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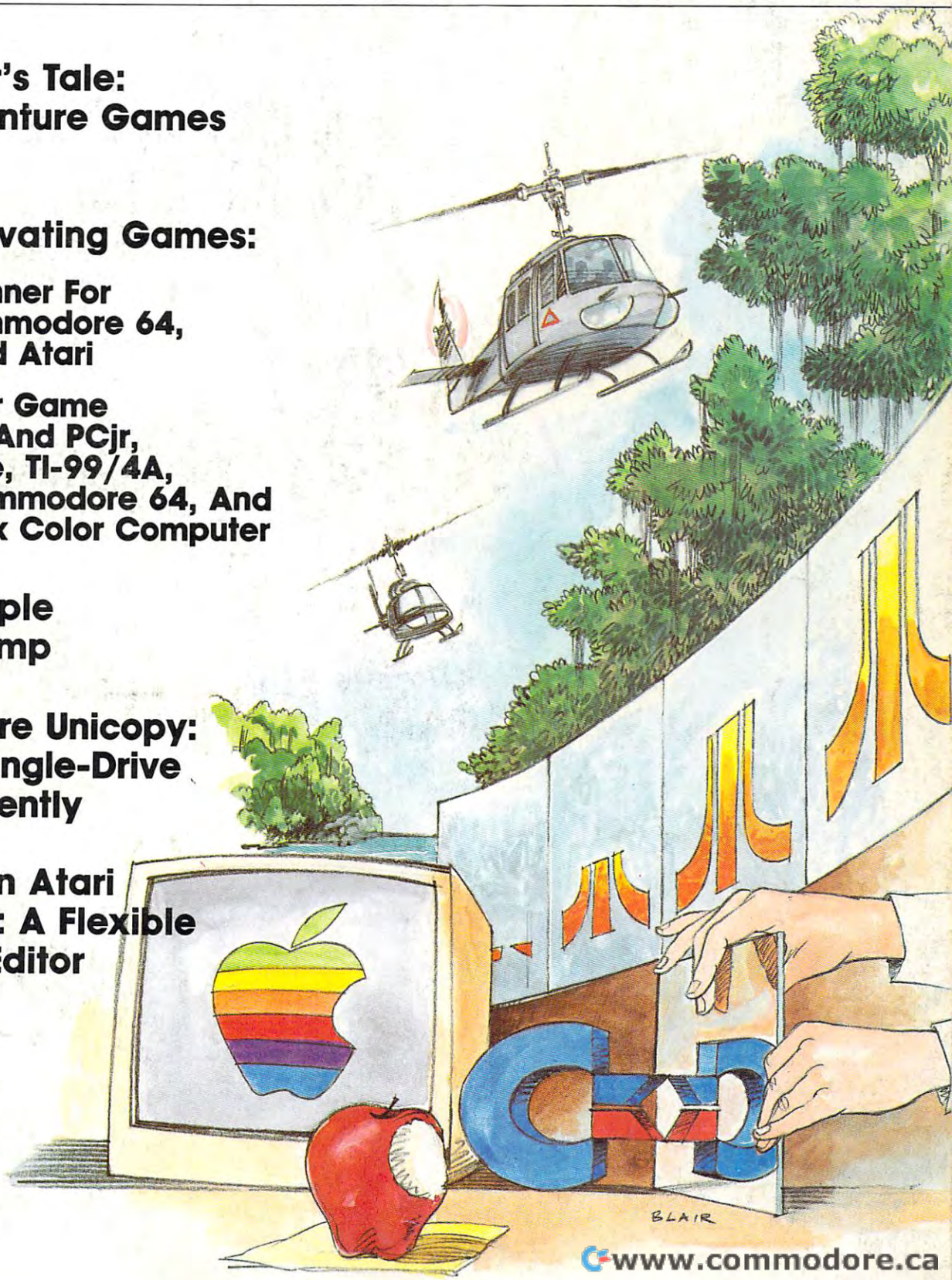

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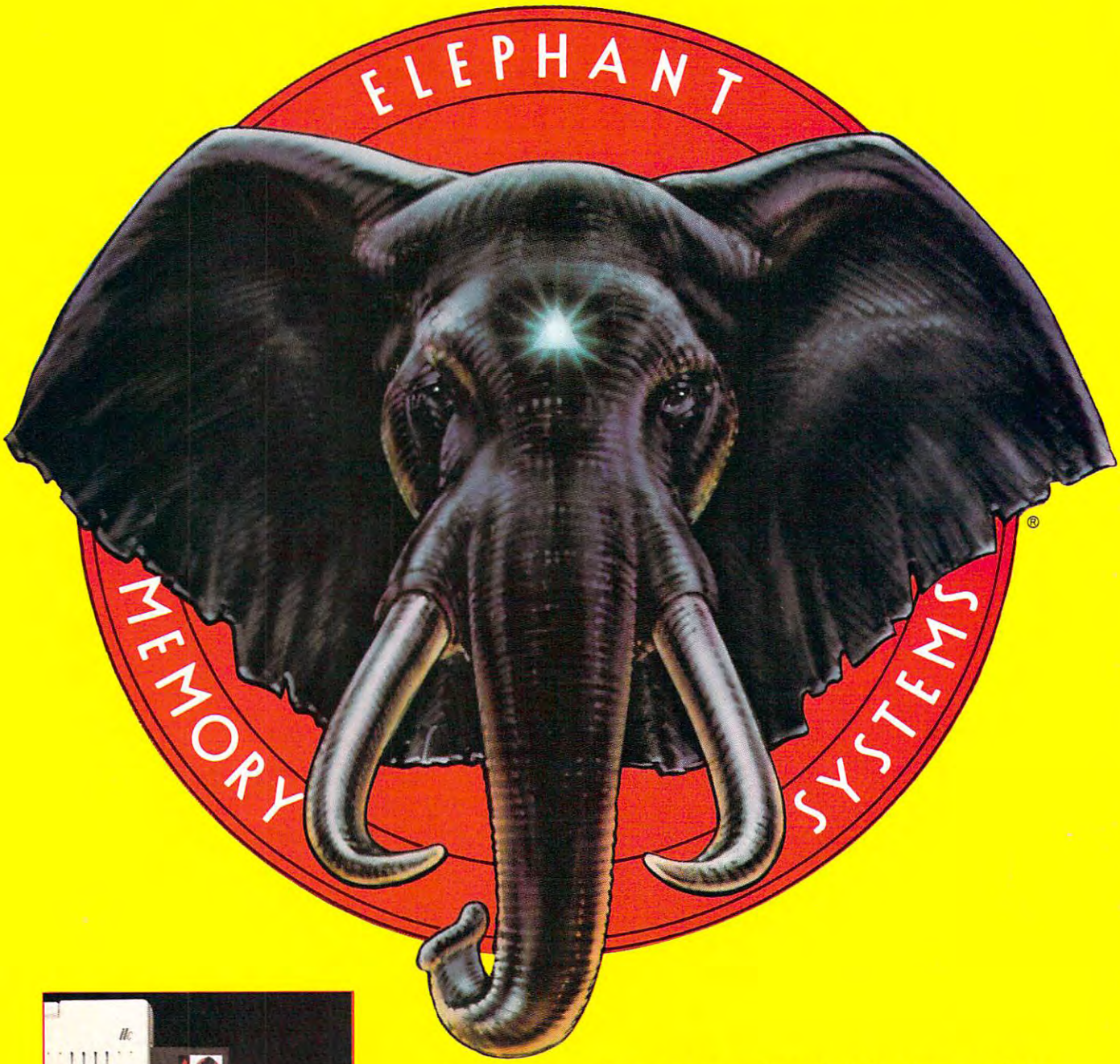

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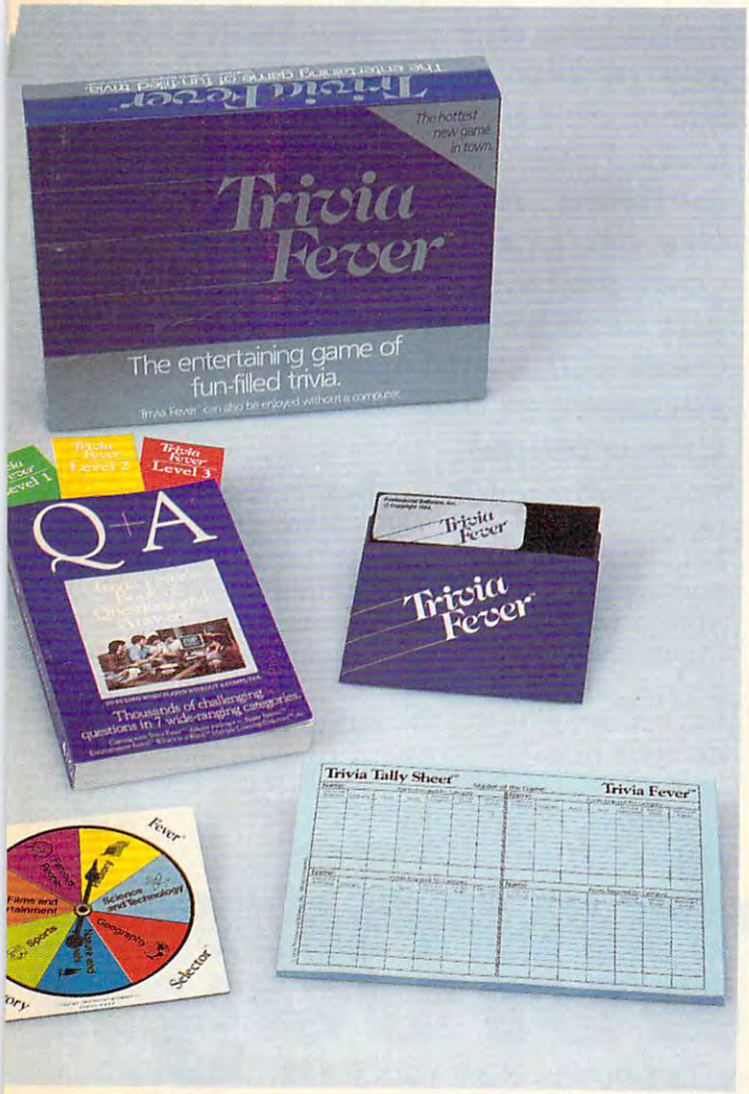

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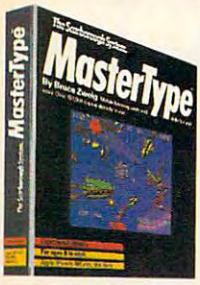

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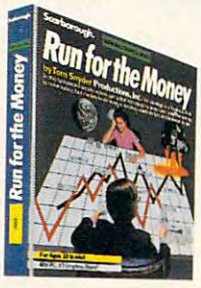

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EDITOR'S NOTES

The Editor's Notes this month are written by Tom R. Halfhill, new editor of COMPUTE!.

Robert Lock
Editor In Chief,
COMPUTE! Publications

A New Beginning

Nearly two and a half years ago, Robert Lock hired me as features editor of COMPUTE!. At that time the editorial staff consisted of four full-time people. We occupied a few offices in an old building near downtown Greensboro, and the circulation of COMPUTE! was about 75,000.

Today COMPUTE! Publications has an editorial staff of more than 50 full-time people. Together with about 70 employees of other departments, we occupy an entire floor in a new office building, with warehouse and shipping facilities across town. COMPUTE! is approaching 400,000 circulation. Our second magazine, COMPUTE!'s GAZETTE, has gained more than 300,000 readers in just over a year of existence, and our Book Division consistently places titles on computer-book bestseller lists. In mid-1983, COMPUTE! Publications became a part of ABC Publishing, a subsidiary of the American Broadcasting Company.

Obviously, we have gone through a great many changes in the past two and a half years. Hundreds of other companies in the computer industry have experienced the same kind of phenomenal growth, of course. But now that the industry is maturing, the spectacular growth of those first few years is leveling off and is becoming more like the steady, sustainable growth common to other industries. Some companies which became accustomed to annual growth rates of 50 percent, 100 percent, or even more are suddenly finding themselves in trouble because they assumed the roller coaster would keep speeding forever. That's partly why some of those companies are cutting back, laying off, and even going out of business. In an industry where the market changes almost monthly, you have to be quick on your feet to survive.

At COMPUTE!, so far we've managed to keep pace with the changes. There have been plenty of growing pains which have demanded much from our staff, but we've always remained flexible and succeeded in pulling together.

My own path shows how fast things change around here. After less than a year as features editor, I was appointed founding editor of our second magazine, COMPUTE!'s GAZETTE. The first few months were a struggle, but with lots of hard work, together we built the GAZETTE into the most successful new magazine in the industry. Then, just as things started rolling along smoothly, I was assigned to another new project—COMPUTE!'s PC & PCjr magazine. The new IBM PCjr was arriving on the market and it seemed destined to become the success story of 1984.

As you probably know by now, things didn't quite work out that way. The PCjr didn't sell, so neither did our new magazine. We decided to stop publication with the October 1984 issue.

But that's not all bad. After more than a year's absence, I'll be returning full-time to our flagship magazine, COMPUTE!—this time as its new editor. Richard Mansfield, who has handled COMPUTE!'s daily duties for more than three years, will continue as senior editor of COMPUTE Publications, helping to supervise editorial operations for both our magazines and our Book Division.

And we have a number of improvements planned for COMPUTE! to strengthen its position as the leading magazine for home, educational, and recreational computing. For one thing, we'll be merging our IBM coverage into COMPUTE! to serve both our existing IBM subscribers and several thousands of new readers joining us next month from COMPUTE!'s PC & PCjr. More programs will be translated for the PC and PCjr, and there'll be some IBM reviews and stand-alone articles as well. We're also adding a new column next month, "IBM Personal Computing," by Donald B. Trivette.

Apple readers can expect more attention, too. With the introduction of the Apple IIc and Macintosh, plus heavily discounted prices on the Apple IIe, we've noticed a resurgence of interest in Apple coverage. More of our programs will be translated for the Apple, and we're beefing up coverage in other areas also.

If you use a Commodore, Atari, or TI, don't despair. You still make up the bulk of our readership and therefore deserve the most coverage in COMPUTE!. We won't let you down. If anything, we plan to strengthen our coverage of your computers.

You might be wondering how it's possible to increase coverage for everybody without taking something away from somebody. That's always a concern in a multimachine magazine. Our solution: We'll be reorganizing our regular columns, streamlining the articles, and taking great pains to make sure the articles and programs we publish continue to be of the highest possible quality.

For example, in coming issues you'll notice that some columns will be consolidated and new ones will be added. Programs will be translated to run on as many computers as possible. And we'll make a renewed commitment to minimize errors and publish the best computer magazine on the market.

You'll begin noticing these improvements within the next few issues—we're making them as fast as possible. That's the way things happen in the computer industry.

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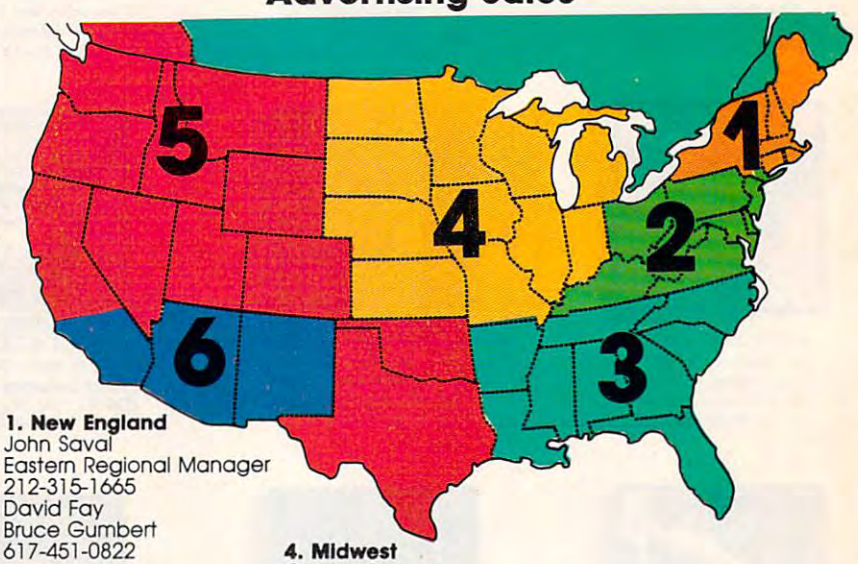

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"Game of the Month" —Byte: February, 1984

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- **T.A.C.** can be played solitaire against the computer or as a two player (or two team) game with the computer as mediator.
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- Choose from five different scenarios to play. Actions range from open meeting engagements to assaults against prepared positions.
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BY RALPH BOSSON

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READERS' FEEDBACK

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What's An EPROM?

I would like to know what an EPROM is. What can an EPROM do for my computer?

Scott Szurgot

An EPROM is a special kind of computer memory. Like ROM (Read Only Memory), it retains information even when the power is turned off. However, it can also be erased or changed, like RAM (Random Access Memory).

EPROM stands for Erasable Programmable Read Only Memory. It can be overwritten, but only by a special device called a burner.

The most frequent use of EPROMs is for creating cartridges at home. With an EPROM and an EPROM burner, the device that writes to the EPROM, you can store a frequently used program on the EPROM and put the EPROM on a cartridge board. Then every time you need to use the program, you can just plug it into the cartridge port. It will be immediately available.

Machine Language Commands

Has COMPUTE! ever published a list of all the 6502 machine language commands? If you have, please let me know in which issue, and if not, please do so. At least, please tell me where I could get such a list.

Steve Brush

Machine Language for Beginners *(COMPUTE! Books) has the list that you are looking for and also includes detailed explanations of how to use the commands. Also, two new COMPUTE! books on machine language are being published this fall.* The Second Book of Machine Language *is a follow-up to* Machine Language for Beginners. *It includes demonstrations of many sophisticated programming techniques and a very powerful, label-based assembler for VIC, Commodore 64, Apple, Atari, and Commodore PET.* Machine Language Routines for the Commodore 64 *contains many instructive example programs and ready-to-use subroutines.*

Commodore 1541 *PRG Problems

I am the owner of a Commodore 64 and a 1541 disk drive. I was recently trying to save a program, but my disk would not accept it. When I tried saving it, I got a READ ERROR 20. I tried saving the program on another disk and had no problems. Can you please tell me what can cause a READ ERROR 20? I also have had problems with files that show up on my directory with an asterisk (*) before the PRG. What causes these asterisks to appear and how do I get rid of them?

Steven Swartzlander

The error you are getting indicates that what's called a block header *has been destroyed on your disk. This may mean that your particular disk* was *ruined by a magnet or even some dust or a hair that slipped into the disk case. Error 20 usually happens when you try to write to a damaged block using the BLOCK-WRITE command. Since you say that you are just trying to save to the disk, it must mean that block 0 of track 18 is damaged. The disk controller always reads this particular block when it is about to save something to the disk. Block 0 on track 18 contains a map, called the BAM (for Block Allocation Map), of the entire disk showing which blocks are used and which are still available.*

The best solution to your problem is to format another disk and try to transfer all the programs stored on the defective disk to the other one, using a disk duplicating program.

