diskette with the Personal Computer, it must be formatted. (If one of your old disks goes bad, you may also be able to recover and continue using it if you format it again.) Formatting a disk completely erases any information you had previously stored on it. Don't apply this process to a used disk unless you're positive you don't need the information it contains.

Disk formatting is done by a utility program called DISKFORMAT. Invoke that utility now with the X(ecute activity in the Command menu. The following series of prompts and responses show how to format the disk in drive #5. (DISKFORMAT can also be applied to diskettes in other drives.) After you are prompted to put the disk to be formatted in the drive, and before you press ⟦ret⟧ to indicate you've done that, *always check that the disk in that drive is the one you intend to format.*

```
Execute what file? DISKFORMAT [ret]
Enter unit number of diskette to be formatted (4..5): 5 [ret]
Insert disk in unit 5 and press <enter>... [ret]
```

DISKFORMAT takes a while to run. When it successfully finishes, one of the following reports are made (depending on whether you used a single-sided drive or a dual-sided drive):

```
320 block disk formatted
```

```
640 block disk formatted
```

If DISKFORMAT gives you an error message instead of one of these reports, there is probably something wrong with the diskette you used. You should try another diskette.

Remove your newly formatted disk from the drive and set it aside. Now format your second blank diskette in the same way. Insert the blank disk in drive #5, invoke X(ecute, and follow the procedure above. When the formatting is done, leave the new disk in the drive.

Invoke F(ile and its T(ransfer activity. To copy your system disk to the newly formatted disk in drive #5, follow the sequence of prompts and responses shown below:

```
Transfer what file? #4: [ret]
To where? #5: [ret]
Transfer 320 blocks? (Y/N) Y
SYSTEM4:               --> #5:
```

Remove the new system diskette and label it. (If you write on the label after it's on the diskette, be sure to use a felt tip pen.) Your back up task is now complete.

Put the remaining blank disk in drive #5 and invoke the Z(ero activity. The function of Z(ero is to create an empty volume (that is, one that has no files) on a disk.

The following sequence of prompts and responses creates a volume called MYVOL: with a size of 100 blocks:

```
Zero dir of what volume? #5: [ret]
Duplicate dir? N
# blocks on the disk? 100 [ret]
New vol name ? MYVOL: [ret]
MYVOL: correct ? Y
MYVOL: zeroed
```

You now have a MYVOL: disk. To confirm that, you can invoke the V(olumes activity. MYVOL: should appear on the on-line volumes list next to "5 #." Remove MYVOL: from the drive and label it as you did your new system volume.

The last thing to do is start up the p-System again using your newly made system disk. Remove the original system diskette and store it in a safe place. Using your new system diskette, follow the procedure in "Bootstrapping the p-System", above. Be sure to take advantage of the shorter process that applies when your system power is already on. When your p-System is started, return to Part 1 at Section 1.9.

E.3 EDITOR SET UP DETAILS

This section is coordinated with Section 2.1 in Part 1.

If you have the full p-System, you already have the Screen-oriented Editor on your system diskette. You can proceed through Chapter 2.

If you have the Runtime Support package, you do not have any text editor. Browse in Chapter 2, if you'd like.

E.4 PASCAL SET UP DETAILS

This section is coordinated with Section 3.4 in Part 1, and tells you where to find the UCSD Pascal compiler in the IBM PC p-System release. If you only have the Runtime Support package, this section is not relevant to you, because Pascal is only available with the full p-System.

The disk labeled PASCAL: (which you should find in the Pascal binder) contains two Pascal compilers. Locate that disk now, insert it in drive #5: (the right one), and invoke the Filer's L(ist directory activity. (Type F L #5: [[ret]] from the Command menu.) You should see the following files:

```
SYSTEM.COMPILER
PASCAL4.COMPILE
```

These two compilers differ only in the size of the real numbers that they support. (See Section 1.18 for a discussion of the topic of real number sizes.) Assuming that you followed our directions for starting up the p-System (Section 1 of this appendix), your system disk should be SYSTEM4:. That disk is configured for four-word real numbers. Therefore, you need the four-word compiler (which is called PASCAL4.COMPILE).

Return now to Section 3.4, and we will show you how to copy this file onto the MYVOL: volume.

E.5 FORTRAN SET UP DETAILS

This section is coordinated with Section 3.5 in Part 1, and tells you where to find the FORTRAN-77 compiler and runtime library in the IBM PC p-System release. If you have only the Runtime Support p-System, FORTRAN is not available to you.

The disk labeled FORTRAN: (which you should find in the FORTRAN binder) contains two FORTRAN compilers and two runtime library files for FORTRAN. Locate that disk now, and insert it the drive #5: (the right hand drive). Invoke the Filer's L(ist directory activity to view the directory of that disk. (Type F L #5: [[ret]] from the Command menu.) You should see the following files:

```
FORTRAN2.CODE
FORTLIB2.CODE
FORTRAN4.CODE
FORTLIB4.CODE
```

There is one compiler/runtime library set supporting two-word real numbers, and one set supporting four-word real numbers. Assuming that you followed the original startup directions in Section 1 of this appendix, your system disk should be SYSTEM4:. That disk is configured for four-word real numbers. Therefore, you need the four-word compiler and the four-word runtime library file. They are the FORTRAN4.CODE and FORTLIB4.CODE files.

Return now to Section 3.5, and we will show you how to copy these files onto the MYVOL: volume.

E.6 DEALING WITH A 40-CHARACTER SCREEN

The p-System is most convenient to use when the display can show a full 80 character line at one time, but forty character displays can also be productively used, because the Personal Computer stores the entire 80 character line in memory, and allows you to choose which of three 40-character portions you want to see.

The choices are the left half (columns 1-40), the middle half (columns 21-60) and the right half (columns 41-80). When the p-System is started, the portion that you see first is the right half.

The rest of this book assumes an 80 character screen. Sample displays shown in the book will be full width. You can use the control sequences described below to see any part of the screen you wish.

Locate the key labeled "Ctrl" on the left side of the keyboard, and the left and right arrow keys on the right side. (The arrow keys also have a digit on them.) Now, press the "Ctrl" key and hold it while pressing the left arrow key. You should see the following characters on the top line:

```
F(ile, C(omp, L(ink, X(ecute, A(ssem,
```

This is the middle 40-character portion of the line. Do the same thing again. Now you see the left half of the line:

```
Command: E(dit, R(un, F(ile, C(omp, L(in
```

Press the same pair of keys one more time, and you will be back to the right half of the line, where you started.

Now move the "window" in the other direction by holding down "Ctrl" and pressing the right arrow key several times.

There is one other potential difficulty that you may have with your display. With some television sets, there is a tendency to "lose" the first one to three characters on a line. If this is the case for you, the 40 character chunks you just saw on your screen have been missing the first few characters (as compared to the printed versions in this book). Use the utility program Tvset to address this problem. Tvset is described in IBM's *Operator's Guide* for the full p-System, and in the reference manual for the *Runtime Support* package.

When you are ready, return to your reading of Chapter 1, Section 1.3.

THE P-SYSTEM ON THE TI PROFESSIONAL

F

This appendix summarizes the aspects of the UCSD p-System which are specific to the Texas Instruments Professional Computer. Each section corresponds to a particular point in Part 1 where you need to follow a computer-specific sequence of operations.

F.1 STARTING THE p-SYSTEM THE FIRST TIME

This section is coordinated with the Section 1.3 in Part 1. It contains two subsections. The first subsection helps you to fill out the inside front cover of this book. The second subsection describes how to start the p-System running on the TI Professional Computer.