Your other problem with file type abbreviations preceded by an asterisk is very common. It occurs when a file has not been properly closed. The file usually cannot be salvaged. To get rid of these files, just place the disk containing them in the drive and type the following line:

```
OPEN 15,8,15,"V":CLOSE 15
```

Your disk will spin for some time and it will even make some noise, and when the red light goes off you will have a disk with usable files. All the asterisk files will have been erased. It is quite important to erase such files lest they corrupt other files on a disk.

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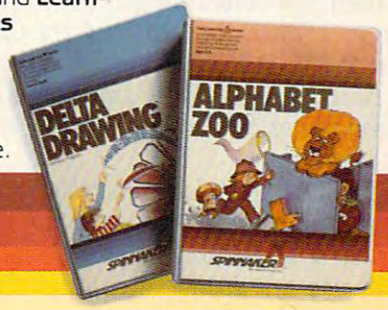

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Erasing Cassettes

How can someone erase cassettes that already have programs on them?

Todd Butcher

Cassettes can be easily erased. The simplest way is to just record something new on top of the old information. Alternatively, if you want to erase a cassette entirely, you could put a computer cassette into an ordinary music tape player and, after turning the volume down, press the play and record buttons simultaneously. Another way to do it is to use a bulk eraser, a device that uses a strong magnetic field to erase tape. These devices are available at record and electronics stores.

Atari CLOAD Problems

I own an Atari 800 with an Atari cassette recorder. I have used my 800 to type in and save programs from COMPUTE! to cassette tape. All of these programs used to load and run properly, but recently I have not been able to CLOAD the same tapes into my computer. I have tried different Atari recorders and even my friend's computer, but have only succeeded in loading in one of the programs. When I attempt to CLOAD a program on my recorder, I get an error 138 or 143. What can I do?

James L. Jenkins

The problem you are experiencing is a very common one. Usually this happens when the Atari recorder has been in use for some time. The reason it happens is that the recorder head needs to be either cleaned or demagnetized, or both. There are several tricks that you can use to see if you might be having other problems. Try connecting the recorder directly to the computer instead of through another peripheral. If this clears up the problem, it could mean that the connection in your other peripheral (disk drive, printer, or expansion box) is soiled or loose.

You can also try completely rewinding the tape and then fast-forwarding it past the tape header. Set the tape counter to zero, and try CLOADing from there. If you still get an error, rewind again and this time try CLOADing from tape counter position 1. Keep doing this in one-step increments until the tape loads.

The last trick is to insert your computer tape into an audio cassette player and listen to it until you hear a screeching sound. Once you hear the sound, you are at the beginning of the program on the tape. Try to get as close as possible to the beginning without passing it, and then try CLOADing it on your Atari recorder. If this does not work, try demagnetizing and cleaning your recorder's head. This is an easy procedure and should be done regularly anyway. Kits are available at any record store.

Once you do manage to CLOAD your programs, you should consider LISTing them to tape instead of CSAVEing them. The advantage: LISTing, combined with the ENTER command, is a more reliable method of loading from cassette than CLOAD. The LIST command takes up more tape and is also slower, but that's a small price to pay for greater reliability.

Disk Density

I recently purchased a disk drive. The instructions specify that you should use single-density disks. However, I have some double-density disks which I would like to be able to use. Will it cause any problems?

James P. Simson

Double-density disks will not cause any problem. Using a product of higher quality than specified never hurts. However, using single-density disks on a drive that specifies double-density could cause difficulties.

Speech For VIC And Atari

I recently bought an Atari 800 and VIC-20 computer. I want to know if there is any way to generate speech on them without spending a small fortune on a speech synthesizer. If it is possible, please explain how.

Mel Barries

To our knowledge there is no easy way to program speech on the VIC or Atari. Usually, special add-ons are necessary to accomplish this task. The S.A.M. *speech program works well, although the number of words you can use at any given time is limited. Many schemes have been invented to simulate speech through software, but all of them require extensive amounts of memory. One such scheme requires a microphone and a board for entering the sounds that you want the computer to mimic. Specially designed software takes volume readings thousands of times for each word, and records the readings in RAM memory. The speech software then uses these volume changes to simulate the sound through your computer's sound chip. COVOX manufactures a good implementation of this technique for the Commodore 64.*

TI Peripheral Expansion Box

Could you please tell me what the peripheral expansion box is needed for and give me some advice on whether I should purchase one or not? I'm a little apprehensive about investing a lot of money in my TI to find out that no one is going to support it. Do you have any suggestions about this?

Todd M. Aube

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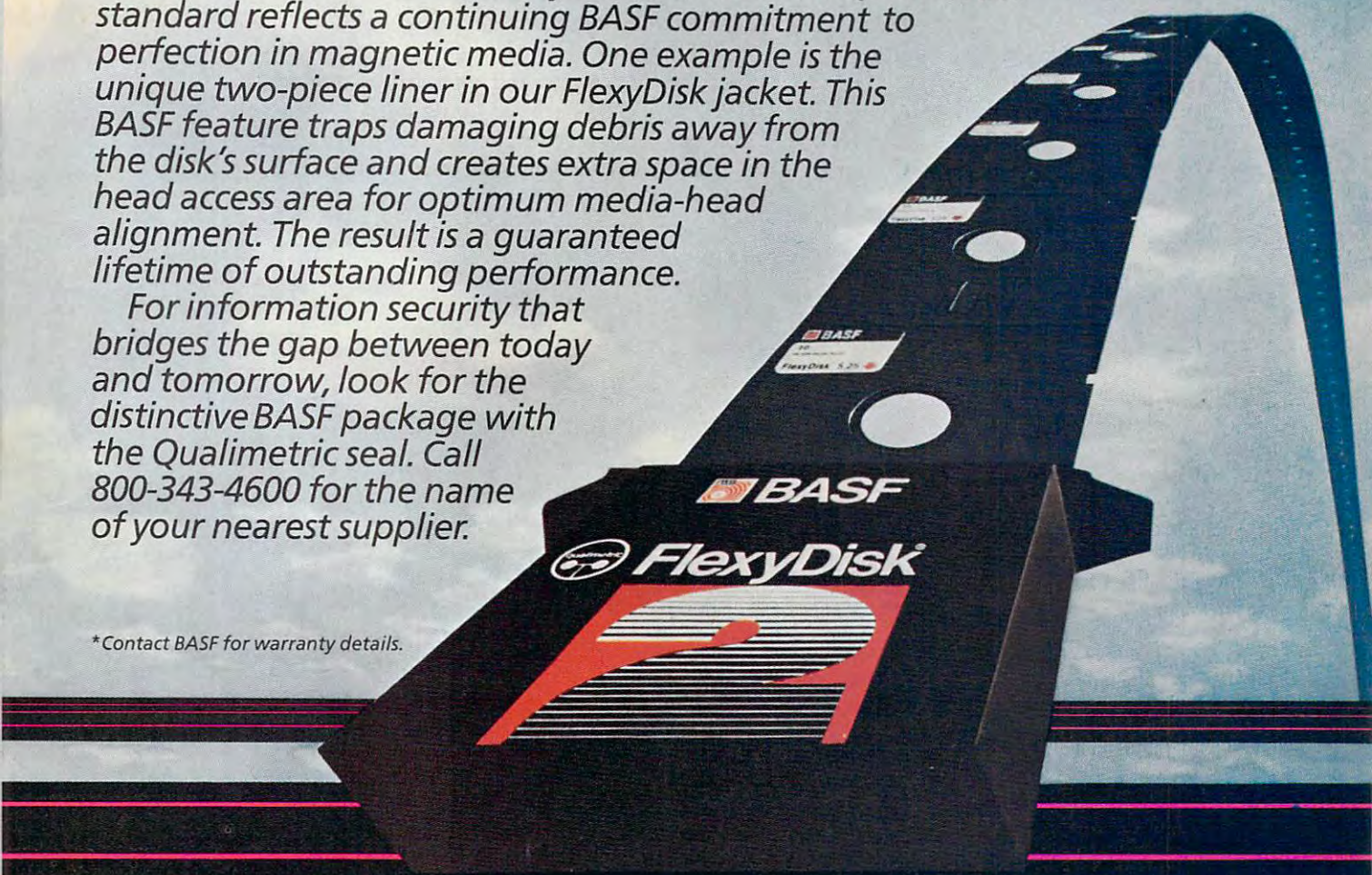

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Since Texas Instruments decided to discontinue the TI, third-party support for this computer is expected to decline. COMPUTE!, *however, will continue to support the TI with new software each month.*

If you have not bought an expansion box yet, you probably won't even be able to find one. Many people who bought TIs early on realized that they would need an expansion box, and consequently most stores have already sold out. The expansion box is required to use the TI peripherals, such as disk drives and printer.

Atari Hex-To-Decimal Conversion

The hex to decimal conversion program in "Readers' Feedback" in the July 1984 COMPUTE! by Frank Sgabellone is quite powerful. However, the modifications necessary to make it run on an Atari might not be too obvious. The following translation will work on Ataris. The value of C in line 20 can be changed, to vary the number of leading zeros.

H. Earl Hill

```
GN 10  DIM A$(16),C$(1)
JN 20  A$="0123456789ABCDEF":? "INPUT
       DEC/HEX (0-65535)":INPUT A:B=
       1:C=3:D=16^C:? A;" = $";:A=A+1
JP 30  IF A-D>1 THEN A=A-D:B=B+1:GOTO
       30
CA 35  J=1
JO 40  C$=A$(B,B+J-1):? C$;:B=1:C=C-1
       :D=16^C:IF C>-1 THEN 30
DG 50  ? "{5 SPACES}":? :GOTO 20
```

Apple Trigonometry

I have an Apple II+ on which I was hoping to be able to do some trigonometry homework. I was testing the SIN, TAN, and COS functions and discovered that when I provided a number within parentheses for these functions to evaluate, the number never matched a set of answers that I have in a chart. I looked up these functions in my Apple manual, and all it gave was an explanation of radians and other things I could not comprehend. Could you give me an understandable explanation of what these functions do?

Chuck Knakal

On computers such as the Apple, TI, Commodore, and many others, the trigonometric functions are always expressed in radians. *Radians are just another way to measure an angle. For example, instead of expressing an angle as 180 degrees, you would say it was one pi radians.*

A complete circle is 360 degrees. In radians, that would be exactly two pi radians (pi is approximately 3.1416). If what you are looking for, though, is an easy way to get answers in degrees from your computer, all you have to do is multiply the angle that you want evaluated by pi and divide that by 180. If you then input that number into the SIN, TAN, or COS functions of your computer, you should get the right answer in degrees.

For example, let's take 90 degrees. The sine of 90 degrees should give you an answer of 1, but since the computer does not work in degrees, PRINT SIN (90) will give you another answer. To get the answer in degrees, just take the 90 and multiply it by 3.1416, then divide the answer by 180. Now take the SIN of that answer and you should get 1. If your computer has a built-in key for pi, use that instead of the approximation because it will give more precise results. For example, on the Commodore VIC and 64, pressing SHIFT and the up-arrow (↑) key will print a pi symbol which can be used in expressions as a constant with the value of pi. On the Atari there's an even simpler way. You can use the DEG statement to switch all calculations to degrees.

64 Reverse Lines

I would like to display 40 reverse spaces per line. But the printed fortieth character causes a line to be skipped before the next line of text is printed. Therefore, I must leave the fortieth column unprinted to. How may I accomplish this feat in 64 BASIC without skipping a line?

Philip A. Egan

Try PRINTing 39 reverse characters on the screen per line, and then add a routine that will POKE reverse characters into the fortieth column of each line. The following should help on the 64:

```
90 FOR X= 1053 TO 2023 STEP 40: POKE X,160:
POKE X+54272,COLOR: NEXT
```

The variable COLOR can be any of the 64's colors.

Program Conversions

I used to own a PET Commodore Computer. Since then, I have been a subscriber to COMPUTE! magazine. COMPUTE! once published a program that would help in converting 64 and VIC-20 programs to the PET. I now own a 64 and need to convert some of my PET software into 64 format. Can you help?

Darren Storkamp

Conversions from one computer to another can sometimes become very involved because of the problems that POKEs or SYSs to machine-specific ROM routines can cause. The best way to attempt something like this might be to try to write a program on the new machine, in your case the 64, that follows the logic and flow of the old program. Even doing it this way, though, does not guarantee that the program will work properly. Some very simple

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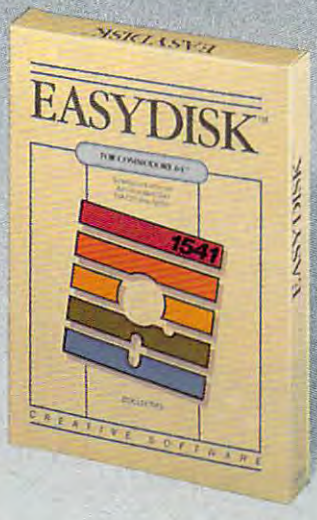

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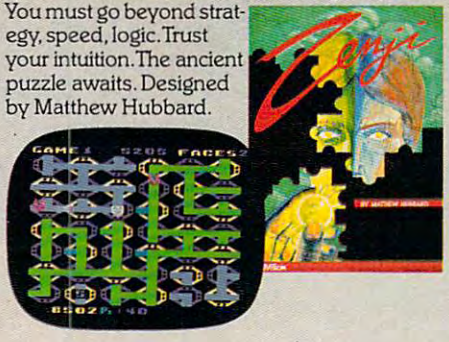
You leave the sun behind as you lower yourself down into the unexplored caverns beneath the Peruvian jungle. Deeper and deeper you go. Past Amazon frogs, condors, and attacking bats. Across eel-infested underground rivers. From cavern to cavern, level to level. Swimming, running, dodging, stumbling, you search for the gold, the Raj diamond and the thing you really treasure... adventure. Head for it. Designed by David Crane.

You have heard the elder speak of one central source and a maze of unconnected grey paths. As you connect each grey path to the central source, what was grey becomes the green of life. When all are connected, then you have achieved "Zenji." But beware the flames and sparks of distraction that move along the paths. You must go beyond strategy, speed, logic. Trust your intuition. The ancient puzzle awaits. Designed by Matthew Hubbard.



You strap on your helicopter prop-pack, check your laser helmet and dynamite. There's no predicting what you'll have to go through to get to the trapped miners. Blocked shafts, molten lava, animals, insects, who knows what lies below. But you'll go, you're in charge of the Helicopter Emergency Rescue Operation. The miners have only one chance. You. The opening shaft is cleared now, it's time to go. Designed by John Van Ryzin.

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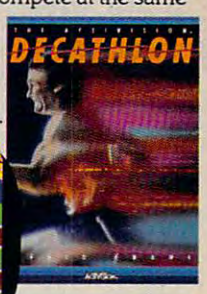

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PET programs can be used on the 64 if you first load a program called a PET emulator into the 64. This program is available from Commodore.

Atari Paddle Programming

I own an Atari 1200XL computer. Can I use the paddle controllers from my Atari 2600 game machine in my own 1200XL programs?

Eric Sneed

Yes. All controllers used on the 2600 game system are compatible with the Atari computer line. As a matter of fact, the 2600 game controllers have become a de facto standard. Atari joysticks also work on the Commodore VIC-20 and 64, Coleco Adam, and on some other game machines. Atari paddles work on the VIC-20 and 64, but give a slightly different range than Commodore paddles. Atari BASIC has two functions, PADDLE and PTRIG, for supporting up to eight paddles on the 400 and 800, and four paddles on the XL series.

VIC Game Loader

In the June issue of COMPUTE!, two recreational programs were presented for the VIC-20, "Pest" and "Olympiad." Both of these programs require 8K expansion and several POKEs before loading. It is quite easy to forget these POKEs and also very inconvenient when you just want to be able to load and run the program. Because of this, I wrote the following routine. It does all the necessary POKEing and then loads either Pest or Olympiad. You can choose by hitting either the P or the O key.

Shawn K. Smith

```
5 PRINT"{CLR}{DOWN}{3 SPACES}{RVS}O{OFF}L
  YMPIAD{4 SPACES}{RVS}P{OFF}EST":rem 141
7 GETA$:IFA$<>"O"ANDA$<>"P"THEN7  :rem 99
10 PRINT"{CLR}{3 DOWN}POKE43,1:POKE44,32:
   POKE8192,0:":PRINT:PRINT:Q$=CHR$(34)
                                  :rem 83
15 IFA$="P"THENA$="{4 SPACES}"+Q$+"OLYMPI
   AD"+Q$+",8{3 UP}":GOTO20       :rem 169
17 A$="{4 SPACES}"+Q$+"OLYMPIAD"+Q$+",8
   {3 UP}"                        :rem 226
20 PRINT"POKE36869,240:POKE36866,150:POKE
   648,30:PRINTCHR$(147)"         :rem 187
30 POKE631,13:POKE632,13:POKE633,63:POKE6
   34,65:POKE635,36:POKE636,13:POKE637,13
   1                              :rem 133
32 POKE198,7                      :rem 153
35 PRINT"{HOME}"                   :rem 76
```

VIC Tape Directory

We bought my VIC-20 a couple of months ago. With it, we also purchased a Commodore Datassette. Our question is: Does the Datassette have a directory? If not, is there any way to obtain something similar to one?

Sharon and Veronica Miller

Computer recorders do not have a directory. A disk, however, must have a directory because it is a random access device—information can be read from anywhere on the surface of the disk. The directory stores information that the drive needs to know in order to get the right program from the right place.

The difference between disk and cassette can be compared to the difference between an audio record and an audio cassette. You can choose to play a specific song if you know on which groove it starts on the record, but on a cassette you would have to search through the tape for the song (tape counters help, but it still is not the same nor as speedy as a record).

On the VIC, however, you can obtain a screen listing of what is on the tape by typing a LOAD command followed by a nonsense name. Here is an example:

```
LOAD "& #$"
```

The computer will search through the tape looking for the nonexistent file and, in the process, print on the screen the names of everything it finds on the tape.

Atari Machine Language

I would like to know how to create an AUTORUN.SYS program in machine language using the Atari *Assembler Editor* cartridge. Also, how do you generate a random number in machine language?

Paul Stach

An AUTORUN.SYS file is much like any machine language binary object file. When DOS boots up, though, it checks for AUTORUN.SYS, and loads it during the boot process. But to make it run automatically, you must append a special run vector at the end of your file. Atari files can load in several stages, each stage going to a different part of memory. After a file is loaded, an attempt is made to execute it by jumping through the address found at $02E0/$02E1. In order to have your machine language run after it has been loaded, the starting address of your program must be loaded into $02E0. This is easily accomplished in the source code. At the end of your listing, include two lines:

```
*=$02E0
.WORD START
```

*This *= is in addition to the original *= at the top of your program. When this is assembled, the assembler appends to your file the initialization address of your program. The label START should be assigned to the RUN address of your program.*

Location 53770 ($D01A) is the hardware random number generator. A LOAD instruction (or a

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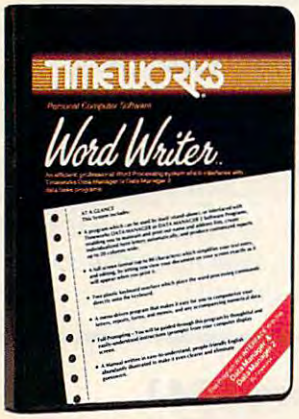
IF YOU CAN FIND A BETTER WORD PROCESSOR OR DATA BASE SYSTEM WE'LL BUY IT FOR YOU.



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Word Writer

This menu-driven system includes:

A program which can be used by itself (stand-alone), or interfaced with Timeworks' Data Manager or Data Manager 2, enabling you to maintain and print out name and address lists, create individualized form letters automatically, and produce customized reports up to 20 columns wide, which can be incorporated into any text produced by the Word Writer.

Two plastic keyboard overlays which place the word processing commands directly onto the keyboard.

A full screen format (up to 80 characters) which simplifies your text entry and editing.

All the essential features—plus some exclusive Timeworks extras—making this system completely functional for most home & business requirements.

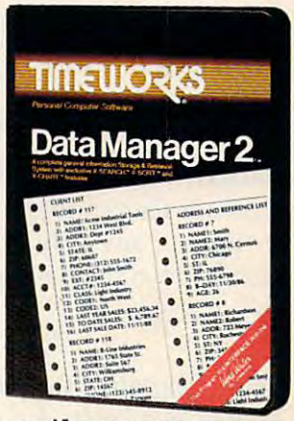
Data Manager 2

This system includes:

A menu-driven program that easily lets you store information on a wide variety of subjects—from general name and address lists, to research data. This program will also calculate and store any corresponding numerical data.

Quick access to important information. Items can be easily retrieved and printed by category, name, index code, date range, amount range, or any category of information stored in the system.

Timeworks exclusive X-Search,™ X-Sort™ and X-Chart™ features allow you to easily cross-search any of the categories. Or arrange your stored items in increasing or decreasing order, alphabetically, numerically or by date. Break down statistical information by up to ten indexed categories of your choice—and graphically review your results.



Arithmetic calculation of your mathematical data is possible, allowing you to perform Payroll calculation, cost estimates and more. Data Manager 2 also produces the Sum, Average and Standard Deviation of statistical data entered into the system, along with Frequency Charts.

When interfaced together, these programs:

Generate customized data reports, which can be incorporated into any written text produced.

Individually address and print form letters automatically.

Print your name and address file onto standard mailing labels.

Transfer and print text information onto labels and tags.

Calculated numerical data from column to column, giving these programs spread-sheet capabilities.

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PEEK in BASIC) will return a random number from 0 to 255. In reality, 53770 is a very high speed counter. It goes so fast, the output seems random. If you need bigger numbers, get two bytes. For smaller ranges, you can chop off the unwanted portion with AND. For example, LDA $D01A/AND #$0F would give you a random number from 0 to 15. Another way to limit the random number is by rejecting unwanted values. For example, if you wanted a random number from 1 to 10, use a loop like:

```
REJECT LDA $D01A     ;Get the random number
       BEQ REJECT    ;If zero, get another
       CMP #11       ;Is the number 11 or
                      higher?
       BCS REJECT    ;If so, the carry will be set
       RTS           ;Return the number in the
                      accumulator
```

Tokenized BASIC

I own a Commodore 64 and would like to know if there is any way of converting tokenized BASIC into regular BASIC. What do I have to do?

Philip Wright

Most computers store BASIC statements and commands as tokens. *A command such as PRINT (five characters, or bytes, long) is converted into a number (one byte) which the computer can later understand to mean PRINT. This saves memory space. As you enter a BASIC program, it is compacted into tokens. Regular BASIC is tokenized BASIC, but if what you need is a file that contains every letter of every command in ASCII, there is an easy way to do this on Commodore computers. With the program in the computer's memory, type in the following lines:*

```
OPEN2,8,2,"program name,S,W":CMD2:LIST
CLOSE2
```

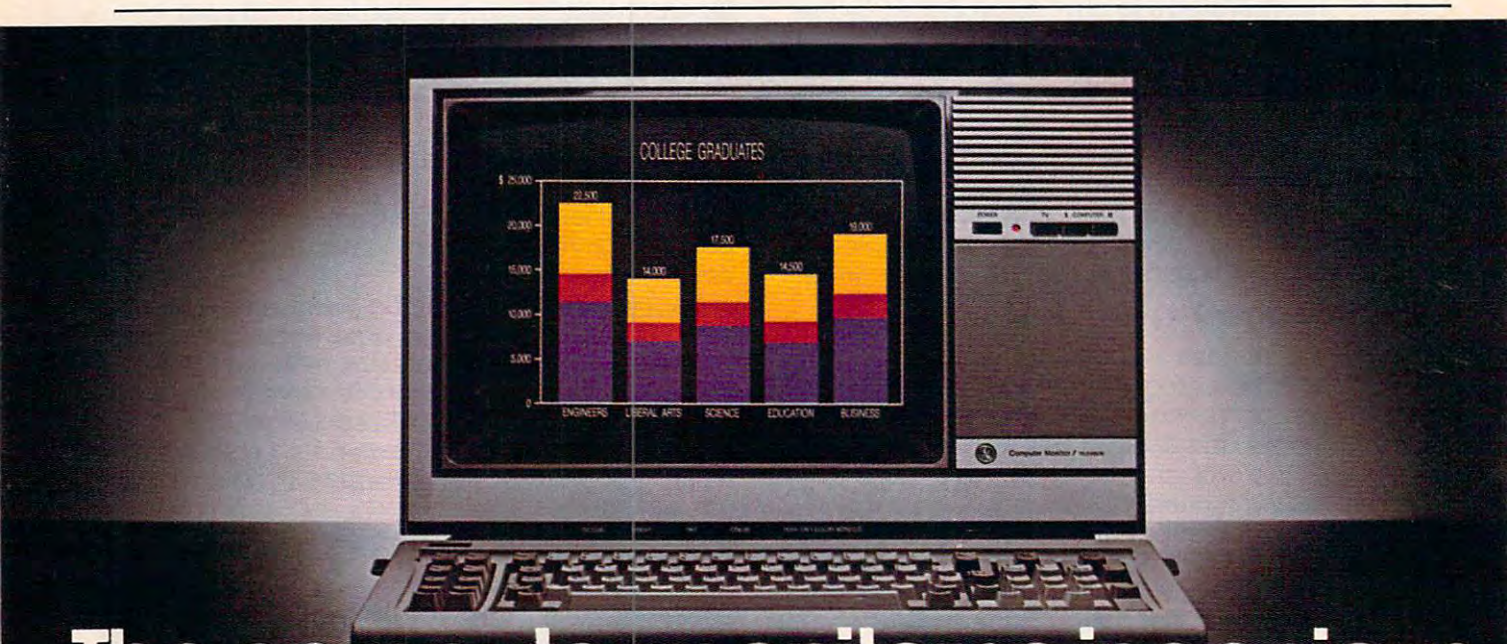
You can insert the name of the file you would like created instead of "program name." After typing the lines and hitting RETURN, you will have a sequential file on your disk that can be read by most word processors. All the letters to commands such as PRINT will be contained in that file.

Rattling Commodore 1541

I have owned a 64 and a 1541 disk drive for some time now and have heard some loud rattling noises coming from my drive. I often hear this noise when finding errors in copy-protected programs. Is this noise harmful to the disk drive?

Harvard Prossfete

The noise that you have been hearing is the disk



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drive's head rattling while attempting to read a block with an error. Usually the drive will attempt to read a bad block three times before giving up and printing an error message. This kind of rattling will eventually knock your disk drive's head out of alignment, causing problems with SAVEs and LOADs.

It is best to avoid searching for errors in copy-protected programs.

XL Upgrade For Atari 800?

I would like to know if it would be possible to build a new ROM Operating System board that would duplicate the XL operating system on my Atari 800. Is it true that Atari will offer a ROM Revision C?

Joseph Fried

If you had access to the ROMs used in an XL computer, you could in theory replace the ROMs on your OS board. You still would not be able to take advantage of many XL features. Bank-switched memory requires more than a new operating system, since there have been some hardware changes in the XL computer series. We know of no plans to offer an upgrade to existing Atari 400 and 800 owners, but some third-party companies market add-on boards with 64K RAM and limited compatibility with the Atari XL computers.

Apple Binary On Ataris

I have used binary with the Apple computer by entering CALL −151 and found it very interesting. How can you do this on the Atari? Please add a little program.

James J. Brennan, Jr.

We assume you are referring to the machine language monitor built into the Apple II. An ML monitor lets you examine and change memory locations, and interact directly with the 6502 microprocessor. A monitor is a tool to help you debug machine language programs. Although there is no built-in ML monitor (sometimes called a debugger) on the Atari, there is one built into the Atari Assembler Editor *cartridge. Several companies sell ML monitors, or build them into their utility packages.*

What Is Binary?

I have heard a lot about binary load and save. This may seem like a silly question, but what is binary, what does it do? Can you write a binary program using a BASIC cartridge on the Atari 400?

S. Jonas

Beginners are often confused by the deluge of

computer terminology. In theory, all files are binary files, since binary numbers (mathematically, base two numbers) are the lifeblood of a computer. Binary numbers are another way of expressing quantity, but they are limited to the digits 1 and 0. The number six, for example, is 0110 in binary.

When people talk about binary files, they are usually referring to a machine language program on disk. On some machines, such as the Apple II, a binary file is special, not interchangeable with BASIC or text files. On the Atari, there really is no distinction. Any BASIC program could be called a binary file. It is possible to create loadable machine language files from BASIC. For a full explanation of binary numbers, take a look at the machine language tutorials in our magazines and books.

Daisychaining

I have just purchased a 1541 disk drive, and I am preparing to buy a printer. I have noticed that a disk drive attaches to the serial port on the back of the 64. How would I hook up a printer if the serial port is already being used by the drive? Would I also have to buy an expansion interface so that I could have more than one thing connected to the serial port at one time?

Jim Eller, Jr.

It is very easy to connect both a printer and a disk drive to the 64 through the serial port. All you have to do is plug the disk drive in the back of the 64 and then plug the printer into the back of the disk drive. There is a serial port on the back of the 1541. This is commonly referred to as daisychaining *because you are chaining the printer to the drive and the drive to the computer. Fortunately, expansion interfaces are not needed for this purpose on the 64.*

WordPro 3 Plus/64 Modification

We've received several letters regarding incompatibility between WordPro *for the 64 and the new Commodore 1526 printer. Apparently, due to modifications in the 1526, many users are encountering problems when printing with it.*

The following is a memo sent to us from Professional Software, distibutors of WordPro. *If you are having problems with* WordPro *and the 1526, enter and run the program below. It will change the* WordPro *program for use with the 1526.*

"Due to the internal timing differences between the new Commodore 1526 printer and most other printers on the market, *WordPro 3 Plus/64* must wait longer than 'normal' before attempting to print on the 1526 printer. Because of this timing difference, your *WordPro 3 Plus/64* program will need to be modified before attempting to use it with the 1526 printer.

"The BASIC program below will perform this modification. Since the modification is performed right on the *WordPro 3 Plus/64* disk, once the modification program is run, it does not ever need to be run again. Note that the program *must be entered exactly as shown,* as it may damage the *WordPro* program if entered incorrectly.

"For your protection, this program *does not* modify the backup program supplied on the *WordPro 3 Plus/64* system disk. Again, since this program modifies the *WordPro* program itself, we *strongly urge* that this program be checked carefully before being run.

"To modify the *WordPro 3 Plus/64* program so that it will operate a Commodore 1526 printer, turn on your Commodore 64 system and type in the following program, pressing <return> at the end of each line. Watch for the proper use of spaces, ones, zeros, commas, and punctuation. DO NOT use any capital letters."

```
10 rem copyright 1984 professional
   software inc
20 open 1,8,15,"i0"
30 open 5,8,5,"#"
40 print#1,"ul 5 0 13 11"
50 print#1,"b-p:5 30"
60 print#5,chr$(208);chr$(51);
70 print#1,"u2 5 0 13 11"
80 print "done":close 1:close 5
```

"Next type LIST and press <return> to list the program. *After carefully checking to see that the program has been correctly entered,* remove the write protect tab from the *WordPro 3 Plus/64* system disk, and insert the system disk into a 1541 and close the door. Type RUN and press <return>.

"The drive activity light should momentarily go on and the disk should spin. After a few seconds, the words 'done' and 'ready.' should appear on the screen and the cursor will reappear. The modification should now be complete. Remember to replace the write protect tab to protect the system disk from accidental erasure. Once the modification has been performed, the program does not need to be rerun.

"If an error message (and not the word 'done') appears on the screen or the disk activity light flashes, the program has been incorrectly entered or the write protect tab has not been removed. Carefully recheck the program for accuracy and repeat the previous steps."

If you would like further information on this modification, or a copy of the modification memo for yourself, you may contact Professional Software at:

Professional Software Inc.
51 Fremont Street
Needham, MA 02194

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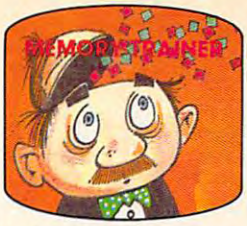

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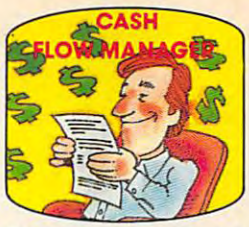

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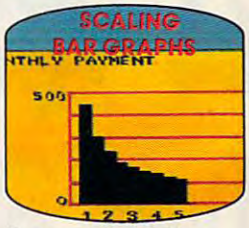
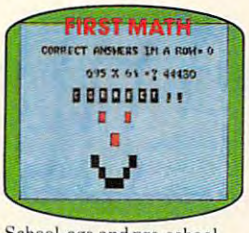


Create multi-colored bar graphs with a surprisingly small amount of memory.

A time-saving organizer for coupons, receipts and more.



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A Parser's Tale

How Adventure Games Work

Charles Brannon, Program Editor

We all know that so far computers are not truly intelligent. Like all machines, computers operate in a consistent, logical, and straightforward way. Unlike people, computers are unable to make arbitrary decisions. Everything is black and white. That's why so many programmers, bent by weeks of midnight programming, cry, "Do what I mean, not what I say!"

Computers make decisions much like your home thermostat. The thermostat does not know that it is too warm, and therefore it needs to turn on the air conditioner. Two dissimilar metals, bound together, twist as one metal expands farther than the other. The metal plates make contact with the air conditioner switch, and separate when they cool down, releasing the air conditioner. A computerized thermostat would be no more aware of its function than the mechanical one. Machines operate in a predictable fashion.

Yet adventure games appear to be smart. In an adventure, you are playing in a specialized world, created by a programmer and administered by the computer. The descriptions paint a mental picture, and as you play you get the illusion that the adventure world is a complete, though tiny, universe. The computer seems to understand what you say, as long as you use the right vocabulary. You can open doors, light lamps, fight with trolls, converse with aliens, question criminals, dig for treasure, even ask for help. While you are playing an adventure, you can remain unaware that you are solving and rearranging a complex data base.

Adventure games, sometimes described as interactive fiction, have a basic story line, characters, and a setting. The setting may be a medieval dungeon, a distant planet (in a

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galaxy far, far away), an alien spaceship, or even a modern shopping mall. You are usually the protagonist, but you are not there in person. Instead, you command your alter ego, who acts out your commands.

Your persona may be a sword-wielding treasure seeker, a detective, or an average, hapless urbanite. You control your character by giving it commands like GO WEST or EAT HOUSE. In fact, you are commanding the computer to carry out your actions. Some adventures let you be more detailed, as in OPEN THE MANILA ENVELOPE, TAKE OUT THE LETTER, AND READ IT TO ME. In order to follow your orders, the computer must break the sentence into subcommands by checking for commas, periods, and conjunctions. Words like IT must be replaced with the most recent object. Adjectives and articles should be discarded. The sentence would become OPEN ENVELOPE/[REMOVE] LETTER/READ [LETTER].

Parsing

The process of breaking down and interpreting your command is called *parsing*. A parser routine within the program breaks each subcommand into an action verb (such as GO, OPEN, or READ) and an object (LETTER, HOUSE). The verb is then looked up in a dictionary of commands and replaced by a number. Most adventure games offer several synonyms. EXAMINE and LOOK are assigned the same number. The number causes the computer to jump to a specific subprogram that handles that action.

The object of a sentence is also turned into a number. This is a little more difficult. For example, the adventure might describe a room with an "old brown bag on the table." The player might say OPEN BAG, or GET THE BROWN BAG, or even TAKE OLD SACK. But BROWN BAG, BAG, and OLD SACK are all reduced to the same number. The GET/TAKE/PICK UP routine then uses that number to handle the request. For example, EAT POISON and EAT TREE must be handled in very different ways.

The more advanced parsers have even more to deal with. If you entered SEE WHAT'S IN THE BAG, the adventure could break it down to SEE BAG. SEE is synonymous with EXAMINE. The EXAMINE routine checks its data base to see just what a BAG is, noting qualities such as the fact that a bag must be opened to see what's inside. You may then be told to open the bag first, or the adventure could assume that's what you've implied.

The Game Data Base

In a way, an adventure is an application like a disk operating system (DOS). In DOS, you use commands to manipulate files, for example, ERASE TEST. An adventure is no different, except you are manipulating the adventure's data base. An adventure data base consists of a map

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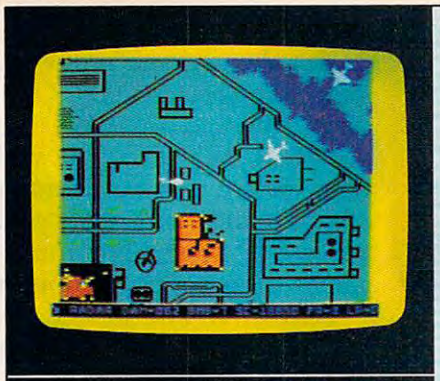
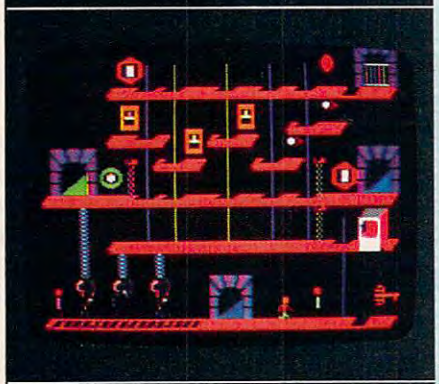


RAID ON BUNGELING BAY

When you shopped for a computer, you wanted one with a lot of intelligence. This game may lead you to regret that choice, as your friendly little computer becomes the brains behind the most fantastic enemy you will ever face: The War Machine.

A monstrous artificial intelligence directs an endless army of self-replicating robot weapons and a complex of factories hidden on six heavily defended islands. Even as you strike at one island, robots beyond your field of vision continue to multiply...to repair the damage you've done...to attack and destroy.

Before all of Humankind is crushed beneath the Bungeling Empire's iron heel, one faint hope remains: you in your helicraft.

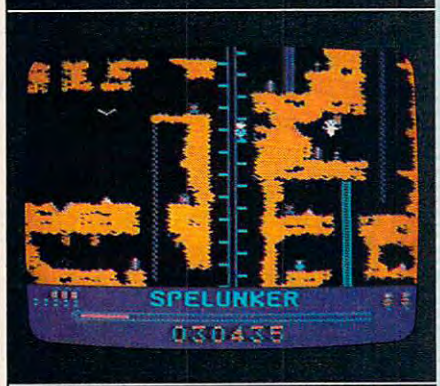


THE CASTLES OF DOCTOR CREEP

Ever dream that you were locked in a haunted castle, wandering blindly through darkened corridors, never knowing what ghastly demons await you? Then you'll feel right at home in *The Castles of Doctor Creep.*

It's a maddening maze of 13 separate castles, more than 200 rooms in all. Sinister surprises await you behind every door: mummies and monsters, forcefields and death rays, trap doors and dead—*very* dead—ends. Remember where you've been and watch where you're going...there's got to be a way out *somewhere*!