Recording Your p-System Details

The specific information, below, is needed to fill in the blank areas in the "p-System Details for Your Computer" form that is inside the front cover of this book. Much of this information is not yet relevant to you, but we ask you to fill it in, nevertheless. As you progress through the hands-on exercises of Part 1, you will need this information. It is convenient to get the information recorded once and for all.

The information to be written in the blanks is **emphasized** in the text below. (The arrow key descriptions are not emphasized. You may want to simply draw in the arrow symbols.) When the CTRL or SHIFT key should be typed together with another key, we put a hyphen in between. Example: "CTRL-C".

Personal computer type: **TI Professional Computer**
Major p-System version: **IV.1**

640 blocks = size of **double-sided diskette** volumes
#4: storage device: **left drive**
#5: storage device: **right drive**
RAM disk volume name: **RAM:**
Universal Medium accessibility: **Native** format
Utility to format diskettes: **FORMAT.CODE**
Need to Z(ero after formatting? **No**

⟦ret⟧	**RETURN**
⟦bs⟧	**BACKSPACE**
⟦delete line⟧	**CTRL-BACKSPACE**
⟦break⟧	**SHIFT-BREAK/PAUSE**
⟦stop/start⟧	**BREAK/PAUSE or CTRL-S**
⟦flush⟧	**CTRL-F**
⟦esc⟧	**ESC**
⟦eof⟧	**CTRL-C**
⟦tab⟧	**TAB**
⟦up⟧	Arrow pointing up, next to HOME
⟦down⟧	Arrow pointing down, next to HOME
⟦right⟧	Arrow pointing right, next to HOME
⟦left⟧	Arrow pointing left, next to HOME
⟦exch-ins⟧	**INS**
⟦exch-del⟧	**DEL**
⟦etx⟧	**CTRL-C**

Bootstrapping the p-System

This subsection describes how to start the p-System running on the TI Professional Computer. This process is called "bootstrapping."

Open the drive cover of the left hand drive, insert the PSYS: diskette, and close the drive cover. The diskette should be inserted with the label facing up (just under your thumb).

If your system power is off, turn on your printer (if you have one) and then switch on your computer. There should be several seconds of silence as your computer checks itself. If the check up finds no problems, the left drive light comes on and you will hear whirring as the p-System is read into main memory.

If your power was turned on before you inserted your diskette, you may be asked to type a key in order to continue the bootstrapping process. After you insert the diskette, type any key and the bootstrapping continues as just described.

After you have already bootstrapped the p-System, you can bootstrap it again without having to turn the power off and back on. With your left hand, press and hold down the two keys marked "CTRL" and "ALT" on the left side of your keyboard. While holding those keys down, press the key marked "DEL". Release all three keys together. The left drive light comes on and you hear whirring as the p-System is read into main memory. Return to Section 1.3.

F.2 MAKING BACK UPS AND CREATING MYVOL:

This section describes operations that you need to do in Section 1.7 of Part 1.

There are two tasks in this section. The first is to make a back up copy of your system diskette and begin using the back up. The second task is to make an empty p-System volume called MYVOL:. Each of these tasks requires a blank diskette.

Before you can use a new diskette with the TI Professional Computer, the disk must be formatted. If one of your old disks goes bad, you may also be able to recover and continue using it if you format it again.

Formatting a disk completely erases any information you had previously stored on it. Don't apply this process to a used disk unless you're positive you don't need the information it contains.

Use X(ecute like this:

```
Execute what file? #5:FORMAT [ret]
```

The FORMAT program displays this prompt:

```
Format which unit number (4,5,9,10) ? _
```

Before doing anything else, remove the system disk from its drive. Then, place your first blank diskette in drive #5 and respond to the FORMAT prompts like this:

```
Format which unit number (4,5,9,10) ? 5 [ret]
Place disk in unit 5 and press return... [ret]
```

FORMAT will also ask you for a name for the new diskette. When this process is completed, the number of blocks on the newly formatted diskette is displayed. Your drives have a 640 block capacity.

If an error is reported during this process, the diskette you're formatting is probably flawed. Set it aside and try another.

Remove your newly formatted disk from the drive and set it aside. Now format your second blank diskette in the same way. When the formatting is done, leave the new disk in the drive and replace the system disk in drive #4.

Invoke F(ile and its T(ransfer activity. To copy your system disk to the newly formatted disk in drive #5, follow the sequence of prompts and responses shown below:

```
Transfer what file? #4: [ret]
To where? #5: [ret]
Transfer 320 blocks? (Y/N) Y
PSYS:     --> #5:
```

Remove the new system diskette from drive #5 and label it. (If you write on the label after it's on the diskette, be sure to use a felt tip pen.) Your back up task is now complete.

Put the first blank diskette back into drive #5 and invoke the Z(ero activity. The following sequence of prompts and responses give the volume the name MYVOL: with a size of 100 blocks:

```
Zero dir of what volume? #5: [ret]
Destroy FORMAT: ? Y
Duplicate dir? N
Are there 320 blks on the disk ? (Y/N) N
# blocks on the disk? 100 [ret]
New vol name ? MYVOL: [ret]
MYVOL: correct ? Y
MYVOL: zeroed
```

You now have a MYVOL: disk. To confirm that, invoke the V(olumes activity. MYVOL: should appear on the on-line volumes list next to "5 #." Remove MYVOL: from the drive and label it as you did your new system volume.

The last thing to do is start up the p-System again using your newly made system disk. Remove the original system diskette and store it in a safe place. Using your new system diskette, follow the procedure outlined in the first section of this appendix. When your new p-System diskette has bootstrapped, return to Part 1 at Section 1.9.

F.3 EDITOR SET UP DETAILS

This section is coordinated with Section 2.1 in Part 1.

Since the Screen-oriented Editor resides on the PSYS: diskette, there is no need to set up the Editor on the TI Professional Computer.

F.4 PASCAL SET UP DETAILS

This section is coordinated with Section 3.4 in Part 1, and tells you where to find the UCSD Pascal compiler with the TI Professional Computer.

Assuming that you have aquired the Pascal compiler, the disk labeled PDEV: contains it. Locate that disk now and simply insert it in drive #5:. The name of the Pascal compiler (including the volume name) is PDEV:SYSTEM.COMPILER. Return now to Section 3.4, and we will show you how to copy SYSTEM.COMPILER onto MYVOL:.

F.5 FORTRAN SET UP DETAILS

This section is coordinated with Section 3.5 in Part 1. FORTRAN is not available with the TI Professional Computer at the time of this writing. You may want to look through Section 3.5 just for interest.

THE P-SYSTEM ON OSBORNE COMPUTERS G

This appendix summarizes the aspects of the UCSD p-System that are specific to the Osborne 1 and the Osborne Executive computers. Each section corresponds to a particular point in Part 1 where you need to follow a computer-specific sequence of operations.

G.1 STARTING THE p-SYSTEM THE FIRST TIME

This section is coordinated with the Section 1.3 in Part 1. It contains two subsections. The first subsection helps you to fill out the inside front cover of this book. The second subsection describes how to start the p-System running on an Osborne computer.

Recording Your p-System Details

The specific information below is needed to fill in the blank areas in the "p-System Details for Your Computer" form that is inside the front cover of this book. Much of this information is not yet relevant to you, but we ask you to fill it in, nevertheless. As you progress through the hands-on exercises of Part 1, you will need this information. It is convenient to get the information recorded once and for all.

The information to be written in the blanks is **emphasized** in the text below. (The arrow key descriptions are not emphasized. You may want to simply draw in the arrow symbols.) When the CTRL key should be typed together with another key, we put a hyphen in between. Example: "CTRL-C".