Better hurry, or you'll wind up playing a rather unpleasant role in one of Doctor Creep's experiments.

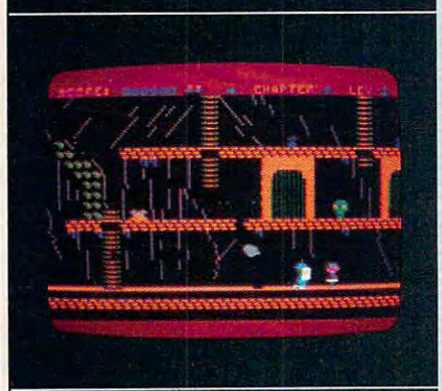


SPELUNKER

Who knows what fabulous treasures—and unspeakable dangers—await you in the world's deepest cave? This is one game you can really get into... and into...and into.

Wander through miles of uncharted passageways, swinging on ropes and ladders, tumbling over subterranean falls and plunging to the very depths of the earth on an abandoned mine railroad. Deadly steam vents and boiling lava pits threaten you at every turn. Chattering bats and the Spirits of dead Spelunkers beg you to join them, permanently.

Let's face it: you're in deep, deep trouble.

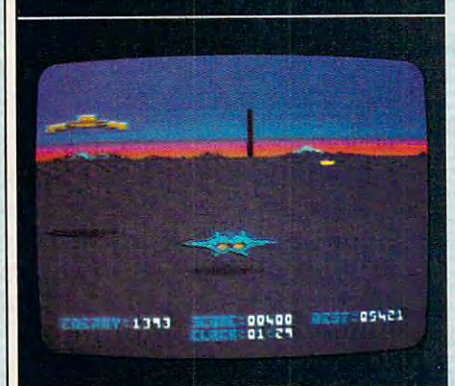


WHISTLER'S BROTHER

You're the star of a full-fledged arcade adventure—and the big question is whether it'll turn out to be a comedy or a tragedy. That's because your co-star and beloved brother, Archaeologist Fenton Q. Fogbank, is rather absent-minded and extremely accident-prone.

As you search for priceless treasures in steaming tropical jungles, ancient cliff villages, musty old tombs and glittering crystal caverns, you control both your character and your brother. The only way to keep him on track and out of trouble is to whistle and pray that he follows you to safety.

Poison arrows, runaway boulders, fearsome frogs and mysterious mummies are only a few of the hazards that'll make you wish you weren't your brother's keeper.



STEALTH

You're all alone on a strange and forbidding planet. On the distant horizon, looming thousands of meters above the blasted landscape, lies your destination: The Dark Tower, home of the mysterious Council of Nine, cruel overlords of a conquered world.

You must maneuver your Stealth Starfighter through an unending assault by the Council's automated arsenal—jets and heat-seeking missiles, photon tanks and anti-aircraft batteries, vaporizing volcanoes and deadly energy fields. Outgunned and outmanned, you must press ever onward, with only your stealth to rely on.

You must reach the Tower. You must destroy it. There's no turning back.

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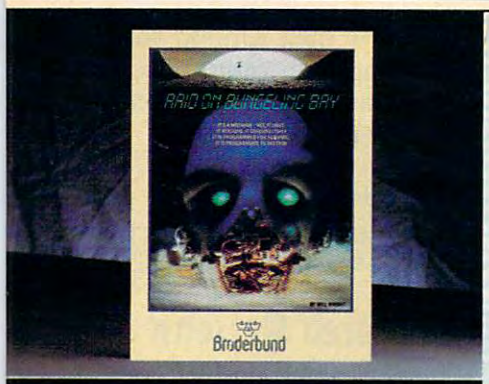

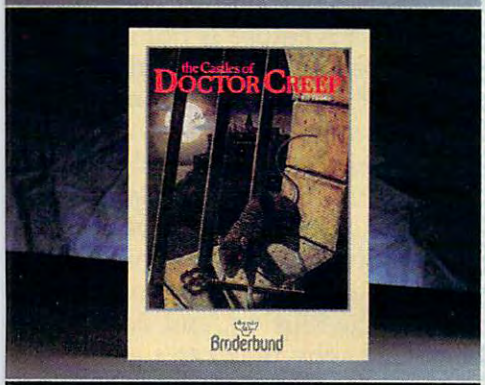

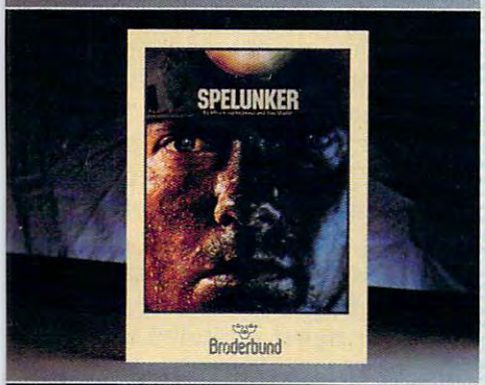

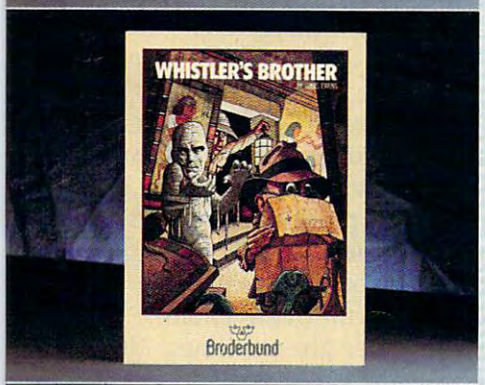

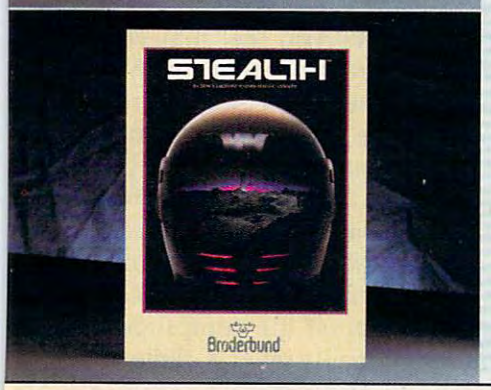

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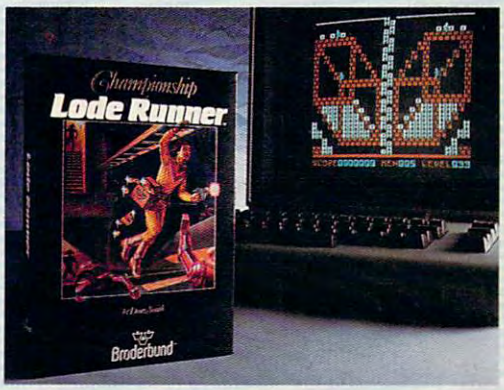

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which describes how rooms or locales are linked together, objects such as treasure, and the status of various objects and situations.

You may be right next to another room, but unless the map allows direct movement to it (through a door, window, or transporter beam), you have to take another route. A room description includes legal exits and where the exits lead to, what objects the room contains, and room status, such as whether it's dark or lit. When you remove an object from a room, the room "forgets" that object. When you drop an object, the object is added to the room's description. Your player's status also has to be updated when you pick up an object, lose an object, gain powers, or get hurt. Some realtime adventures (where the clock keeps ticking and action keeps happening while you are deciding what to do) even take into account player fatigue. Your alter ego must sleep to regain energy.

Objects must be monitored. A lamp has a certain fuel supply, which is used up over time. The lamp can be either on or off, which temporarily affects the room description, lighting up a dark room. Some objects are incomplete in themselves, and must be assembled with other objects. For example, you could separately collect a bottle, some string, and some cooking oil. If it occurred to you to MAKE LAMP, the three items would become a crude lamp. A new object has been created, replacing the three separate ones. Don't think that you can make anything you want, though. Unless the programmer planned ahead to specifically allow you to create a lamp, you couldn't assemble one, even if you had all the necessary parts.

There are also variables for global status, such as the time of day. In a space adventure, there may be a status for the entire ship, like fuel and shields remaining. In more complex adventures, other people are like independent objects, with their own characteristics and descriptions. All these qualities, though, are numbers, and these numbers let a computer make arbitrary decisions. You can't GO NORTH if there is no north exit. If you have no sword, you can't fight with it. Unless you have a lamp, you cannot see within a dark room. The computer does not decide these things as a person would. It just understands statements like:

```
IF OBJECT=10 THEN PRINT
"YOU CANNOT SEE HERE."
```

"It can be disturbing when you penetrate the illusion and realize you are the one being programmed."

Anticipated Actions

The most difficult part of designing an adventure is not creating the basic plot and world, but in anticipating the actions the player might take. Again, there is nothing open-ended in an adventure. Every possible action you may try has to have been predicted and programmed for. Some players become frustrated by the illusion, and don't understand why they can't get the computer to do what they want. Certain synonyms just aren't in the adventure dictionary. You may be faced with a locked door, but without a key. "But, aha!," you say, "I have a crowbar that worked on another door." You try the crowbar, and it doesn't work. The programmer either forgot about the crowbar, or never intended it to be that easy.

It can be disturbing when you penetrate the illusion and realize you are the one being programmed. The adventure may have many solutions, but you are just trying to figure out one of the predetermined actions planned for you. No action you take could be described as creative or innovative, since the programmer already knew that you would try it. An adventure tries to make you feel that you are participating and affecting the outcome of the adventure, but you are really just solving a complex puzzle or maze. If you realize this, the frustration may disappear, and you can concentrate on cracking the programmer's schemes. You aren't really playing against the computer, but trying to unravel a cleverly contrived mystery. ©

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Is A Picture Worth A Thousand Words?

Selby Bateman, Features Editor

A debate is raging between proponents of traditional, text-based computer adventure games and the new graphics adventure games. Welcome to the ultimate adventure: A titanic struggle is underway for your attention and your money. At stake, the fate of major software companies and the careers of computer programmers. What will you choose: Text or Graphics?

A killer stalks Hampstead Manor. You are confronted in the Troll Room; your sword glows with a strange light. The people of Sosaria look to you to save them once again. The half-light of a dank dungeon corridor stretches before you. King Edward of Daventry lies dying; you are the last hope in all the land.

What adventurer worth his steel could turn away from such challenges? Thousands of computer owners have already answered the call in scenarios like the ones above. And if you haven't yet ventured forth on any of these quests, the chances are good that you will sometime in the future.

The scenes described represent a wide range of popular adventure games: *Ripper* (Microcomputer Games, division of Avalon Hill), an all-text adventure in which you track the infamous Jack the Ripper; *ZORK I: The Great Underground Empire* (Infocom), the first installment in an immensely popular all-text series; *Exodus: Ultima III* (Origin Systems), a highly successful role-playing, graphics-and-text adventure series; *Wizardry: Proving Grounds of the Mad Overlord* (Sir-Tech), one of the most complex and popular text-and-minimal-graphics, fantasy role-playing games ever made; and *King's Quest* (Sierra), a breakthrough in graphics-oriented adventure games.

These are but a few examples of what has become a

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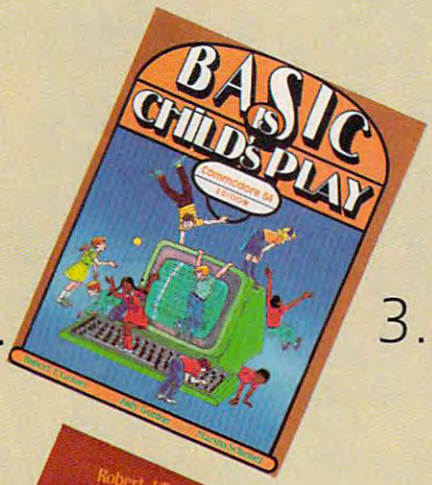

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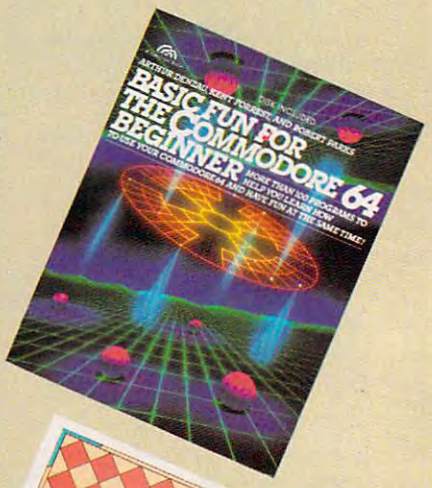

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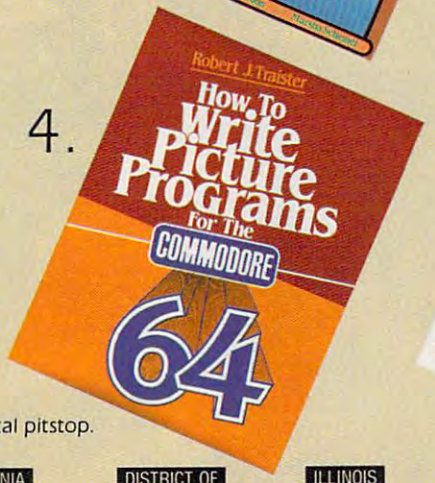

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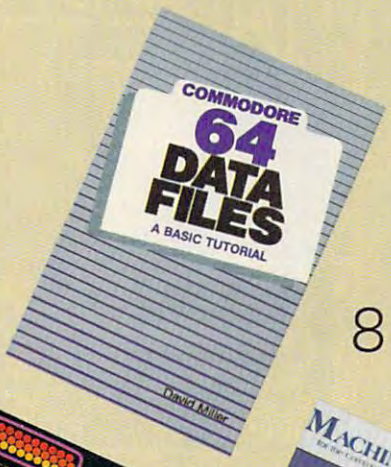

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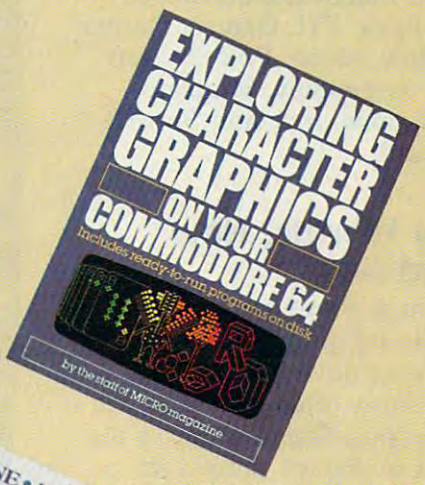

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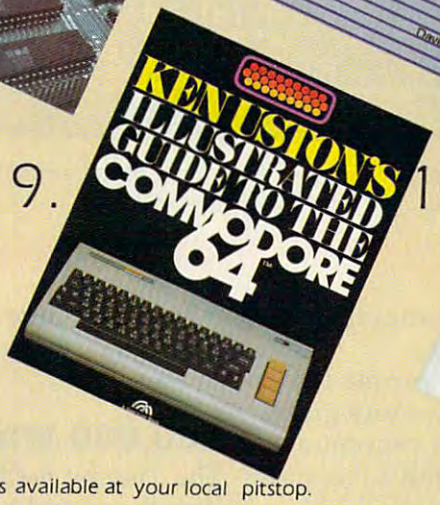

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major genre in computer games. Other companies with adventure game products include Adventure International, Black Knight Industries, Electronic Arts, Epyx, FTL Games, Harper and Row, Muse, Pryority Software, Screenplay, Strategic Simulations, Inc., and Sunrise Software.

New Worlds, New Identities

Although these games are usually lumped together as computer adventure games, the differences often outweigh the similarities. Such programs attempt to engage the player in solving puzzles, exploring new worlds, and trying on new identities.

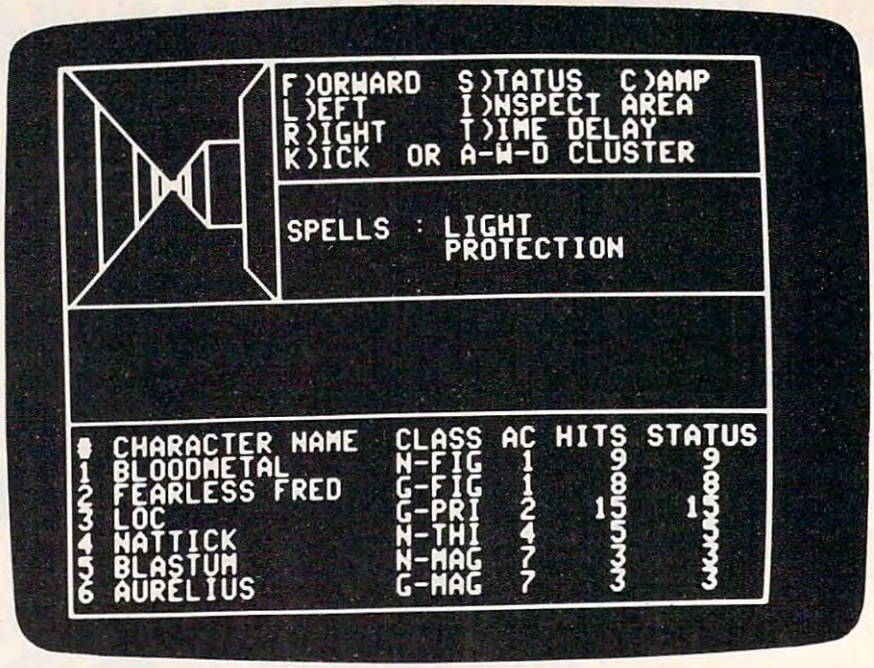
While arcade-style action games reward a sense of quick-reflex timing, superior hand-eye coordination, and visual perception, adventure games usually require patience, intelligence, curiosity, imagination, and the capacity to immerse yourself temporarily in another world—a willing suspension of disbelief.

Beyond these characteristics there are differences which attract some players. Does the adventure game have only text, omitting colorful graphics completely? Is there a balance between text and graphics? Or, finally, do graphic images actually carry the game itself, leaving text in a subservient role or completely absent?

The Graphics-Text Tradeoff

What do these differences mean to adventure game players?

"The fact of the matter is that whenever you put graphics into a program, you've got to take something out because you've only got a limited amount of space on the diskette," says Robert Woodhead, coauthor of Sir-Tech's *Wizardry*, one of the all-time best-selling games for Apple II computers.



In Sir-Tech's Wizardry, *a three-dimensional maze outline appears onscreen alongside status and command text information.*

"The Infocom people have said, 'We won't have any graphics at all so we can concentrate on the content of the adventure, the substance of it. We'll let people think up their own scenes,'" says Woodhead. "The hi-res adventure people—and we've done one [*Crypt of Medea* for Apple computers]—have said, 'We think the graphics are important, so we're going to have lots of nice graphics. Our adventure won't be as complex, but we think the graphics will make up for that.'