Personal computer type: **Osborne 1 or Executive**
Major p-System version: **IV.1**

390 blocks = size of **Osborne format diskette**
320 blocks = size of **Universal Medium format diskette**
#4: storage device: **Drive A** (top drive on Executive)
#5: storage device: **Drive B** (bottom drive on Executive)
RAM disk volume name: **not supported**
Universal Medium accessibility: a **native** format
Utility to format diskettes: **UTIL.CODE**
Need to Z(ero after formatting? **Yes**

⟦ret⟧	**RETURN**
⟦bs⟧	Arrow pointing left
⟦delete line⟧	**CTRL-U**
⟦break⟧	**CTRL-B**
⟦stop/start⟧	**CTRL-S**
⟦flush⟧	**CTRL-F**
⟦esc⟧	**ESC**
⟦eof⟧	**CTRL-C**
⟦tab⟧	**TAB**
⟦up⟧	Arrow pointing up
⟦down⟧	Arrow pointing down
⟦right⟧	Arrow pointing right
⟦left⟧	Arrow pointing left
⟦exch-ins⟧	**CTRL-X**
⟦exch-del⟧	**CTRL-Z**
⟦etx⟧	**CTRL-C**

You can summarize the remainder of this subsection in the "Other notes" portion of the inside front cover.

The Osborne 1 p-System can maintain a screen image that has more horizontal lines and more vertical columns than are actually displayed. In other words, the visible screen is simply a "window" into a larger display maintained inside the computer. You can move this window around by typing CTRL together with any of the arrow keys. This capability is particularly useful if you have a 52-column screen and wish to work with 80-column screen images.

If you have an Executive, the previous paragraph doesn't concern you, since your screen is capable of showing 80-column screens directly.

On both Osborne models , keys on the keyboard repeat automatically if you hold them down more than a second or so.

Bootstrapping the p-System

This subsection describes how to start the p-System running on an Osborne computer. This process is called "bootstrapping."

The first step is to turn your computer on (if it was off), or press the RESET button (if your computer was already on). The Osborne 1's power switch is located in the same compartment where the power cord is attached. The Executive's power switch is the blue button on the right side of the front panel.

After you take this first step, you are immediately prompted by a message on the screen to insert a disk in drive A and press RETURN. Open the drive cover of Drive A, insert your p-System diskette (which is labelled "OSBORNE:"), and close the drive cover. The diskette should be inserted with the label facing up (just under your thumb).

After the disk is loaded, press RETURN. The light on Drive A will come on and you will hear whirring as the p-System is read into main memory. After considerable disk activity, the p-System "welcome" message appears on the screen.

If you have an Executive, you can return now to your reading of Section 1.3. If you have an Osborne 1, the top line of your screen should look like this:

```
Command: E(dit, R(un, F(ile, C(omp,?  [IV.12 B]
```

This is a portion of the **Command menu** (which will be explained when you return to your reading of Part 1). If your computer is set up to display 80 columns at once on the screen, then this top line occupies only a fraction of the width of your screen. If, on the other hand, your computer can display only 52 columns, then this line occupies most of your screen.

The p-System is most commonly used with 80-column screens, so we have assumed that size in the rest of this book. The p-System can adapt to other screen sizes. The Osborne 1 p-System initially assumes that your screen can only show 52 characters at a time.

As we mentioned earlier, your screen is a "window" into a larger screen area. You can type CTRL and one of the arrow keys to move this window. Therefore, for instance, if you should find yourself typing characters off the right edge of the screen, you can type CTRL and left arrow to move the window to the right, so you can see the area of the screen on which you're typing. Use CTRL with right arrow and left arrow right now to experiment with moving the window. When you're finished experimenting, be sure to return the window to its original position.

Because the Osborne actually maintains a larger screen than is visible, you can tell the p-System to assume an 80-column screen, and just use the window movement keys when you want to look at a portion of the screen that is not visible. As you get more experienced with the p-System, and particularly as you get into text editing and program development in Chapters 2 and 3, you will probably want to switch the p-System to an 80-column mode of operation. We'll deal with that when you return to this appendix from Chapter 2.

Now you can return to your reading of Section 1.3.

G.2 MAKING BACK UPS AND CREATING MYVOL:

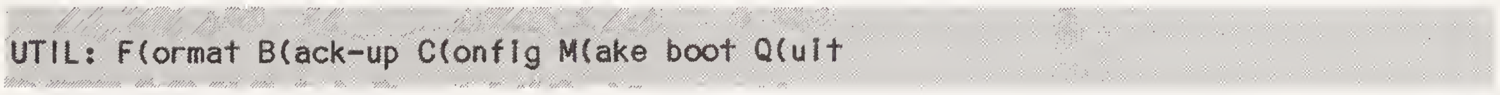
This section describes operations that you need to do in Section 1.7 of Part 1.

There are two tasks in this section. The first is to make an empty p-System volume called MYVOL:. The second task is to make a back up copy of your system diskette and begin using the back up. Each of these tasks requires a blank diskette, so you need two of them to go on from here.

Before you can use a new diskette with your Osborne computer, the disk must be formatted. If one of your old disks goes bad, you may also be able to recover and continue using it if you format it again.

Formatting a disk completely erases any information you had previously stored on it. Don't apply this process to a used disk unless you're positive you don't need the information it contains.

You can use the UTIL program on your OSBORNE: diskette to format diskettes and do several other useful housekeeping operations. Invoke UTIL now by typing X UTIL [[ret]]. The UTIL program displays this prompt:


```
UTIL: F(ormat B(ack-up C(onfig M(ake boot Q(uit
```

Four housekeeping activities can be selected from this menu. Our immediate need is to format a diskette, so select F(ormat by typing F. You are asked to indicate the drive in which you're going to put the disk you want formatted. Type 5 [[ret]] to select drive B (which the p-System refers to as drive #5).

You are now asked to choose between Osborne format and Univeral Medium format for your new disk. Refer to your

Osborne documentation for a discussion of these two formats. For now, simply type O. When you are prompted to do so, load the blank disk in drive B, and press return. The format operation then begins, and dots are written to your screen as the operation proceeds. Here is the screen you should see when the format operation successfully completes:

```
Disk Format Utility

Enter unit number of disk to be formatted (4,5) 5 ⟦ret⟧


WARNING: Format will destroy all data on the disk

OSBORNE or Universal format? (O/U) O

Place disk to be formatted in drive #5
  and press RETURN when ready ⟦ret⟧
Formatting ...................
           ...................
Format successfully completed
```

If an error is reported during the format operation, the diskette you're formatting is probably flawed. Set it aside and try another.

Now you need to create an empty volume called MYVOL: on the diskette you've just formatted. The Z(ero activity in the Filer is the tool you need for this purpose. Type Q to leave the UTIL program, then F Z to invoke the Filer's Z(ero activity. Follow the sequence of prompts and responses below to create the empty volume.

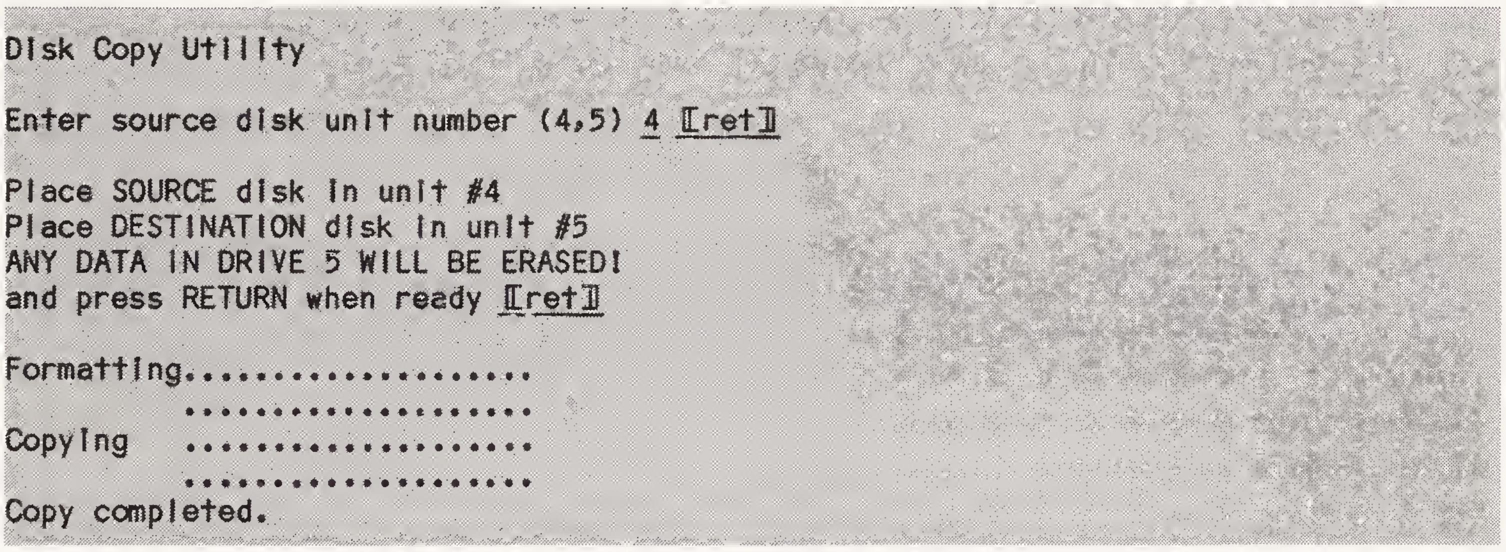
```
Zero dir of what volume? #5: ⟦ret⟧
Duplicate dir? N
# blocks on the disk? 100 ⟦ret⟧
New vol name ? MYVOL: ⟦ret⟧
MYVOL: correct ? Y
MYVOL: zeroed
```

You now have a MYVOL: disk. To confirm that, invoke the V(olumes activity. MYVOL: should appear on the on-line volumes list next to "5 #."

Now we move on to the second task: making a copy of your OSBORNE: diskette. Use Q(uit to leave the Filer and execute UTIL by entering the following: X UTIL ⟦ret⟧.

This time, press B to select the B(ack-up activity. You are immediately asked to identify the drive containing the disk you want to copy. Since the disk you want to copy is OSBORNE: in drive #4 (drive A, that is) enter 4 [[ret]] in response to this prompt. (You could also choose to copy the disk in drive B by entering 5 [[ret]].)

After a reminder about the copy operation you have requested, you are asked confirm your readiness by pressing [[ret]]. Then the destination disk (which will become the new system disk) is formatted and the copy made. Here is the screen that results from a successful copy operation:



```
Disk Copy Utility

Enter source disk unit number (4,5) 4 [ret]

Place SOURCE disk in unit #4
Place DESTINATION disk in unit #5
ANY DATA IN DRIVE 5 WILL BE ERASED!
and press RETURN when ready [ret]

Formatting..................
          ..................
Copying   ..................
          ..................
Copy completed.
```

When the copying is done, remove the newly made system disk from Drive B and label it "OSBORNE:". (If you write on the label after it's on the diskette, be sure to use a felt tip pen.) Remove your original system disk from Drive A and store it away in a safe place. Put your newly made copy in Drive A and press RESET, followed by RETURN, to start up the p-System using the new diskette.

Both tasks are now complete. Return to Part 1 at Section 1.9.

G.3 EDITOR SET UP DETAILS

This section is coordinated with Section 2.1 in Part 1.

Since the Screen-oriented Editor is already on the OSBORNE: diskette, there is no need for you to set up the Editor. If you have an Executive, return now to Section

2.2. If you have an Osborne 1, you may need to change the screen size configured for your p-System. The rest of this section explains how.

If you p-System is still configured to use a 52-column screen, you should probably change to the 80-column orientation for this chapter. If your screen can show only 52 columns, you can use CTRL and the arrow keys to see any part of the 80 columns that you want.

The file called SYSTEM.MISCINFO on your OSBORNE: diskette contains the screen width used by the p-System. To change to 80-column orientation, you need to establish the file 80COL.MISCINFO as your SYSTEM.MISCINFO. Enter the Filer and invoke the C(hange activity twice as shown in the screens below to make this change, and preserve your current MISCINFO file as 52COL.MISCINFO:

```
Change what file? SYSTEM.MISCINFO [ret]
To what? 52COL.MISCINFO [ret]
SYSTEM.MISCINFO      ---> 52COL.MISCINFO
```

```
Change what file? 80COL.MISCINFO [ret]
To what? SYSTEM.MISCINFO [ret]
80COL.MISCINFO      ---> SYSTEM.MISCINFO
```

You can use a similar sequence if you ever want to change back to the 52-column orientation. Return now to Section 2.2.

G.4 PASCAL SET UP DETAILS

This section is coordinated with Sections 3.4 and 3.5 in Part 1. At the time of this writing, Osborne has not yet released the Pascal and FORTRAN compilers for use on Osborne computers. Therefore, we don't know the details of setting up to use them. The documentation supplied with your language should describe the files needed for using it. When you know the files that are needed, return to Part 1 and follow the directions for copying the file(s) to your MYVOL: volume.

THE P-SYSTEM ON OTHER COMPUTERS

H

This appendix summarizes the computer-specific information that is needed in order to use this book. There is not enough room in the book to have an appendix for each of the computers that run the UCSD p-System. This appendix provides general guidance for those using computers that we haven't covered specifically in the previous appendices.

Your p-System supplier may have anticipated your use of this book and provided a section in your p-System documentation that follows the format of this appendix. If so, use that section instead of this appendix. Otherwise, use this appendix to help you find the information that you need in the documentation provided by your p-System supplier. If your documentation package contains a supplement that is specific to your computer, that is an excellent place to look.

We assume here that your computer's hardware is installed and configured correctly. We also assume that the p-System is adapted to your particular computer. If it is not, you should read Section 1.2.

There are two major configurations of the p-System offered on many computers. One is called the **runtime system** and the other is called the **development system.**

The runtime system is an inexpensive way to get the capability of running p-System application programs that others have developed. This package does not necessarily include all of the major p-System components. If this is the case with the p-System package that you have, the parts of this book that deal with those components will not apply directly to you. You may want to look through those sections anyway to help decide whether you want to acquire the full p-System.

If you want to develop your own programs, you'll need to acquire the development system. This package usually includes the major p-System components described in this book (although some of these components may be optional products).

There are certain minimum hardware facilities that are required in order for the p-System to run on a particular personal computer. These minimum requirements are:

The UCSD p-System cannot run on all personal computers; there are certain minimum hardware requirements. These requirements are:

o At least 64k bytes of main memory. (Each "k" of memory is 1,024 bytes.)

o At least 160k bytes of disk storage for simple applications and 320k bytes of disk storage for larger applications and program development work.

o A display and keyboard.

H.1 STARTING THE p-SYSTEM THE FIRST TIME

This section is coordinated with the Section 1.3 in Part 1. It has two subsections. The first subsection should help you to fill in the blanks on the inside front cover of this book. The second subsection is intended to help you start the p-System running on your computer.

Recording Your p-System Details

The "p-System Details for Your Computer" form inside the front cover is a handy place to record computer-specific details about your p-System. You may want to look at the corresponding sections in the three previous appendices to see the type of information you'll be entering.