"And individual consumers have to decide. Generally, they like both," he adds. "In a program like *Wizardry*, we decided that we wanted a lot of content, but that we could put in a little graphics. And the graphics are of a special form—maze plotting. Because the [memory] resources required to do that are not incredibly huge, it works out very well. It conveys the desired information and it's sufficiently sparse so that people embellish it in their own minds. It reaches a little bit of a happy medium."

200,000 Wizards

The "happy medium" Woodhead and coauthor Andrew Greenberg sought with *Wizardry* obviously worked. To date, they have shipped over 200,000 copies of the complex fantasy role-playing game. And out of the thousands of letters they've received from players, Woodhead says that only a half-dozen have been negative.

From one to six players may take part, and a total of 50 different magical spells can be cast. The game takes a minimum of 70 hours to complete as you and your compatriots wander through a ten-level, 3-D mazelike dungeon fighting monsters, finding treasure, and seeking clues to the game's puzzles. As with almost all adventures, games can be saved to disk since time requirements for each program are lengthy.

So complex and rich an imaginary world is *Wizardry* that it has been used for everything

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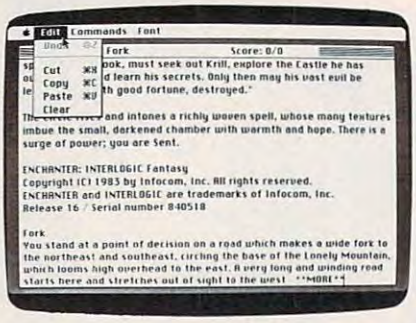
On To Qyntarr

Sir-Tech Software's next game, says Woodhead, will be an all-text adventure called *The Mines of Qyntarr*, in the tradition of the original *ZORK* created by Infocom.

"It's an extremely complex and involved adventure game. And the major effort we're making right now is to make it a lot more user-friendly in terms of its command parser. [See "The Parser's Tale" in this issue.] I hope to get a command parser running that understands more complex grammar than *ZORK*," adds Woodhead.

In speaking with programmers and designers of adventure games, the name Infocom almost invariably comes into the conversation. It's widely acknowledged that the Cambridge, Massachusetts, based company is the uncontested leader in the production of sophisticated, all-text adventure games.



Infocom's adventures are considered the standard for quality in all-text formats. Here, on the Macintosh, a pull-down menu can be seen in the upper left corner.

ZORK Forever!

ZORK, for example, has a command parser vocabulary in excess of 600 words, allowing significant variety in the kinds of sentences that the game can understand. Infocom's new release, *Sorcerer*, a sequel to another Infocom game, *Enchanter*, has a vocabulary in excess of a thousand words.

Infocom has spent its time and efforts developing the plot, the writing, the puzzles, and the parsing rather than on sound and graphics—the latter two of which Infocom vice president and master programmer Marc Blank calls "bells and whistles."

And the results have demonstrated the popularity of well-done all-text games. The *ZORK* series, which Blank coauthored, has already well surpassed the quarter million mark in number of disks sold. A now-defunct *ZORK* User Group (ZUG) boasted more than 20,000 members nationwide. *ZORK* T-shirts, bumper stickers, posters, and special clue books have all flourished. Infocom's games are available in versions for most personal computers.

When game historians give credit for the development and the legitimization of the term *interactive fiction* as applied to a certain type of computer adventure game, it will be Infocom which will get the laurels.

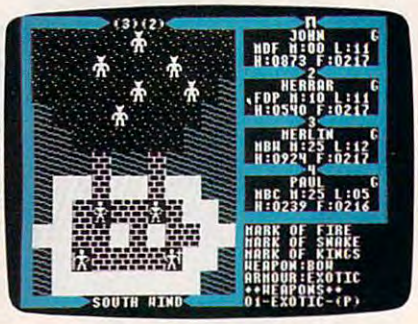
Seeing The Movie Vs. Reading The Book

But what about the future of all-text adventure games as computers become powerful enough to have sophisticated parsers *and* colorful graphics all at the same time?

"For the next year or so there'll still be a market for the incredibly well-done text adventures," says Richard Garriott, coauthor of Origin Systems' *Ultima* series of fantasy role-playing games, available for Apple, Atari, and Commodore machines. "Anybody other than the Infocom style cannot succeed at this point. Infocom has put together a very, very sophisticated parser, and the non-player characters within the game actually have some intelligence to their movements.

"I really think that as we develop better computer systems that surely this same kind of technique—if not the quality that Infocom is putting into their games—can also then have the added feature of the realtime graphics and animation put on top as well," he says.

"The standard argument is



Origin Systems' Exodus: Ultima III *offers graphic images of the game at left while game information is displayed at right.*

that the game with graphics is like going to see the movie and the game with text is like reading the book," adds Garriott. "Some people will still have some preference between the two. But the vast majority of the marketed products will almost have to turn to graphics because of the demand of the public."

"You Can Do Anything You Want"

Garriott, 23, has been writing computer fantasy-adventure games since his sophomore year in high school. He completed 28 fantasy games while still in high school, learning more about the genre with each attempt.

Origin Systems' *Ultima* fantasy role-playing series is a testament to the strength of Garriott's game-designing talents. "The key to the *Ultima* se-

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ries is really just the way the role-playing gives the player a great deal of freedom with what his options are at any point in the game," says Garriott. "It's basically a game in which you're living out your life. And you can do anything you want."

Are You Man Or Fuzzy?

In *Exodus*, the third game in the *Ultima* series, evil again walks the land of Sosaria. Will you confront this evil as Human, Elf, Dwarf, Bobbit, or Fuzzy? Now determine your strength, dexterity, intelligence, and wisdom. Choose your profession from among about a dozen possible types ranging from Cleric to Thief. Then, with a band of cohorts, go forth. But be quick about it: *Ultima IV* is already well along in development.

Quite a different approach has been taken—and very successfully—by Sierra in its graphic adventure game, *King's Quest*, for the IBM PC and PCjr.

Requiring 128K of memory and the use of a color monitor, the adventure game actually lets you control the movements of an onscreen knight, Sir Grahame, as he moves about the colorful kingdom of Daventry.

The movement is smooth, the screens are redrawn rapidly, and Sir Grahame is seen walking in front of, behind, and even between objects. He climbs, jumps, ducks, swims, and can be warned of impending danger by sound effects. The command parser for such a game is necessarily much smaller than that used in an Infocom game, but the play requirements are not based on having a huge volume of words.

There are helpful fairies, elves, condors, and a godmother. But there are also unfriendly sorcerers, dwarfs, ogres, wolves, and an airborne witch.

Roberta Williams, who designed *King's Quest* for Sierra, admits that the game represents a big change from what has been done with computer adventure games in the past. "There's nothing like it," she says. "It's innovative."

Sierra's King's Quest, *for the PC and PCjr with 128K, offers the best quality graphics in an adventure thus far.*

The interaction between the text and the onscreen graphics is clearly the way many future adventure games will be constructed. One element complements the other.

Bowing And Doffing

For example, as Sir Grahame stands before King Edward, type in the words BOW TO THE KING. As you hit the RETURN key, Sir Grahame can be seen bowing and doffing his cap.

And, Williams adds, subtle clues can be built visually into the game that an all-text adventure couldn't have. When Sir Grahame stumbles upon the house of a poor woodcutter and his wife, the screen shows an old and pitifully thin couple in a rundown house. The room is bare of food, a subtle clue to the player that an offering of something to eat might be very much appreciated by this mysterious couple.

While *King's Quest* uses text to supplement its high-quality graphics in the adventure, such action-adventure games as Electronic Arts' *Seven Cities of Gold*, Epyx's *Temple of Apshai*, and Muse's *Castle Wolfenstein* offer a range of adventure and strategy combinations primarily without text. The gradations in type of game play—as well as quality of play—being offered to computer owners today are already staggering in number. There is, it seems, something for just about anyone.

The tradeoff which programmers and game designers now must make because of computer memory limitations will not always be a problem, notes Dave Albert, executive vice president of Penguin Software.

Penguin has released such adventures and fantasy role-playing games as *Transylvania* (Apple II, Macintosh, Atari, Commodore 64), *The Coveted Mirror* (Apple II family), and *Expedition Amazon* (Commodore 64).

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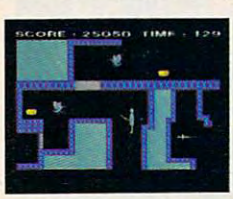

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The Apshai series is the standard by which all other adventure games are judged. And novices will not survive.

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"The Consumer Wants Pictures"

"In order to have the graphic images, you have to cut back on the amount of text. But that's becoming less of a reality, both through text compaction methods and because all of a sudden 128K seems to be starting to become a standard. And pretty soon, 512K will become a standard, and then it will become irrelevant," says Albert.

Penguin's newest fantasy role-playing game is *Xyphus* for the Apple II. Players may create characters who continue through different scenarios. The game also offers four-player independent movement, a variety of magical spells, and a mixture of graphics with text that reveals information about the status of the game.

Agreeing with Albert is Mike Cullum, new product director for Avalon Hill's Microcomputer Games division: "We've just released an all-text adventure game, *Ripper*, for the Commodore 64. Personally, I like the text games," he says. "But we have found that the averate consumer wants the pictures."

No Excuses

"As machines grow with more and more memory and sophistication, there won't be any excuse [not to have graphics]," he says.

One very popular game for Avalon Hill has been its all-text adventure *Empire of the OverMind*, for Apple II and Atari computers, which is still selling well, notes Jack Dodd, Avalon Hill's director of marketing. But with another of their releases, *Jupiter Mission 1999*, for Atari and Commodore 64 computers, the company mixed graphics and text in a very complex adventure.

"Of course, it took us four disks to do it," Dodd says with a laugh. "But it has all the meat of a text-type adventure."

Penguin Software's Transylvania *(at left) offers graphics alongside the text, here on the Macintosh version.* Xyphus *(at right), also from Penguin, is a graphics-based fantasy role-playing game for the Apple II computers.*

Trillium For Apple, Commodore

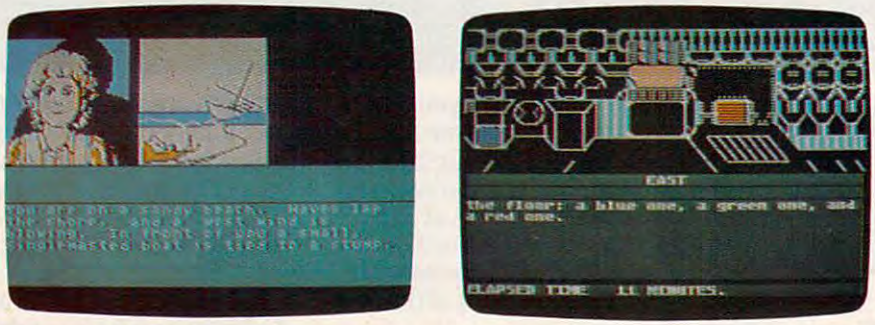
One of the most recent trends in the computer adventure genre is the use of well-known writers and the conversion of popular books into computer-game formats. No one is so far doing this more aggressively than Spinnaker Software's Trillium line of adventure games.

"We're trying to make a game that is based on plot and characterization—the way a book is—not puzzles," says Seth Godin, Trillium product manager. The Trillium series, which uses graphics and text, seeks to minimize the frustration factor, which has turned many would-be adventurers away from some computer games, adds Godin. To help achieve this, each of the games focuses on plot and characterization more than puzzles, and also includes a hint book and a list of the words that the game understands.

"If you read *Fahrenheit 451*, you don't get stuck on page 50. And if you play the game, you don't get stuck on frame 50, because the whole idea is that you're interested in the game because of the characters and the plot and what's happening," he says.

In addition to Ray Bradbury's *Fahrenheit 451*, the Trillium line will initially consist of adventure games based on such popular books as Arthur C. Clarke's *Rendezvous With Rama*, Michael Crichton's *Amazon*, Byron Preiss and Michael Reeves's *Dragonworld*, and Robert A. Heinlein's *Starman Jones*.

One of the games, *Shadowkeep*, actually preceded the book, which was later written by Alan Dean Foster, author of *Alien* and the Spellsinger series. The games are expected to be in stores by the end of Sep-



Spinnaker's Trillium adventure-game series offers graphics and text as shown from two of its titles, Dragonworld *(at left) and* Rendezvous With Rama *(at right).*

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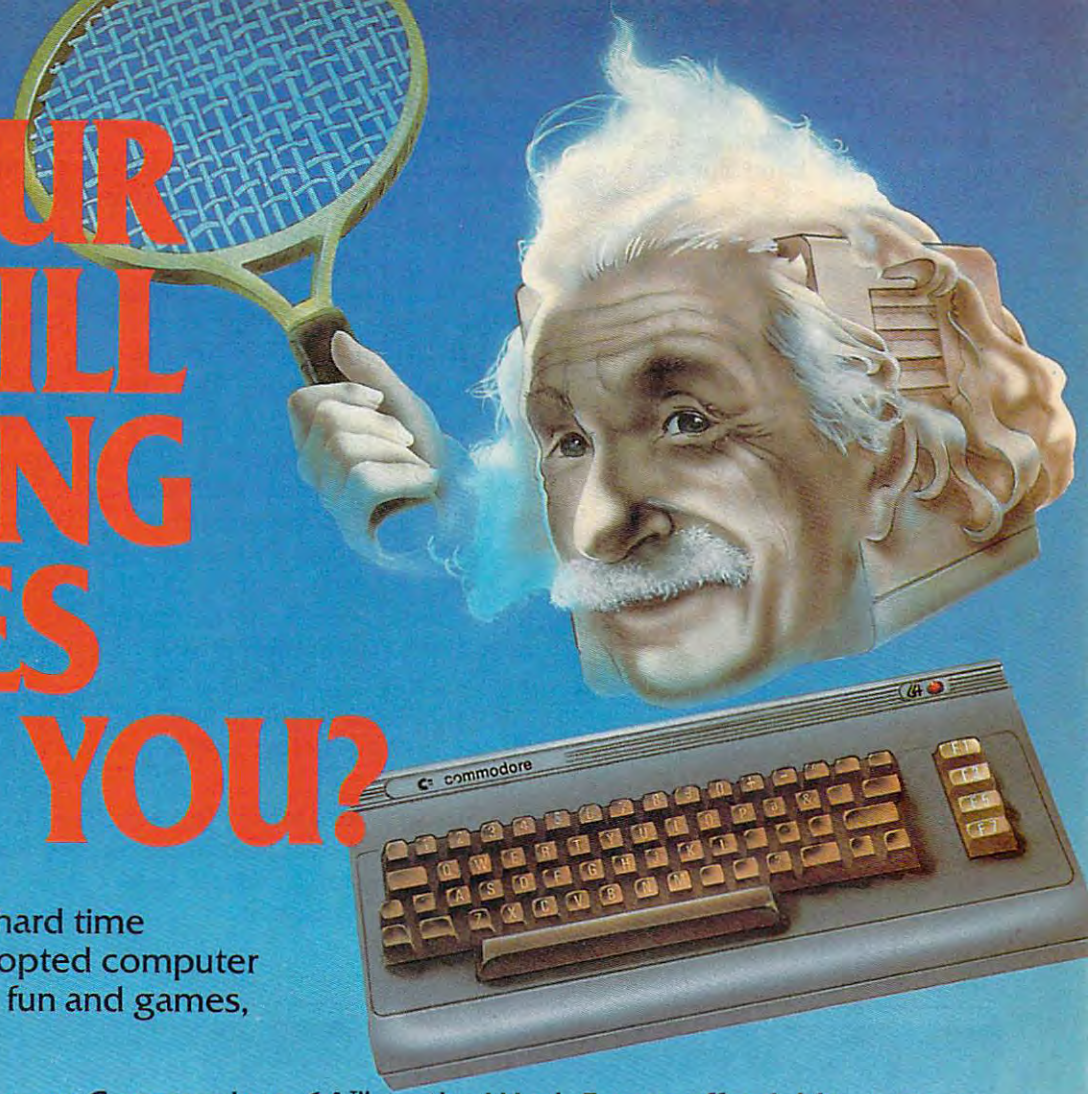

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tember or the first of October for the Commodore 64 and the Apple II line. Later conversions will follow.

Enthusiasm Is The Key

Although some adventure-game companies privately complain that signing a big-name author doesn't necessarily mean a first-rate game, Godin believes Spinnaker has found a good combination of talent and procedure.

"In every case, we worked with the authors to create the world [of the book] again," he says. "In the case of *Dragonworld* and *Amazon*, Byron Preiss and Michael Crichton wrote every word of the game. In the case of *Fahrenheit 451* and *Rendezvous With Rama*, we worked with the authors on the editings and the way it worked. We didn't just buy their names."

All of the games use graphics with text, and allow interaction between the two. For example, as *Amazon* opens, a research station somewhere along the Amazon River has obviously been attacked. Suddenly, as your mock video transmission fades, you briefly glimpse an intruder. To find out what's happened and who the intruder is, you must travel to the Amazon and explore.

As microcomputers continue to grow more powerful, a generation of avid adventure-game designers and programmers is growing more sophisticated. And, while the debate over text versus graphics will surely continue, there is a fundamental enthusiasm shared by all the best adventure-game producers.

This enthusiasm is the key, they all admit, to the continuing improvement of computer-based adventures. As Robert Woodhead says of his *Wizardry* game: "It's a good game that was a labor of love, and we didn't write it for anyone else but ourselves. People appreciate that."

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Commodore Prepares To Roll Out The Plus/4

Selby Bateman, Features Editor
Tom R. Halfhill, Staff Editor

Here's a hands-on report on Commodore's new Plus/4, a $300 64K computer with built-in productivity software scheduled for release this fall. Commodore calls it "The Productivity Machine."

Commodore's new Plus/4 computer is an interesting hybrid: part programming machine and part productivity package.

Commodore says the Plus/4 is not a replacement for the popular Commodore 64, but instead addresses a new market with an emphasis on practical applications for home and small business. It will be accompanied by a new line of peripherals—some of which are compatible with the 64 and VIC-20—plus a scaled-down 16K version, the $100 Commodore 16, which replaces the discontinued VIC.

At the heart of the Plus/4 and Commodore 16 is the new 7501 microprocessor, an eight-bit chip which is machine language-compatible with the 6502/6510 found in the VIC and 64. However, because of memory differences, practically no VIC and 64 software will run on the Plus/4 and Commodore 16.

Since announcing the Plus/4, Commodore has wavered about whether it will actually market the computer. As of this writing (mid-August), Commodore began shipping review units to major magazines and was preparing to launch a national advertising campaign October 8, so it appears the Plus/4 will hit the shelves barely in time for the Christmas season.

Improved Features

As a programming machine, the Plus/4 has several advantages over the two-year-old 64. It has a new, more powerful BASIC (BASIC 3.5) with over 75 commands, including more than a dozen for sound and graphics. There's a built-in machine language monitor with 17 commands. There are 16 primary colors, just like the 64, but each color now has eight luminances (shades), for a total of 128 hues. You can define an independent window anywhere on the screen by specifying its upper-left and lower-right corners, and all subsequent screen output will be redirected to this window. And a new bank-switching technique leaves the 64K computer with a spacious 60K RAM for BASIC programming.