In the first two blank lines, you should enter the type of your computer (such as Osborne or Apple) and your major p-System version (such as IV.0 or IV.1). If you are uncertain about the latter item, wait until the next section, when you will start up the p-System. The p-System version number will be displayed in square brackets at the upper right-hand corner of the screen.

In the next four lines, you can record the type and capacity of the various disk types that can be used with your computer. It is likely that you'll only need one of these lines because you have only one type of disk on your computer, but we provided four lines just to be safe.

In the p-System, disk capacity is expressed in **blocks**, each of which can hold 512 characters. For each type of disk on your computer, enter its capacity in blocks, followed (after the colon) by the disk type. For instance, you might enter "320" and "single-sided diskette". If you have trouble finding out this disk capacity information, skip it for now.

In the next two lines, you should identify your first and second disk drives. These drives are called #4 and #5, respectively, in the p-System. On your computer, for example, #4 may be the left drive, drive A, or drive 0.

If a RAM disk is available on your computer, you should next record the name used to refer to that "disk" in your p-System. You can go through all of Part 1 of this book without knowing this name, so don't worry if you can't determine it easily. Enter "none" if you don't have RAM disk.

On the next line, you can record the kind of access you have to applications distributed on Universal Medium diskettes. The possibilities are discussed in Section 1.16. You can wait until you get to that section to fill in this item, if you wish. This information is only important when you want to acquire Universal Medium applications.

The next line refers to a program you may be using in the next subsection to format your two blank diskettes. You should record the name of the program used for this purpose on your computer. Possible names include DISKFORMAT, FORMAT, TURNKEY, and CONFIG. (All these names would have the .CODE suffix.)

The next line also deals with the preparation of diskettes for use. On some computers, you need to do a "Z(ero" operation after formatting a disk. On other computers, the "Z(ero" is done automatically as part of the format operation. You'll find out in the next subsection which of these alternatives applies on your computer (and what a "Z(ero" operation is!).

The remaining items of the form describe the special keys used in the p-System. Somewhere in your documentation there should be a table of these keys. This table should show you what you need to type in order to produce them. Some of these keys may be obvious. For example, ⟦ret⟧ is often marked "RETURN". For some of these keys, you may have to type two physical keys, together. For example, ⟦eof⟧ is often produced by holding down the Control key and typing "C". The special keys you'll need to use first in Chapter 1 are ⟦ret⟧, ⟦bs⟧ and ⟦break⟧.

You can use the "Other Notes" section of this form for any miscellaneous information that you find pertinent.

Bootstrapping the p-System

The next step is to start the p-System running on your computer. You should consult your documentation to see how to bootstrap the p-System.

This process usually involves placing a bootable system disk into the appropriate drive, so make sure you have the correct disk. Depending upon the computer, the bootstrapping process may take from several seconds to a minute to complete. When it's done, a welcome message is displayed. At that point, you should return to Section 1.9.

H.2 MAKING BACK UPS AND CREATING MYVOL:

This section describes operations that you need to do in Section 1.7 of Part 1.

There are two tasks in this section. The first task is to make a back up copy of your system diskette and begin using the back up copy. The second task is to make an empty p-System volume called MYVOL:. Each of these tasks requires a blank diskette, so you need two of them to go on from here.

On many computers, you must format a new diskette before you can use it. Sometimes a used disk may be reformatted in an attempt to eliminate diskette surface problems. However, formatting a disk completely erases any information you had previously stored on it. Don't apply this process to a used disk unless you're positive you don't need the information it contains.

If you need to format disks with your computer, you will find a disk formatting utility in your p-System package. You may have already determined (in the previous subsection) what this utility is called. You should now consult your documentation to find out how to use your disk formatting program (if your computer requires one). Then format the two new diskettes.

The next step is to copy a system disk onto one of the newly formatted disks. If your p-System has a utility that does this job, use it. Otherwise, place one of the newly formatted disks in #5, and the system disk in #4 (where it probably is already). Invoke F(ile and its T(ransfer activity. You should now follow the sequence of prompts and responses shown below. (The fourth line may not appear.)

```
Transfer what file? #4: [ret]
To where? #5: [ret]
Transfer ### blocks? (Y/N) Y
Destroy BLANK: ? Y
```

You should see the capacity of your system disk (in blocks) instead of the "###" shown above. The "Destroy BLANK:" prompt only appears if your disk formatting utility places a p-System directory on a newly formatted diskette. This prompt may contain some other volume name than "BLANK".

There may be one more step you need to take to complete your new system disk. During the bootstrap process, most computers load a small program from a fixed place on the disk (often at the beginning). This "bootstrap code" proceeds to load the rest of the p-System and start it. A system disk is only bootable if it has this code. If you're lucky, the volume-to-volume transfer operation above moved the bootstrap code from your current system volume to the new one. Alternatively, your disk formatter may automatically install this bootstrap code on new disks it creates.

If neither of the possibilities above applies on your computer, you probably need to do an explicit operation to copy the bootstrap code from your current system disk to the new one you're creating; therefore, you should have a utility program (or an activity within a utility program) to do the job. This utility is often called "Booter." Your documentation should give details on using this bootstrap copy facility if you need it. Follow those directions to complete the creation of your new system diskette. If no such directions are provided, you don't need them (probably because your bootstrap code was automatically copied by one of the methods described in the previous paragraph).

Now, remove the new system diskette and label it. (If you write on the label after it's on the diskette, be sure to use a felt tip pen.) The back up task is now complete.

In order to create MYVOL: with a size of 100 blocks, put the remaining blank disk in drive #5 and invoke the Z(ero activity. The function of Z(ero is to create an empty volume (that is, one that has no files). You should select Z(ero and respond like this:

```
Zero dir of what volume? #5: [ret]
Destroy BLANK: ? (Y/N) _
```

The second line may not appear. If it does appear, you should look at the volume name (it may not be "BLANK:"). If that volume name is similar to "BLANK:" or "FORMAT:", then this is the name that your disk formatter gave to your new disk. If this volume name is similar to "SYSTEM:", "PASCAL", or "PSYS:", then *you are using Z(ero on the WRONG disk!!* You have accidentally started to Z(ero one of your p-System diskettes; type "N" and start over, making sure to follow the instructions above carefully.

Z(ero displays several more prompts. If the "Destroy BLANK: ?" prompt appeared above, you should follow this sequence of prompts and responses:

```
Zero dir of what volume? #5: [ret]
Destroy BLANK: ? (Y/N) _
Duplicate dir? N
Are there ### blks on the disk ? (Y/N) N
# blocks on the disk? 100 [ret]
New vol name ? MYVOL: [ret]
MYVOL: correct ? Y
MYVOL: zeroed
```

If the "Destroy BLANK: ?" prompt did not appear, you should follow this sequence of prompts and responses:

```
Zero dir of what volume? #5: [ret]
Duplicate dir? N
# blocks on the disk? 100 [ret]
New vol name ? MYVOL: [ret]
MYVOL: correct ? Y
MYVOL: zeroed
```

You now have a MYVOL: disk. To confirm that, you can invoke the V(olumes activity. MYVOL: should appear in the on-line volumes list next to "5 #". Remove MYVOL: from the drive and label it as you did your new system volume.

The last thing to do is start up the p-System again using your newly made system disk. Remove the original system diskette and store it in a safe place. Using your new system diskette, follow the bootstrapping procedure that you used earlier in this appendix. If there is a short cut procedure for booting when the computer is already turned on, you may want to use it. When your new p-System diskette has successfully bootstrapped, return to Part 1 at Section 1.9.

H.3 EDITOR SET UP DETAILS

This section is coordinated with Section 2.1 in Part 1.

If you have the full p-System, you have the Screen-oriented Editor. It is probably on your system diskette which means that there is nothing that you need to do in order to set it up.

If SYSTEM.EDITOR is on another disk, you need to copy it onto MYVOL:. Enter the Filer and select T(ransfer. Now, place the disk containing SYSTEM.EDITOR in #4, and MYVOL: in #5. Follow this sequence:

```
Transfer what file ? #4:SYSTEM.EDITOR [ret]
To where ? MYVOL:SYSTEM.EDITOR [ret]
```

Now place the system disk back into #4 and return to the Command menu by typing Q. You can now proceed through Chapter 2.

If you have the runtime system, it is possible that you do not have the Editor. You may want to look through Chapter 2 anyway, however.

H.4 PASCAL SET UP DETAILS

This section is coordinated with Section 3.4 in Part 1, and is intended to help you find the Pascal compiler. It is possible that you do not have this compiler. For example, you may have the runtime system, or you may only have FORTRAN. If this is the case you will not be able to follow along with Section 3.4.

If you do have the Pascal compiler, it is probably on a disk with a name such as PASCAL:. Locate that disk now, insert it in drive #5: and invoke the Filer's L(ist directory activity. (Type F L #5: [[ret]] from the Command menu.) Most likely, you should see the file SYSTEM.COMPILER. If, for some reason, the compiler has a different name, you should note it. You should also note the name of the disk that contains the compiler.

On IV.0 systems, it is possible that you have two compilers; one for two-word real numbers, and one for four-word real numbers. (See Section 1.18 for a discussion of real number sizes.) You should note the name of the compiler that corresponds to the real number size of the system that you are using. For example, you may have these two files:

```
SYSTEM.COMPILER
PASCAL4.COMPILE
```

The first compiler is for two-word systems and the second compiler is for four-word systems. Your documentation should state the real size of the system disk that you are using.

Return now to Section 3.4, and we will show you how to copy the compiler onto the MYVOL: volume.

H.5 FORTRAN SET UP DETAILS

This section is coordinated with Section 3.5 in Part 1, and attempts to assist you in setting up the FORTRAN-77 compiler and associated runtime library. FORTRAN may not be available with your particular p-System package.

If you do have FORTRAN-77, it is usually on a disk labeled FORTRAN:. Locate that disk now, and insert it the drive #5:. Invoke the Filer's L(ist directory activity to view the directory of that disk. (Type F L #5: [ret] from the Command menu.) You will probably see the following files:

```
FORTRAN2.CODE
FORTLIB2.CODE
FORTRAN4.CODE
FORTLIB4.CODE
```

There is one compiler/runtime library set supporting two-word real numbers, and one set supporting four-word real numbers. If you are using a two-word real system, you need the first two files. Similarly, you need the last two files if you are using a four-word system. If you are uncertain which size of real numbers is supported by the system you are using, you should consult your other documentation. The system disk should be designated as supporting two-word reals, four-word reals, or no real number arithmetic at all.

If the system that you are using doesn't support real numbers, you can't use FORTRAN. You may have another system disk which does support real numbers. With some systems you must first reconfigure the p-machine emulator in order to use real numbers. This should be explained in your other documentation.

When you have determined which two of these four files are needed, return to Section 3.5, and we will show you how to copy these files onto the MYVOL: volume.

GLOSSARY

Activity: An item on the menu of a p-System program. For example, X(ecute is an activity on the Command menu.

Adaptable System: A variation of the p-System that allows you to write the low-level device interface code which handles the peripherals on a specific computer. Once this installation process is done, the p-System can be used on the new computer.

Anchor: In the Screen-oriented Editor, the position of the cursor when D(elete is invoked. When the cursor is moved away from this position, text disappears. When the cursor is moved toward this position, text reappears.

Application Program: A computer program that meets specific needs of a personal computer user. Examples include a payroll program or an oil well supervision program.

Assembler: A program that translates human-readable assembly language into machine code.

Associate time: The time taken by the Version IV operating system to find and stitch together the units referenced by a program. This stitching together must occur before the program can begin execution.

Back File: A back up file for text files that is identified by the suffix .BACK; for example, FILENAME.BACK.

Back Up: The operation of making an extra copy of important information (usually on a storage volume, in this book). Also, the extra copy that results from this operation.

Bad Block: A 512-byte area on a storage volume that is somehow damaged. The result is that information cannot be stored or retrieved from there.

Bad File: An immobile file used to prevent the use of bad blocks on a disk. A bad file is identified by the suffix .BAD; for example, BAD.00120.BAD.

BASIC: A popular high level programming language that is supported in the p-System.

BIOS: Basic Input/Output Subsystem; that portion of a p-machine emulator that is specific to a particular brand of computer.

Bit: The minimum unit of storage on most computers. A bit is either "on" or "off."

Block: The 512-byte unit of storage and retrieval that is used with p-System storage volumes.

Block-Structured Device: Referred to in this book as "Storage Volume." Earlier p-System documentation, and many p-System prompts and error messages still use "block-structured device," or "blocked device," when referring to storage volumes.

Bootstrap: The action of starting (or that piece of code which starts) the p-System running. You must bootstrap the p-System before you can do anything with it.

Boot Volume: See "System Disk."

Bug: A defect in a program that causes it not to operate as intended.

Byte: A unit of computer storage. Usually has the capacity to store 8 bits of information, or a number in the range 0 through 255.

Chaining: See "Program Chaining."

Client: A program or unit which uses another unit.

Code File: A file that contains the compiled or assembled version of a program or program segment. Usually identified by the suffix .CODE; for example, FILENAME.CODE.

Code Segment: The smallest component of a p-System program that can be moved into (or removed from) main memory during the running of the program.

Communication Volume: A p-System I/O device that doesn't store information on a long-term basis; for example, the console or the printer.

Compilation Unit: A unit (as represented in any of the three p-System languages) or a program. The smallest module that a language allows to be compiled separately.

Compiled Listing: The source lines of a program, annotated by the compiler with details of the results of compilation, including sizes of statements, sizes of data areas, and other information.

Compiler: A program that translates the human-readable source text of a program into p-machine-executable p-code.

Copy Buffer: In the Editor, a storage area in which text can be temporarily stored after it has been deleted from the workspace or while it is being copied from one place to another in the workspace.

Cursor: An indicator that highlights a particular point on a display screen. In many situations, characters typed at the keyboard appear on the screen at the location of the cursor.

Data Entry Prompt: See "Prompt."

Data File: A file that contains arbitrary user data. No particular internal structure is assumed. No special file name suffix is required, but .DATA is often used.

Declare: To establish the name and type of an identifier used in a computer program. Some languages (Pascal, for instance) require that all identifiers be declared before they are used.

Decode: A utility used to inspect the contents of code files.

Default: A state or action which will take effect unless an explicit action is taken to choose another possibility. For instance, in S(et E(nvironment in the Editor, there are many options that can be set. All of them have default settings which determine the operation of the Editor until they are changed.

Default Disk: The volume where the p-System looks for a file unless the file specification explicitly indicates another volume.

Delimiter: A "fence" that marks the boundaries of a sequence of characters. In the Editor, for instance, delimiters enclose the target string sought by F(ind. These delimiter characters cannot be letters or numbers, but they can be any of the special characters, such as "&" or "/".

Device: Peripheral equipment accessible to the p-System. There are two varieties: storage and communication. Originally, and sometimes still, a device was referred to as a "unit." This usage has been changed to avoid confusion with the UCSD Pascal language construct of the same name.