As a productivity machine, the Plus/4 has four application programs built into ROM: a word processor, a spreadsheet, a file manager, and a business graphics generator. All the programs are integrated with each other. For example, a portion of the spreadsheet can be cut and pasted into a document on the word processor. There's also a windowing capability so you can display two of the programs on screen at once. Commodore's marketing strategy for the Plus/4 centers on these built-in applications, titled *3-Plus-1*. They were developed for Commodore by International Tri Micro.

DSAVE, SCNCLR, And HELP

The Plus/4's keyboard differs slightly from those on the 64 and VIC. Above the keyboard are four special function keys with eight predefined functions: RUN *3-Plus-1*, DLOAD (disk load), DIRECTORY, SCNCLR (screen-clear), DSAVE, RUN, LIST, and HELP. The new KEY command lets you display the functions currently programmed

The Commodore Plus/4 may finally reach dealers this fall.

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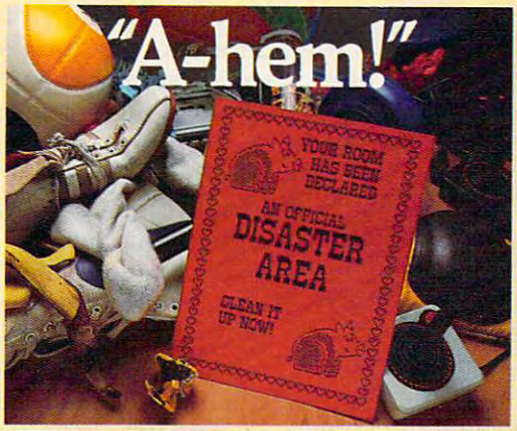

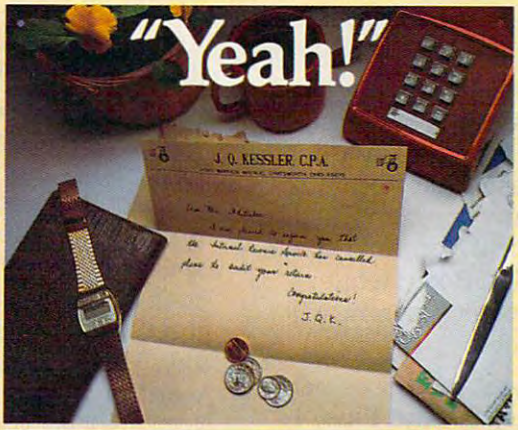

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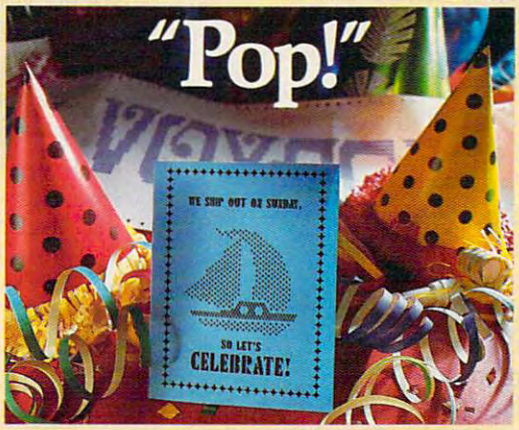

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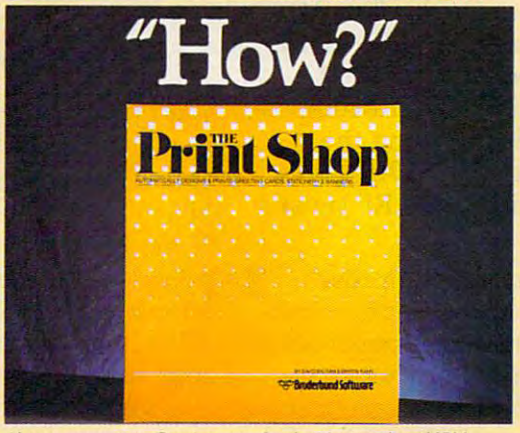

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for each key and easily reprogram them yourself.

The main keyboard has 59 typewriter-like keys and four separate arrow-shaped cursor keys. All of the standard PET/VIC/64 graphics characters have been retained on the front of the keycaps, with two additions: FLASH ON and FLASH OFF, to display flashing characters on the screen. The Plus/4 keyboard feels looser and springier than a 64 keyboard, very much like the Commodore SX-64 transportable.

There's also a reset button next to the power switch. It's a cold-start reset that normally wipes out any program held in memory, but if you hold down the RUN/STOP key while pressing it your program will not be harmed.

Peripheral interfaces have been changed on the Plus/4. While it can use the same 1541 disk drive and serial printers designed for the VIC and 64, the Plus/4 has a parallel port for a much faster drive, the SFS-481. The Plus/4's cassette port and two joystick ports are not compatible with current Commodore cassette recorders and game controllers. Another port resembles a Commodore 64 expansion port and is labeled "Memory Expansion," although no expanders for the Plus/4 have been announced. Finally, there are two video output jacks: one for standard composite monitors (including the Commodore 1701/1702), and another which feeds RF signals to a TV.

Despite these improvements, the Plus/4 lacks a few significant features found on the less expensive 64. There's no sound synthesizer chip—just two tone-generators which do not offer the flexibility of the 64's SID chip. And although the Plus/4 has 128 colors and a high-resolution graphics mode of 320 × 200 pixels, it has no sprites. So the Plus/4 and Commodore 64 are differentiated by more than just $100 in price. The Plus/4 is better suited to more "serious" applications and programming, while the 64 has superior graphics and sound.

Instant Software

When you turn on the Plus/4, you can immediately run the built-in software by pressing the F1 function key and then RETURN. Since *3-Plus-1* is in ROM, there's no waiting for a disk or tape to load. The computer runs the software instantly, defaulting to the word processor.

You control *3-Plus-1* by typing two-letter commands at a special screen prompt. The prompt appears when you press the Commodore logo key and C key. For example, to leave the word processor and enter the spreadsheet, you type the command TC ("To Calculator").

Although having four integrated programs instantly available is a powerful feature, not all of the programs are as powerful as software available separately. The word processor may be the weakest link. For one thing, it limits you to only 99 lines of text, so extended documents are beyond its scope.

Second, the word processor's editing functions are a bit unusual. When you insert characters, the entire document is pushed forward on the screen, not just the text up to the next carriage return. You can disable this movement, but then words start wrapping around into half-lines. Also, the text scrolls horizontally as it's entered to simulate an 80-column (actually 77-column) screen. This can take some getting used to unless you've previously worked with horizontal scrolling. Your text marches off the screen to the left as you type, and then wraps around at the start of the next line. Therefore, you can't view a whole sentence on the screen at once, unless it's less than 40 characters long.

New Name, Same Machine

The Plus/4 was originally announced at the Winter Consumer Electronics Show (CES) in January as the Commodore 264. Although the name has changed, the design is essentially the same—with one important difference. The 264 was going to be offered in several different configurations. Buyers could pick what applications software they wanted built into the computer.

By the Summer CES in June, Commodore had abandoned that concept. Apparently dealers had rebelled against the idea of installing their own ROM chips or stocking many models of the same computer. Commodore also dropped plans to introduce the Commodore 364, a deluxe version of the 264 with a speech synthesizer and numeric keypad.

Commodore plans to release about 30 programs for the Plus/4 to coincide with the computer's introduction. These will consist primarily of productivity packages, with some educational programs and a few of the most popular games available for the 64.

The on-again, off-again history of the Plus/4 means it's possible that Commodore may decide at the last moment not to release the computer. However, a source working with the company claims "all systems are go."

Commodore is obviously banking on its assessment that the next large segment of the computer-buying population wants a productivity-oriented machine at an affordable price. At the same time, the company will closely watch how the new computer affects the Commodore 64, a phenomenally popular computer which continues to sell briskly. ©

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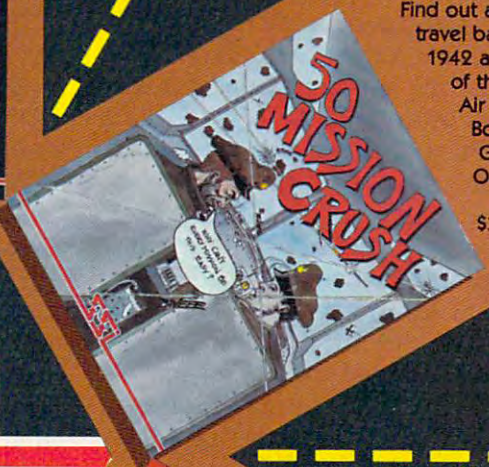

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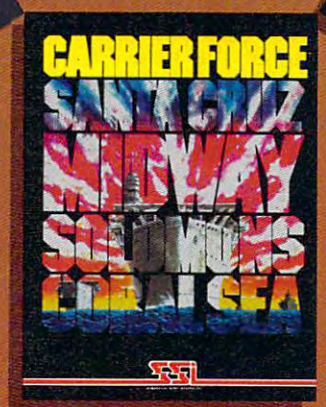

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IBM's New & Improved PCjr

Tom R. Halfhill, Staff Editor

As expected, in late July IBM finally announced a new keyboard and memory expansion option for the PCjr. Coupled with June's price cuts and some more hardware and software, the improvements make Junior much more competitive in the marketplace. The next few months will be crucial: Can IBM turn the PCjr around? Here's an analysis of the new developments.

Déjà vu was unavoidable. For the second time in nine months, with only 24 hours' notice, IBM had summoned dozens of editors, reporters, and photographers from all over the country to New York for a press conference. This one was scheduled for 10 a.m. on July 31 at IBM's Gallery of Science & Art in midtown Manhattan—the same spot where, almost exactly nine months to the hour before, IBM had staged a similar media event to unveil its new PCjr.

Debarking from cabs, press people signed in at the same table set up in the same glass-walled lobby overlooking Madison Avenue. From there they passed the guards and descended the curving stairs to the same lower lobby, where the same tables adorned with white tablecloths and gleaming silverware served up the same selection of breakfast rolls, coffee, and tea. PCjrs were set up at the far end of the same long hallway, barely within view, and the same velvet ropes and business-suited guards held the crowd back until the official stroke of ten.

But not everything was the same. Nine months before, the excited gathering of journalists had buzzed with anticipation about the long-awaited "Peanut" that was sure to conquer the home computer market, legitimize a confused industry, and establish new standards for others to follow. This time, the journalists had come to see how IBM would respond to months of criticism, bad press, and disappointing sales.

Something else was different, too—this time there seemed to be little room for surprise. For months, rumors had been circulating about a new typewriter-style keyboard and a memory expansion option that would make the PCjr more palatable to the public. Only the details remained in doubt.

When the clock struck ten and the velvet ropes were finally dropped, everyone hurried down the hall for their first glimpse of the new PCjr, just as they had on November 1. But a surprise awaited them after all. The PCjrs were set up where everyone expected, busily running various demo programs, but the keyboards were missing. And IBM's public relations people were ushering everybody into an auditorium off the hallway. The waiting wasn't over yet; no one would be allowed to see the keyboard until after the press conference.

During the next hour, IBM downplayed the PCjr improvements. Dozens of people had traveled thousands of miles to see the rejuvenated Junior, but IBM insisted that the main reason for the press conference was to formally announce its Writing to Read project, a new computer-aided method for teaching kindergartners how to read and write. IBM showed a ten-minute film on Writing to Read, then introduced some teachers, parents, and children flown in from three school districts around the country which had successfully tested the system.

Meanwhile, reporters who had grabbed press kits on their way down the hall were flipping through the photos and press releases to find something about the PCjr keyboard. The information and pictures were there, but at the very back of the kit.

Finally, after a question-and-answer session with Philip D. Estridge, president of IBM's Entry Systems Division, the press conference was over. The journalists spilled out into the hallway and descended on the PCjrs, hooked up to their new keyboards at last. Hundreds of fingers began drumming on the keys, assessing the "feel." Now it was IBM's turn to hold its breath.

A minute later, heads started nodding in approval. Compliments were offered. Lenses focused on the new keyboards, shutters began clicking, and videotape started rolling. IBM employees began to smile. Perhaps, if they were lucky, the mistake of the old keyboard would soon be forgotten.

Then it happened. A man walked up to one PCjr and identified himself as a reporter from *The New York Times*. As he experimented with the new keyboard, the IBM publicist as-

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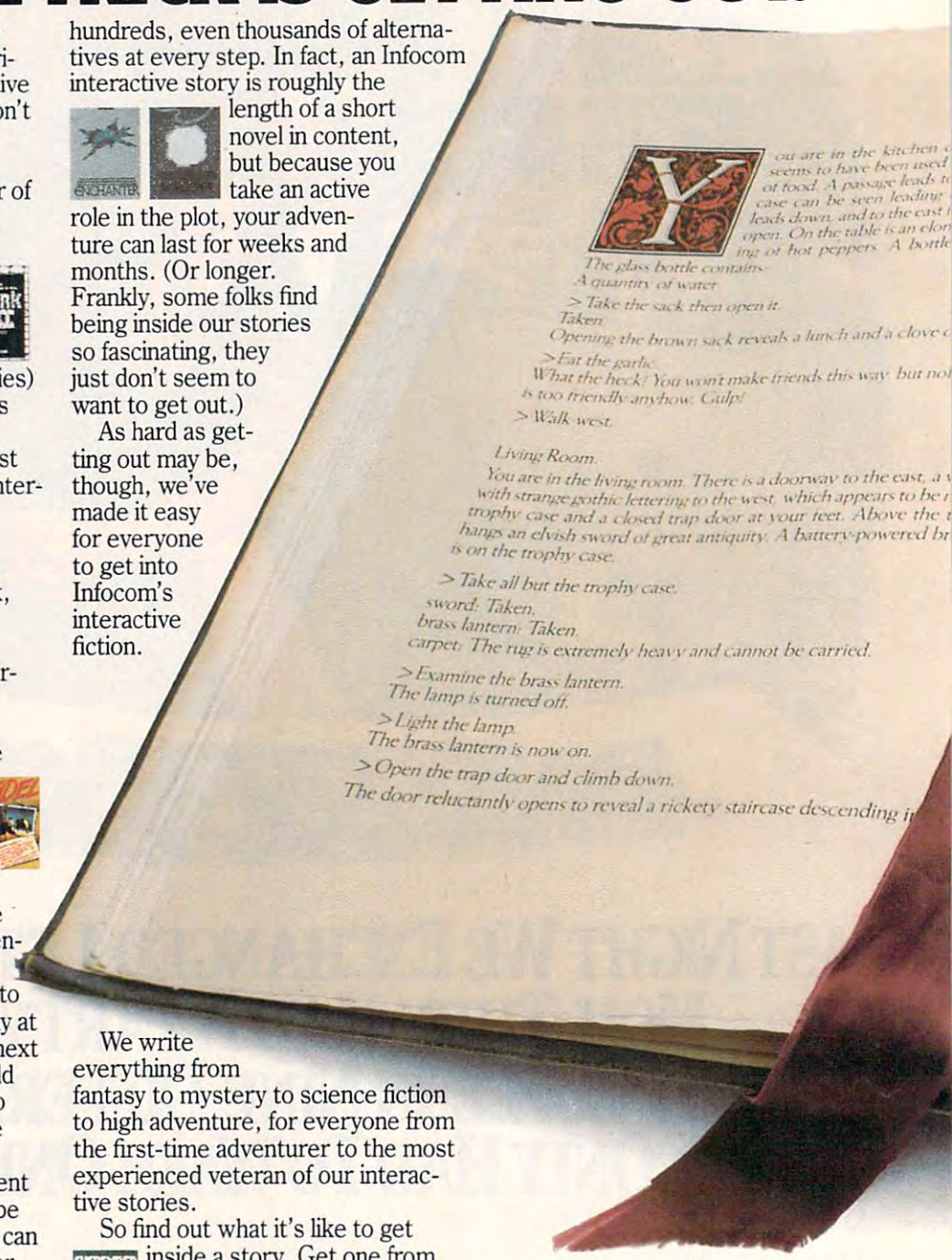

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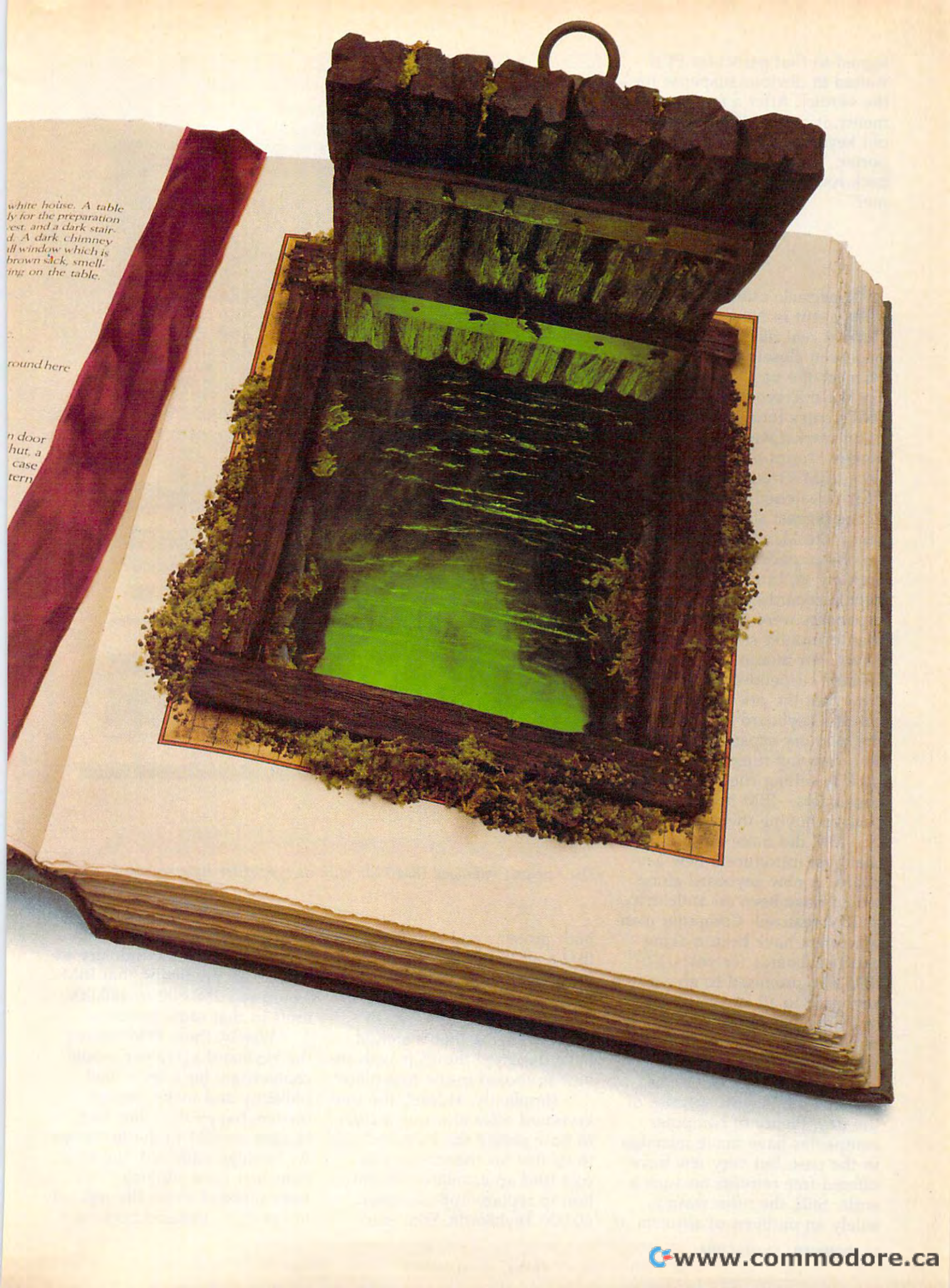

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signed to that particular PCjr waited in obvious suspense for the verdict. After a few moments, it came: "What was the old keyboard like?" said the reporter. "Do you have one in the back room you could show me?"