Device Number: A number used to refer to a particular storage or communications volume. It is always preceded by a number sign (#) and usually followed by a colon (:). Also known as "unit number." Example: #5:.

Direction Indicator: In the Screen-oriented Editor or EDVANCE, the flag at the upper left corner of the screen that indicates the assumed direction for various editor operations.

Directory: An area on a storage volume that contains "house-keeping" information (such as names and locations) about the files on the volume.

Directory Listing: A human-readable list, usually on the console, of the files on a given storage volume, along with miscellaneous information about each file.

Editor: A p-System program that is used to examine, create and modify text files.

EDVANCE: The Advanced Editor. EDVANCE incorporates a wide range of enhancements over the p-System Screen-oriented Editor.

Execute: To give control of the p-System to a program (usually via the X(ecute activity).

Execution Error: An error detected by the p-System during the execution of a program. When such an error is detected, a message is produced on the console. The message includes error coordinates indicating the program section that was executing when the error occurred. Usually the program must be canceled and the p-System reinitialized.

Execution Option String: A sequence of execution option statements, usually entered in response to the X(ecute prompt. Individual execution options can affect a variety of aspects of p-System operation, such as the prefix volume, the source of input, and so on.

Extended Memory: A facility available on some p-Systems that allows programs to use up to 64,000 bytes of main memory for data, plus another 64,000 bytes for program segments.

File: A named collection of information on a storage volume. Also (less frequently), a stream of information transmitted through a communication volume.

File Specification: A description of a source for input or a destination for output in the p-System. A file specification has three major components, all of which are optional: the Volume ID, the File Name, and the Size Specification.

File Suffix: One of several special endings for file names. The file suffix usually indicates the file type. The standard file suffixes are .TEXT, .CODE, .SVOL, .BACK, .DATA, .BAD, and .FOTO.

Floating Point Number: See "Real Number."

Format: To prepare a disk for use with the p-System. This involves writing addresses and other control information on the disk. Any user information previously stored on the disk is destroyed by this operation.

FORTRAN-77: A popular high level programming language supported in the p-System.

Foto File: A file that contains graphic images for use by Turtlegraphics. The name of the file has the suffix .FOTO; for example, PICTURE.FOTO.

Fragmented: The condition of a p-System storage volume when the total unused space on it is spread among many small areas. The size of the largest file that can be stored on a fragmented volume is the size of the largest single area.

Identifier: The name of an object in a programming language such as Pascal.

I/O: Input and output.

I/O Error: An error detected by the p-System during an input or output operation. For example, a disk write will fail if the disk has been inappropriately removed from its drive. An I/O error is one kind of execution error.

I/O Redirection: A feature that allows the p-System's input to come from some place other than the keyboard. Also, output for the p-System can be sent to some place other than the screen.

I/O Result: A number indicating the success or failure of a p-System I/O operation. If this number is zero, the operation was a success; otherwise, the number identifies the problem that occurred during the I/O operation.

Instruction Set: The fundamental operations that a microprocessor is capable of performing. Different kinds of microprocessors usually have different instruction sets.

Integer number: A whole number (without a fractional part).

Interpreter: See "p-machine emulator."

KSAM: Keyed sequential access method; a file management facility available for the p-System.

Library: A code file that contains one or more units which can be used by programs or other units.

Library Text File: A text file containing a list of library file names. When a program is invoked, the libraries listed in the current library text file are searched for any units needed by the program.

Library Utility: The p-System library management facility. It is used to inspect, modify, and create libraries and other code files.

Linker: A p-System program that combines assembled code files with each other or with a compiled code file. Also called a "link editor."

Long Integer: A language feature of UCSD Pascal that supports integer arithmetic with up to 36 decimal digits of precision.

Marker: A named, invisible flag on a particular location within a text file.

Menu: A list of available activities that is displayed on the screen by the operating system and many p-System programs. An activity can be selected from a menu with a single keystroke.

Microprocessor: A miniaturized computer. Provides the computational power for most personal computers. Executes the instructions of the software running in the personal computer.

Module: A component of some larger structure with the attribute that it can be handled separately from the rest of the structure in some sense. A UCSD Pascal unit is a module of a program.

Mount: To cause a subsidiary volume to be accessible to the p-System.

Multitasking: The execution of two or more tasks concurrently within a single UCSD Pascal program.

Native Code: Machine level code that is produced by the native code generator as the translation of a section of p-code.

Native Code Generator: A program that translates portions of an executable p-code file into native code. The resulting code file always contains a combination of p-code and n-code.

n-code: See "Native Code."

Nonblock-Structured Device: Referred to in this book as "Communication Volume." Earlier p-System documentation, and many p-System prompts and error messages still use "nonblock-structured device," or "unblocked device," when referring to communication volumes.

Object code: The machine-readable representation of a computer program.

On-Line: The status of a volume when the p-System can access it. For a storage volume to be on-line, the disk must be in the appropriate drive. For a communications volume to be on-line, the I/O device must be properly connected and turned on.

Pascal: A widely used high level language. UCSD Pascal, an extended version of this language, is the principal programming language in the p-System.

p-code: Psuedo-code: p-machine code generated by the p-System compilers and executed by the p-machine emulators.

p-machine: An idealized pseudo-computer optimized for high level language execution on small host machines; the foundation of the p-System's portability.

p-machine emulator: The part of the p-System that allows a host microcomputer to imitate the operation of the p-machine. It is implemented in the assembly language of the host computer.

PME: See "p-machine emulator."

Portability: The ability to move executable code between dissimilar microcomputers without recompilation or other change. This is possible in the p-System because programs are compiled into p-code that can be executed on any computer on which the UCSD p-System has been installed.

Prefix disk: See "Default Disk."

Print Spooler: A facility for printing text files concurrently with other activities in the p-System (particularly text editing).

Procedure: A named subprogram that handles part of the job of a larger program or unit.

Program: A set of detailed instructions that direct a computer in the performance of a specific task. Also, the process of creating such a set of instructions.

Program Chaining: Causing the automatic execution of one program from another program.

Prompt: A request (by a p-System program) for information from the p-System user; the user is expected to enter the information at the keyboard, followed by [[ret]].

p-System: See "UCSD p-System."

RAM: Random Access Memory. See "Main Memory."

RAM Disk: A logical storage volume maintained in main memory. It can generally be used for the same purposes as a conventional disk volume (including storage of files), but the information it contains is usually lost when the computer is turned off.

Real Number: A number that can have a fractional part, such as "5.67982".

Reboot: To start up the p-System again. To "rebootstrap."

Redirect: See "I/O Redirection."

Root Volume: See "System Disk."

Runtime Software: p-System software that is needed to run programs.

Screen-oriented Editor: The principal text editing tool of the p-System. It is optimized for use with display consoles, rather than printing consoles.

Script File: A file containing characters representing the keystrokes that you would type during a session with the p-System. When p-System input is redirected to this script file, those keystrokes are read as if they were coming from the keyboard, and the session is recreated.

Segment: See "Code Segment."

Source text: The human-readable form of a computer program. (Also referred to as "source code.")

Special Character: A visible character that is not a number (0 through 9) and not a letter (A through Z). Examples of special characters include "*", "/", "(", and "@".

Special Key: A keyboard key that has a particular meaning to the p-System other than representing an ordinary visible character. Example: the [[ret]] key.

Storage Volume: An input/output device that can store information written to it, for retrieval at a later time. Usually some sort of a disk, but can be an area of main memory, as well. (See "RAM disk".)

Subsidiary Volume: A file on a storage volume that contains its own volume structure with a directory and files. This subsidiary volume becomes accessible to the p-System when it is "mounted." The subsidiary volume facility of p-System Version IV.1 supports a two-level file heirarchy.