Spectacle aside, the media event in New York came as real relief to those who had been closely following the PCjr for the past nine months. For the microcomputer industry, IBM's entry into the home computer market was one of the biggest stories of 1983. Likewise, IBM's troubles with the PCjr threatened to become one of the biggest stories of 1984. Since late March, when the first reports of poor sales began trickling in, rumors of price cuts, new keyboards, and memory expanders were traded faster than computer stocks on Wall Street. For months everything seemed suspended in limbo. Now that the price has been cut, the keyboard replaced, and the memory expanded, IBM can stop denying rumors and go back to selling computers. And consumers—IBM hopes—can go back to buying them.

IBM did more on July 31 than just introduce a new keyboard. A new keyboard alone would have been an anticlimax, as IBM realized. Computer manufacturers have been making good keyboards for years. So IBM also promised to give a free keyboard to all current owners of PCjrs, and to those who buy remaining inventories of PCjrs with old keyboards.

This generous offer was perhaps the biggest surprise of the day. Plenty of computer companies have made mistakes in the past, but very few have offered free retrofits on such a scale. Still, the offer wasn't solely an outburst of altruism. It both protects and reinforces IBM's all-important reputation for dependability and service. And as an IBM publicist confided, it's also IBM's way of acknowledging that it should have designed the PCjr with the new keyboard in the first place.

The new and improved IBM PCjr with its typewriter-style keyboard.

(Implicitly, at least, the free keyboard offer also was a clue to how poorly the PCjr had sold in its first six months; it will cost IBM an estimated $5 million to replace approximately 60,000 keyboards. Soon after the PCjr was unveiled in November 1983, some industry experts were predicting that IBM would sell 250,000 to 480,000 units in that same period.)

Wisely, then, IBM figured the keyboard giveaway would compensate for a lot of bad publicity and make present owners happy that they had bought an IBM in the first place. As Estridge admitted, the criticism had been stinging: "We were puzzled about the reaction to the PCjr, puzzled because it

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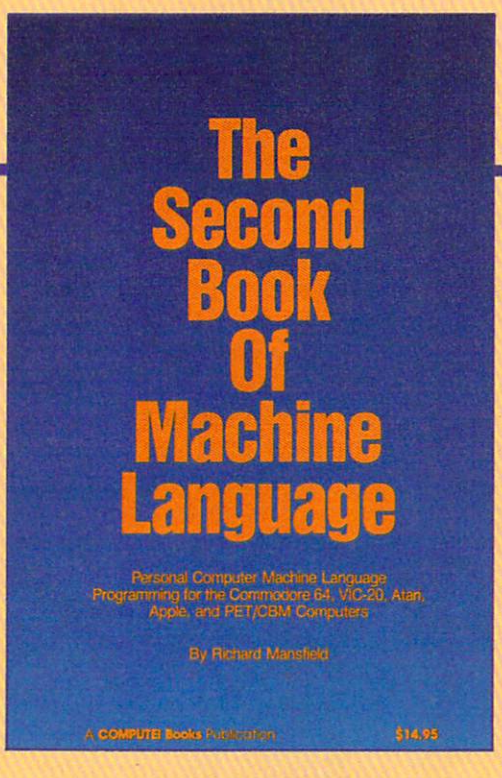

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was so intense....You can't wake up and eat breakfast every morning and read in the paper that you have a crummy keyboard and not be impressed."

But apparently IBM also faced a public relations dilemma. Judging from the way the event was organized, IBM didn't want the keyboard announcement to monopolize *too* much attention. Essentially, they were patching up what has been an embarrassing episode for the world's largest computer company. So IBM surrounded the keyboard announcement with a press kit full of other announcements—all of which were interesting, but none of which would have drawn the same number of journalists to New York on 24 hours' notice.

It was a futile effort, however. The new keyboard was the talk of the day.

Here's what IBM announced on July 31:

• PCjr typewriter-style keyboard. Available now, the new cordless keyboard is a significant improvement over the old chiclet-style "Freeboard." Except for the new keys and the lettering on the keycaps, it's virtually identical to the old model. In fact, it's made for IBM by the same outside company and built into the same case. IBM says the infrared link has been slightly improved. The F and J keycaps have raised ridges so your fingers can more easily find the home row without glancing away from the screen. Although the keyboard isn't quite as good as you might expect for a computer in the PCjr's price range—there's still no separate special function keys or numeric keypad—it should satisfy the vast majority of complaints about the old keyboard.

• Optional memory expansion to 512K RAM. The expanders are snap-on modules which attach to the right side of the PCjr system unit. Each module contains 128K; snapping three of them together yields a total of 512K, counting the 128K already installed inside an Enhanced Model PCjr. The extra memory requires a specially configured version of DOS 2.1. Configuration programs are included with the modules. You can configure the memory to act like contiguous RAM (as in the PC) or as a RAMdisk. When the memory is set up as a RAMdisk, addressed as drive C:, a PCjr with only one physical disk drive can run some PC software designed for two-drive systems. IBM's memory modules will retail for $325 each. Although memory expansion to as much as 640K was already available from several outside companies, IBM knows that many owners prefer to stick with pure IBM equipment when expanding their machines. The expansion option also shows that IBM itself is addressing the complaint that the PCjr is not as PC-compatible as promised. Furthermore, it signals a shift in IBM's marketing orientation for the PCjr, as we'll explain below.

• Power expansion attachment. This is an auxiliary power supply required if more than one 128K memory expander is added to a PCjr. It snaps onto the right side of the system unit between the expanders and the computer. It has its own power transformer that plugs into a wall socket. The retail price is $150.

• *Lotus 1-2-3* on cartridge. Strictly speaking, this wasn't an IBM announcement, but it was announced simultaneously in Boston by Lotus Development Corp. The extremely popular spreadsheet/data base/business graphics package will be available on plug-in ROM cartridge for the PCjr in the fourth quarter of 1984. Actually, the PC disk version of *Lotus 1-2-3* will run on a PCjr if you add one of the new memory expanders for a system total of 256K, but the cartridge version will work on a standard 128K PCjr. That means you'll be able to run best-selling *Lotus* on a computer that costs less than $1000.

• PCjr speech attachment. Like the memory expanders, this is a module for the right side of the system unit. It has a 196-word vocabulary in ROM and a microphone jack so you can record your own words and sounds on disk. Output is routed through the TV speaker or the audio jack. Programs incorporating speech and other sounds can be written for the attachment. The retail price is $300.

• *PCjr Colorpaint* on cartridge. This is a $99 graphics-drawing program very similar to Apple's *MacPaint* for the Macintosh, except it lets you draw in 16 colors. Like *MacPaint*, it works with a mouse controller (not included) that lets you select drawing options by pulling out hideaway menus and pointing to icons.

• *Managing Your Money* on cartridge and disk. Written by financial expert Andrew Tobias, this budgeting program has proven very popular on the IBM PC. It runs on a 128K PCjr and retails for $199.

• PCjr educational discounts for schools and full-time teachers. Two systems are being offered: an Enhanced Model PCjr with DOS 2.1, Cartridge BASIC, an RF modulator, and keyboard cord will cost $700 in quantities of one to 14, and $675 for 15 or more; and the same system with an IBM PCjr Color Display (RGB monitor) instead of the RF modulator will cost $950 in quantities of one to 14, and $900 for 15 or more.

• Eight new educational programs for homes and schools.

• Writing to Read. This is a language laboratory for schools

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Closeup of the keyboard. You'll notice that the key layout is exactly the same—but the "feel" is certainly different.

consisting of IBM personal computers, speech attachments, Selectric typewriters, special software, workbooks, cassette tapes, and other materials. It teaches kindergartners and first-graders how to read by encouraging them to write original stories and essays. The system was tested over the last two years by more than 22,000 pupils in 225 schools and declared a success by some leading educators.

Now for the $64K question: Will IBM's long-awaited improvements finally make the PCjr the popular computer it was supposed to be?

We probably won't know for sure until Christmas. But one thing is certain—at $999 list, the new and improved PCjr is now a solid contender in the marketplace. Its closest competitors are the Apple IIe and IIc. For a list price of $995, the IIe offers only 64K RAM, no disk drive, and only 40 columns in text mode. It can be expanded to a maximum 128K and 80 columns. For $1295, the IIc includes 128K RAM, switchable 40/80 columns, and a built-in disk drive. But Apple disk drives have less than half the capacity of IBM drives. Also, neither Apple can match the PCjr's graphics, sound, and memory expansion capabilities.

Apple II series computers do have a larger software base, especially in terms of home and educational programs. But IBM is rapidly catching up, and the new memory expansion modules allow the PCjr to run hundreds of PC programs which were incompatible before.

Of course, list prices don't tell the whole story. With typical discounts, you can usually buy an Apple IIe system with a disk drive and monochrome monitor for under $1000. But the PCjr also is being aggressively discounted. In early August, a local ComputerLand was selling the Enhanced Model PCjr for only $699—a full $300 off the list price. At $699 for 128K, a 360K double-sided disk drive, and the new keyboard, the PCjr will be hard to beat.

The improved PCjr will probably even cut into sales of the IBM PC. This is what IBM tried to avoid when it first introduced the PCjr, but IBM seems less concerned now. For one thing, IBM was almost forced to upgrade the PCjr after all the resistance it met. And second, IBM is preparing to introduce a new machine that will likely displace the PC as IBM's top-line personal computer.

Following is a breakdown of how much money could be saved by purchasing a PCjr instead of a PC (the computers are equipped to approximate each other's capabilities). All amounts are retail list prices for IBM products.

Standard IBM PC with 256K RAM, one 360K disk drive:	*$1995*
Asynchronous communications adapter:	*100*
Color/graphics adapter:	*244*
Game control adapter:	*45*
Printer adapter:	*75*
DOS 2.1:	*65*
TOTAL:	*$2524*

Enhanced Model PCjr with 128K RAM, one 360K disk drive:	*$ 999*
128K RAM memory module:	*325*
Cartridge BASIC:	*75*
DOS 2.1:	*65*
TOTAL:	*$1464*

Although the two systems are similarly equipped, there are still some differences, of course. Even with the color/graphics adapter, the PC lacks some of the PCjr's graphics and sound capabilities. But the PC runs programs faster, has faster disk input/output, and provides simultaneous disk I/O with its DMA (Direct Memory Access) controller. The PCjr has a cordless keyboard, but the PC's keyboard has separate special function keys, a numeric keypad, and better feel. Both computers could be expanded to 640K RAM, multiple floppy disk

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drives, and a hard disk—though you'd have to buy non-IBM products for the PCjr.

All things considered, the new and improved PCjr is very nearly as powerful as a PC and can save you more than $1000. It seems likely that many people will opt for the PCjr.

It also seems probable that the PCjr's market will shift somewhat. IBM is no longer pushing the PCjr as a home computer—at least, not to the same extent it was before. Some journalists at the July 31 press conference noticed the difference as soon as they saw the roomful of Juniors running demo programs. Nine months earlier, nearly all the PCjrs were running games and other home applications. This time, the computers were running more "serious" programs, including business software. A couple of reporters put the question to Philip Estridge, the Entry Systems Division president: Is the PCjr still a home computer, or not?

Estridge wouldn't answer yes or no. Instead, he said IBM perceives that leisure use of home computers is declining and that more people are demanding serious applications. Recent IBM research, he added, indicates that 75 percent of the people who buy a PCjr have access to an IBM PC at work. Therefore, IBM assumes these people want a computer at home that can run PC programs from the office.

To reach that market, Estridge said IBM's new advertising for the PCjr will emphasize that it's a general-purpose computer which can be adapted to a variety of applications. "Trying to describe a computer as a 'home computer' or a 'business computer' or an educational computer,' I don't think the statistics are there to support such a niche," said Estridge. "People buy a computer because they have a purpose for it."

Of course, practically any computer these days can be adapted to home, educational, or business applications. It's just that some computers are more powerful for certain applications than others. But these distinctions could blur as even the low-end computers grow increasingly powerful. (In fact, some machines for less than $500 will soon appear which offer more processing power than a $4000 PC-XT.) At that point, prices, target strategies, and software libraries may stratify the personal computer market more than computing power.

In the final analysis, it will be the consumers who'll decide where—or if—the PCjr fits in.©

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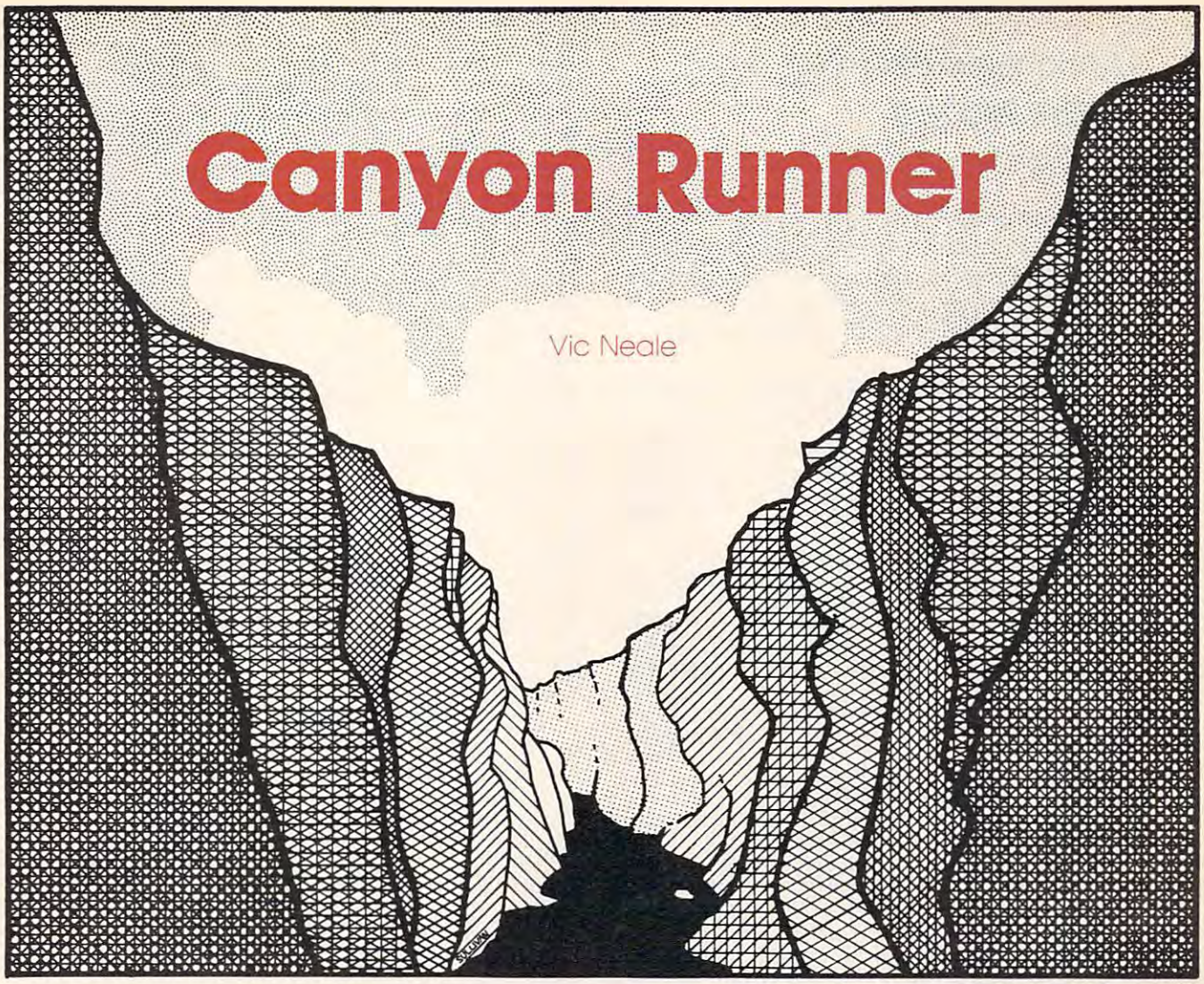
Canyon Runner

Vic Neale



In "Canyon Runner" you are a pilot on a mission through a very perilous canyon. You must survive this test. The only way to do so is by maneuvering your tiny plane through the endlessly scrolling canyon. Versions for VIC-20, Commodore 64, Atari, and Apple.

At first, it's easy. But chunks of rock and other obstacles soon get in your way as you maneuver through the canyon. Any of these could lead to the destruction of your plane.

To avoid disaster, you have to avoid all the dark areas and hit all the areas marked BONUS. When you begin to think that everything is going to be fine and that you are home safe, things suddenly become difficult and you encounter a mind-boggling time warp. The time warp has enveloped part of the canyon. The pulsing colors of the time warp can easily distract you, so be careful. If you make it through this time warp, you will be faced with a narrower canyon.

The game is joystick-controlled. At the start of the game, you may choose at which skill level you would like to begin. The easiest level is number 5 and the hardest is number 1. Between 1 and 5 there are other degrees of difficulty. Every time you make it through a color zone, you advance a level, so it might be best to start at the easiest level just to get some practice. You gain points in the game according to how long you can manage to survive.

The VIC version of the game is divided into two parts so that it will fit into the limited memory of the unexpanded VIC. The first part (Program 1) will automatically load and run the second part (Program 2), provided you save Program 2 with the filename CR. If you are using tape instead of disk, be sure to change the 8 to a 1 in line 50 of Program 1. Be sure to save Program 2 immediately following Program 1 on the same tape. When you load and run Program 1, leave the PLAY button on the Datassette depressed to load and run Program 2.

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Commodore 64 And Atari Notes

Kevin Mykytyn, Editorial Programmer

In the Commodore 64 and Atari versions of "Canyon Runner," you are trying to guide your helicopter through an ever-changing canyon, shoot your opponent's helicopter, and avoid the salvos your opponent may fire at you.

Both programs are written entirely in machine language and must be entered using the MLX machine language editor. Be sure you read and understand the MLX article elsewhere in this issue before you begin typing.

The Commodore 64 version of MLX will ask you for the starting and ending address of the machine language. For Canyon Runner (Program 3), the starting address is 49152 and the ending address is 51720. To run the program, load it by filename followed by ,1,1 for tape or ,8,1 for disk, then SYS 49152.

Atari MLX also asks for several addresses. The starting and ending addresses are 8192 and 9904, respectively. The run/init address is 8192. MLX will allow disk users to create either a boot disk or a binary file. If you select the binary file option, the program must be loaded with DOS menu selection L (binary load). If you use the filename AUTORUN.SYS for the binary file, the game will automatically load and run when you boot the system. Tape owners should create a boot tape using the appropriate MLX option.