Substitute String: The character pattern that is to take the place of instances of the target string which are found by the R(eplace activity in the Screen-oriented Editor.

.SVOL File: A file identified by the suffix .SVOL that contains a subsidiary volume; for example, NAME.SVOL.

Syntax: The rules governing the structure of a program written in a computer programming language.

Syntax Error: A place in a computer program where the rules of the programming language are violated.

System Disk: The disk from which the p-System was bootstrapped. It contains the operating system software. Also known as "root" or "boot" disk. All three of these adjectives also occur with "volume" instead of "disk."

System Files: The disk files which contain the main components of the UCSD p-System.

Target String: The character pattern sought by the F(ind and R(eplace activities in the Screen-oriented Editor.

Text File: A file that contains user-readable information (as opposed to machine code); usually identified by one of the suffixes .TEXT or .BACK.

Turtlegraphics: A package of routines that creates and manipulates images on a graphic display.

Type Ahead: A capability of a p-System implementation to store keystrokes that are typed before the p-System is ready to process them.

UCSD: University of California at San Diego. Site of the original development work on the p-System.

UCSD Pascal: A programming language, an extended version of the language Pascal.

UCSD Pascal System: The original name of the p-System.

UCSD p-System: A portable microcomputer software environment for execution and development of applications programs.

Unblocked Volume: See "Nonblock-structured Volume."

Unit: A package of routines and associated data structures written in a p-System programming language (usually UCSD Pascal). The facilities implemented by the unit (or a subset of them) can be used by programs or by other units.

Universal Medium: A 5-1/4 inch diskette format that is accessible to many types of small computers. It facilitates the distribution of p-System-based personal computer application programs.

Utilities: Programs that assist in various areas of p-System use such as developing programs, maintaining files, printing files, and so forth.

Volume: A logical entity representing a p-System peripheral device. There are two categories of volumes: storage volumes (such as a disk) and communicaton volumes (such as the console or the printer).

Volume ID: Short for "Volume Identifier." The designation of a particular volume; for instance, its name or device number.

Window: In the Screen-oriented Editor, the portion of the display screen that is used to show a section of the workspace being edited.

Workfile: Special file(s) that are automatically processed by major p-System components, including the editors and compilers. This automatic handling is particularly convenient during the development of small programs.

Workspace: Text kept in main memory by a p-System Editor during the editing process. Also called the "buffer."

Write-Protect: Mark a storage volume in some way so that an error is reported if the p-System attempts to write information onto the volume. (Reading is allowed, but writing is not.) Used to protect valuable data from accidental erasure. The physical mechanism used to signal write-protection of a volume varies with the storage medium used. For instance, 5-1/4 inch diskettes have a different convention than 8 inch diskettes. Check the documentation for your computer to find out how to write-protect the media that you use.

XenoFile: A utility package that allows you to access disks that contain data formatted for the CP/M operating system.

YALOE: Yet Another Line-Oriented Editor; the p-System editor used with printing terminals rather than with display terminals.

Wild Cards: Special symbols in file names that allow a group of files to be represented by a single file name.

INDEX

QUICK INDEX TO MAJOR p-SYSTEM ACTIVITIES

Menu	Def. Page	Errors Page	Activity
Command:	163	342	A(ssemble assembly language
	166	343	C(ompile high level language
	169	343	D(ebug a program
	170	344	E(dit a text file
	171	345	F(ile manage
	172		H(alt the p-System
	173		I(nitialize the p-System
	174	345	L(ink edit assembly language
	176	346	M(onitor keystrokes for script
	178		R(un the workfile
	179	346	U(ser program restart
	180	347	X(ecute a program
Editor:	206	349	A(djust horizontal positioning
	209	350	C(opy text at cursor
	211	350	D(elete text
	213	351	F(ind text pattern
	215	351	I(nsert text
	219	352	J(ump in workspace
	220	352	K(olumn move
	222	353	M(argins enforce
	224		P(age move
	201	353	Q(uit editor
	225	353	R(eplace text pattern
	228	354	S(et E(nvironment for editing
	233	354	S(et M(arker in workspace
	234		V(erify window status
	235	355	X(change characters
	237	355	Z(ap some text from workspace
Filer*:	245	358	B(ad block scan
	247	358	C(hange file name(s)
	249		D(ate set
	250		E(xtended directory list
	252	359	F(lip-swap/lock. Load/unload Filer
	253	359	G(et a new workfile
	255	359	K(runch a volume
	258		L(ist directory
	260	360	M(ake a file
	262		N(ew. Clear workfile
	263	360	O(n-line/off-line
	265		P(refix disk choice
	243		Q(uit the Filer
	267		R(emove file(s)
	269	360	S(ave workfile
	271	361	T(ransfer file(s)
	275		V(olumes list
	277		W(hat. Workfile status

p-SYSTEM FILE CONVENTIONS

A File Specification ("Spec") has three parts: **Volume ID**, **File Name**, and **Size Spec.** These must occur in that order, but any of the three can be left out. If the File Name is omitted, the File Spec refers to an entire volume. The Size Spec is only used when a file is created.

If the **Volume ID** is...	Then the file is on the...
o left out or ":"	o **default** volume.
o **Volume Name** ":"	o named volume.
o "*"	o **system** volume.
o "#" **Device Number** ":"	o volume associated with that device.

A **Volume Name** must...
- o have seven characters or fewer.
- o contain only letters (A - Z), digits (0 - 9), period, underline, dash, slash, and back slash.

A **File Name...**
- o must have fifteen characters or fewer.
- o must contain valid characters as defined above.
- o may have a **File Suffix** indicating its type.

If the **File Suffix** is...	Then the file is...
o ".TEXT"	o a text file.
o ".BACK"	o a backup text file.
o ".CODE"	o an executable code file.
o ".SVOL"	o a subsidiary volume file.
o ".BAD"	o a file containing bad blocks.
o anything else	o a data file.

If the **Size Spec** is...	Then the size of the file is the...
o left out or "[0]"	o largest unused area.
o "[" **number** "]"	o indicated number of blocks.
o "[*]"	o larger of 1) second largest area, or 2) half the largest area.

The standard **Device Numbers** and **Volume Names** are:

#1:	CONSOLE:	Display and keyboard with echo
#2:	SYSTERM:	Display and keyboard without echo
#3:		Reserved for future use
#4:	________	First storage device
#5:	________	Second storage device
#6:	PRINTER:	Printing device
#7:	REMIN:	Serial input
#8:	REMOUT:	Serial output

PERSONAL COMPUTING WITH THE UCSD P-SYSTEM™

Mark Overgaard • Stan Stringfellow

This book introduces you to the UCSD p-System, a software environment that can be used on most kinds of personal computers. The p-System allows you to use a host of application programs that others have developed. These programs can help you to run a company, to write a book, or assist you in many other pursuits.

You can even develop your own programs, either for use as serious tools or for entertainment or education. This book emphasizes three types of p-System uses: using application programs that others have developed; editing and printing texts; and developing your own programs.

Each of the three parts of the book provides a different perspective on their three areas:

- **Getting Started** shows you (in a "hands-on," step-by-step fashion) enough of the capabilities of the p-System for useful work in the three areas of interest.
- **Getting Interested** provides descriptions of all the basic p-System facilities and is organized so that you can read it systematically or reference it occasionally.
- **Getting Serious** provides a "larger view" of the p-System, describes aspects of the p-System's design that may influence how you use the system in the longer term, and introduces the wide range of additional tools and program building blocks that are available for the p-System.

PRENTICE-HALL, INC., Engl

ISBN 0-13-658070-