The game requires two joysticks and has many options. You may choose the type of shot by pressing A for altitude bombs or D for detonation bombs. Altitude bombs will always explode at the altitude they are fired, while detonation bombs will change their altitude as you change the altitude of your helicopter. On the Commodore 64, you may also choose the solo option. This allows player 1 to practice flying through the canyon, although firing will not work properly.

At the bottom left and bottom right of the screen are the numbers from 1 to 9. The present difficulty level will be highlighted. These numbers indicate each player's individual difficulty level. The lower, the more difficult. Each player can change his difficulty level by moving his joystick from side to side.

The width of the canyon is also selectable, with three widths to choose from. On the 64, make your selection by pressing the 1, 2, or 3 key. On the Atari, use the SELECT key. Choosing width 3 will give a very narrow canyon that can challenge even an experienced player.

After the options have been chosen, begin the game on the 64 by pressing both joysticks up simultaneously, or on the Atari by pressing the START key. All action is controlled with the joysticks. You can change your altitude by moving the joystick back and forth and fly from side to side by moving the joystick left and right. The 64 version provides a graphic altimeter at the bottom of the screen to indicate your altitude, while the Atari version's altimeter has a digital readout.

To fire a bomb at your opponent, simply press the joystick button. The flight of the bomb can be heard as a whistling sound. The Commodore 64 version utilizes sprite priorities to simulate explosions above and below the target. The Atari version achieves the same effect with player/missile graphics.

Program 1: Canyon Runner, VIC Loader

Refer to the "Automatic Proofreader" article before typing this program in.

```
10 POKE51,0:POKE55,0:POKE52,28:POKE56,28:
   CLR:POKE36869,255              :rem 173
15 PRINT"{CLR}{9 DOWN}{4 RIGHT}CANYON RUN
   NER"                           :rem 121
16 PRINT"{3 DOWN}{5 RIGHT}PLEASE WAIT
   {WHT}"                         :rem 240
20 FORI=7168TO7679:POKEI,PEEK(I+25600):NE
   XT                             :rem 99
30 FORI=7384TO7399:READA:POKEI,A:NEXT
                                  :rem 84
40 DATA 255,255,255,255,255,255,255,255,1
   95,231,231,231,0,0,165,231     :rem 229
50 S$="LO"+CHR$(34)+"CR"+CHR$(34)+",8:"+C
   HR$(131):REM CHANGE 8 TO 1 FOR TAPE US
   ERS                            :rem 214
60 FORI=1TOLEN(S$):POKE630+I,ASC(MID$(S$,
   I)):NEXT:POKE198,I:END         :rem 93
```

Program 2: Canyon Runner, VIC Main Program

Refer to the "Automatic Proofreader" article before typing this program in.

```
5 SYS 65017:POKE36869,255         :rem 120
10 PRINT"{CLR}":POKE36879,8:POKE36878,15:
   S5=36875:S1=36877:C=30720:S2=36876
                                  :rem 132
11 DEFFNR(X)=INT(RND(1)*X)+1:DEFFNP(X)=X+
   (PEEK(1)-PEEK(2)):DIMB$(15),T%(5),P(7)
```


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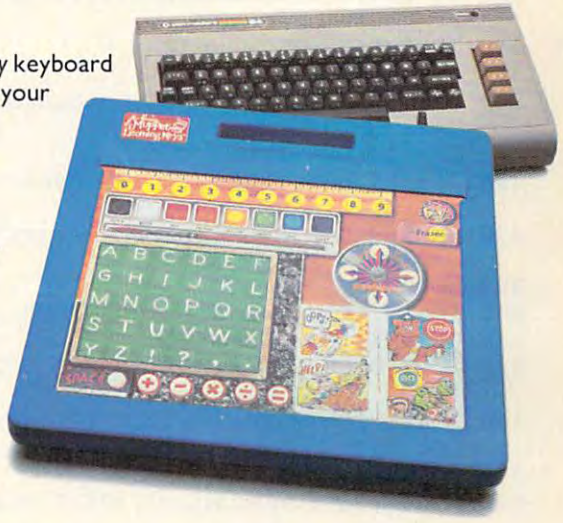

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```
   ,L(7)                                :rem 0
20 FORX=0TO7:READL(X):NEXT              :rem 203
40 FORX=1TO6:READC%(X):NEXT             :rem 202
100 GOSUB815:FORX=828TO871:READA:POKEX,A:
    NEXT                                :rem 136
110 FORX=1TO15:READB$(X):NEXT:FORX=1TO5:R
    EADT%(X):NEXT                       :rem 214
115 PRINT"{CLR}{DOWN}ENTER LEVEL":PRINT"
    {2 DOWN}5 EASY..HARD 1"             :rem 66
116 GETSK$:SK=VAL(SK$):IFSK>5ORSK<1THEN11
    6                                   :rem 146
120 B=0:P=7910:SC=0:S=7:X2=1:DL=SK*(15+(S
    K-5)):R=(SK*4)+20:H=SK*5            :rem 171
130 PRINT"{CLR}"SPC(S)"{WHT}{RVS} READY
    {2 SPACES}":FORX=1TO21:PRINTSPC(S)B$(
    1):NEXT:POKEP,28:FORD=1TO1500:rem 124
135 NEXT:TI$="000000"                   :rem 116
140 POKES5,128+(100-DL):POKES1,128+(100-D
    L):FORX=1TO5                        :rem 26
220 FORY1=1TO40:FORY=1TO5:J=X:J1=X:IFFNR(
    H)=1THENJ1=((X*2)+3+FNR(2))         :rem 130
230 GOSUB780                            :rem 180
270 IFPEEK(P)=32THEN630                 :rem 88
280 TU=0:GOSUB810:NEXT                  :rem 124
290 IFFNR(R)=1THENK=X:K1=K:GOTO400
                                        :rem 117
305 TU=230:J=X:J1=X:FORY=1TO25:GOSUB800
                                        :rem 186
310 IFPEEK(P)=32THEN630                 :rem 83
315 GOSUB810                            :rem 178
320 IFY=13ANDX=5THENJ1=1:TU=0:GOSUB760:S=
    S-4:IFS<2THENS=2                    :rem 115
325 IFY=13ANDX=5THENNEXT                :rem 46
330 IFY=13THENJ1=J1+1:TU=0:GOSUB760:NEXT
                                        :rem 253
370 NEXT:R=R-5:H=H-4:DL=DL-10:IFDL<0THEND
    L=0:R=10:H=3:GOTO140                :rem 248
380 GOTO140                             :rem 105
400 FORZ=1TO13:J=X:J1=X:GOSUB800        :rem 255
410 IFPEEK(P)=32THEN630                 :rem 84
420 TU=240:GOSUB810:NEXT:POKES5,228:POKES
    1,228                               :rem 76
430 FORZ1=1TO10:FORZ=KTO1STEP-1:J=Z:J1=Z:
    GOSUB780                            :rem 172
470 IFPEEK(P)=32THEN630                 :rem 90
480 POKEP,28:FORD=1TODL/2:NEXT:NEXT:K=4
                                        :rem 0
490 FORZ=2TO5:J=Z:J1=Z:GOSUB780         :rem 229
530 IFPEEK(P)=32THEN630                 :rem 87
540 POKEP,28:FORD=1TODL/2:NEXT:NEXT:NEXT
                                        :rem 128
550 FORZ=4TOK1:IFS>INT((Z+11)/2)THENS=S-2
                                        :rem 11
560 IFS<INT((Z+11)/2)THENS=S+1          :rem 252
570 J=Z:J1=Z:GOSUB800                   :rem 27
580 IFPEEK(P)=32THEN630                 :rem 92
590 TU=0:GOSUB810:NEXT                  :rem 128
600 FORZ=1TO13:J=X:J1=X:GOSUB800        :rem 1
610 IFPEEK(P)=32THEN630                 :rem 86
620 TU=240:GOSUB810:NEXT:SC=SC+5000
                                        :rem 115
625 POKES5,128+(100-DL):POKES1,128+(100-D
    L)                                  :rem 99
627 POKEP+C,T%(X):POKEP,27:PRINTSPC(S)"
    {WHT}{RVS}BONUS":POKEP,28:GOTO290
                                        :rem 184
630 E$=TI$:POKES5,0:POKES1,0:POKES2,0:POK
    EP+C,2                              :rem 101
640 FORX=180TO220STEP2:POKES2,X:FORD=1TO5
    0:NEXT:NEXT                         :rem 147
650 POKES2,0:FORX=0TO7:P(X)=P+L(X):POKEP,
    42:NEXT:POKES1,175                  :rem 197
660 FORX=15TO7STEP-1:FORY=0TO7:POKEP(Y),4
    6:P(Y)=P(Y)+L(Y):POKEP(Y)+C,1:POKEP(Y
    ),90:NEXT                           :rem 215
670 POKE36878,X:NEXT                    :rem 217
700 POKES1,0:POKE36878,15               :rem 177
710 S9=((VAL(MID$(E$,5,2)))+((VAL(MID$(E$
    ,3,2)))*60)):SC=SC+(S9*10)          :rem 234
720 PRINT"{CLR}{6 RIGHT}{CYN}GAME OVER":P
    RINT"{2 DOWN}"S9"SEC. IN TUNNEL"
                                        :rem 19
722 PRINT"{2 DOWN}SCORE:"SC             :rem 218
725 PRINT"{3 DOWN} FIRE BUTTON TO PLAY"
                                        :rem 125
726 PRINT"{DOWN}C TO CHANGE SKILL
    {5 SPACES}{DOWN}S TO STOP"          :rem 217
730 IF-((PEEK(37151)AND32)=0)=1THEN120
                                        :rem 68
735 GETA$:IFA$="C"THEN115               :rem 156
740 IFA$<>"S"THEN730                    :rem 105
750 END                                 :rem 115
760 POKEP+C,T%(J):POKEP,27:PRINTSPC(S)"
    {WHT}{RVS}BONUS":POKEP,28           :rem 154
770 B=B+1000:SC=SC+B:RETURN             :rem 117
780 T=FNR(4):IFT<=2THENS=S+1:IFS>J+10THEN
    S=S-2                               :rem 114
790 IFT>=3THENS=S-1:IFS<2THENS=S+2
                                        :rem 154
800 POKEP+C,T%(J):SYS828:POKEP,27:P=FNP(P
    ):PRINTSPC(S)B$(J1):RETURN          :rem 215
810 POKEP,28:POKES2,TU:FORD=1TODL:NEXT:PO
    KES2,0:RETURN                       :rem 84
815 FORD=1TO1500:NEXT:RETURN            :rem 51
820 DATA-22,-21,1,23,22,21,-1,-23,28,159
                                        :rem 183
830 DATA156,30,3[illegible],158,169,128,141,19,145,
    169,0,133,1,1[illegible],2,169,127,141,34,145,
    162,119                             :rem 141
840 DATA236,32,145,208,4,169,1,133,1,169,
    255,141,34,145,162,110,236,17,145,208
    ,4,169                              :rem 92
850 DATA1,133,2,96,"{BLU}[[[[[[[[","{GRN}
    [[[[[[[","{YEL}[[[[[[","{PUR}[[[[[","
    {RED}[[[[","{BLU}[[[{2 SPACES}[[["
                                        :rem 194
860 DATA"{BLU}[ [[[ [[","{GRN}[[[{OFF}
    {2 SPACES}[[","{GRN}[{OFF}{2 SPACES}[
    [[[","{YEL}[[[{OFF}{2 SPACES}[","
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Program 3: Canyon Runner For The 64

Version by Kevin Mykytyn, Editorial Programmer

Refer to the MLX article before typing this program in.

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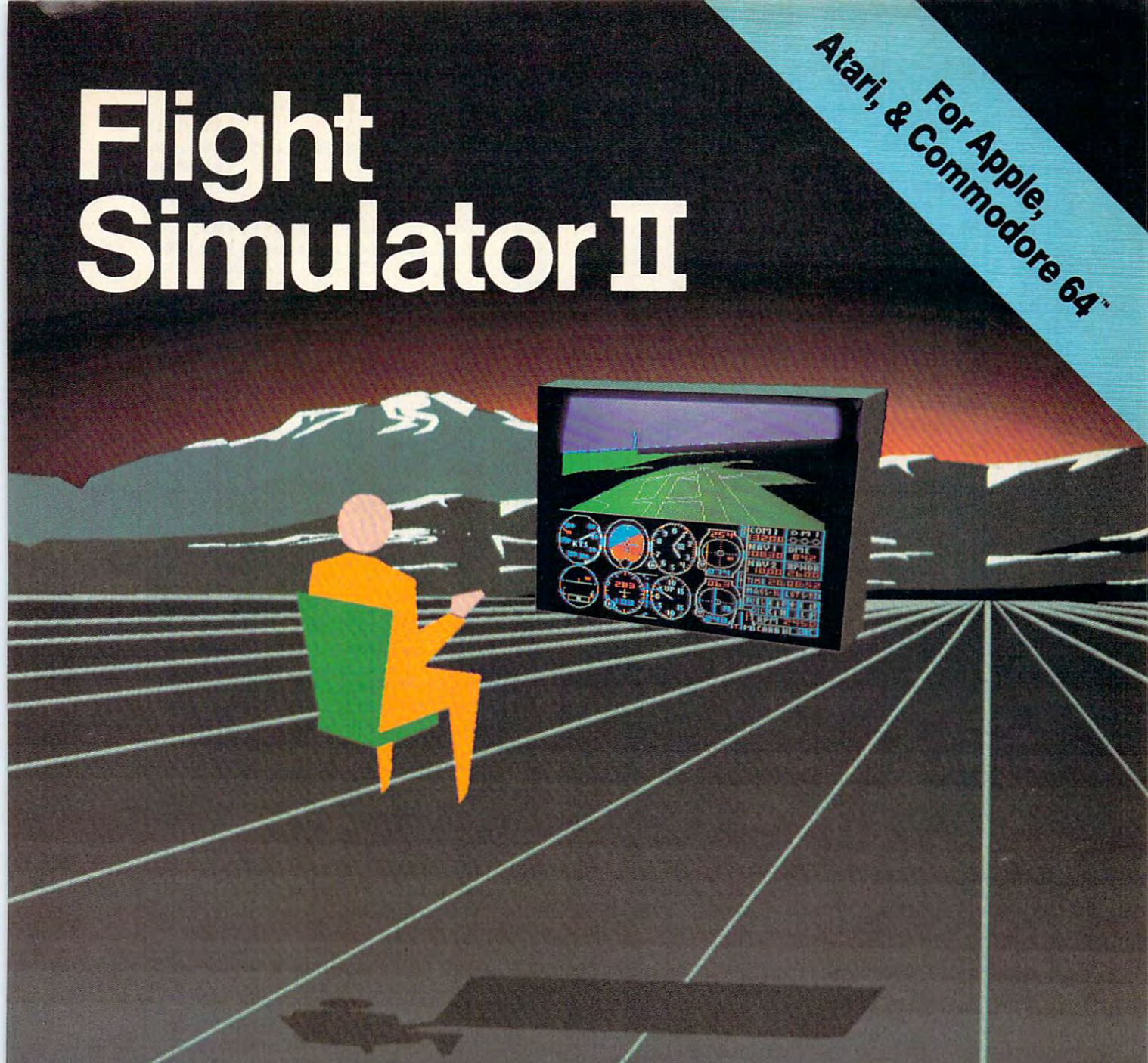

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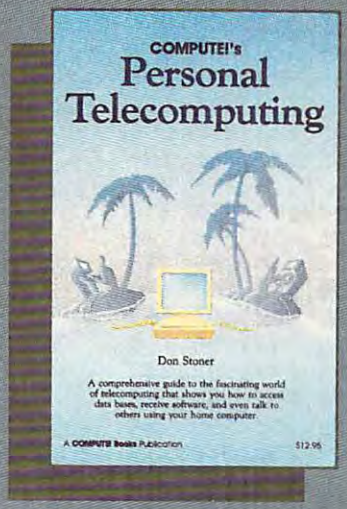

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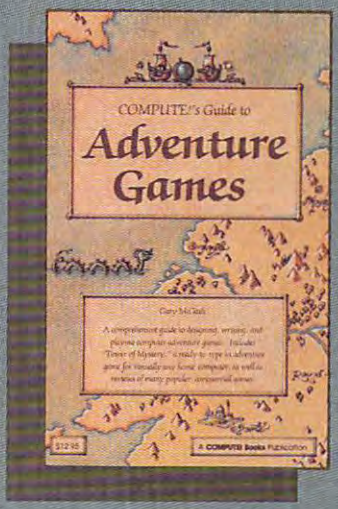

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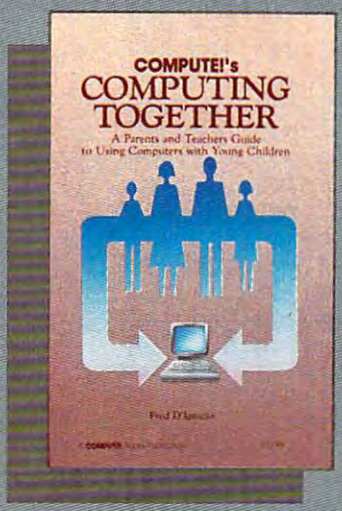

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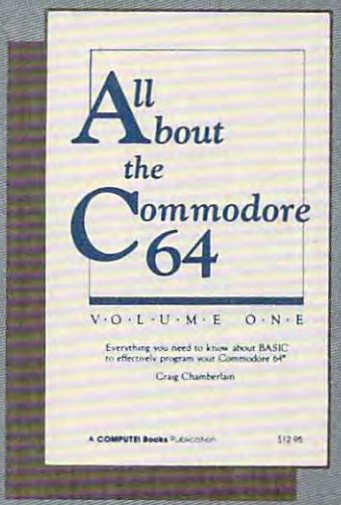

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Program 4: Atari Canyon Runner

Version by Kevin Mykytyn, Editorial Programmer

Refer to the MLX article before typing this program in.

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8192:169,015,141,200,002,165,180
8198:106,056,233,008,141,007,045
8204:212,133,204,133,206,056,188
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Apple Version Notes

Kevin Martin, Editorial Programmer

The object of the two-player Apple version of "Canyon Runner" is to navigate through a twisting canyon while trying to shoot down an opponent. But beware, your opponent will also be shooting at you.

The program is written in two parts and requires game paddles and a disk drive. Program 5 is all machine language and must be entered with the built-in monitor (see your Apple manual if you are unsure of how this is done). After Program 5 is entered, BSAVE it with the filename CANYON.ML using a starting address of $6000 and length of $923. Once you have saved Program 5, enter the loader program (Program 6) and save it. To play the game, load and run Program 6, which will load in and check the machine language from Program 5, then start the game.

When the program is run, you will be presented with a screen containing many options. Each player can choose his own level of difficulty. Player 1 increases or decreases his difficulty level by pressing X or Z, respectively, while player 2 uses the left and right arrow keys to accomplish this. If you wish to play alone, press S for the solo option.

There are two types of shots. If you press A at the start of the game you will be playing with altitude bombs which explode at the altitude at which they are fired.

The second type of bomb, the detonation bomb (chosen at the start of the game by pressing D), will change its altitude as you change the altitude of your plane, so you can continue to adjust your altitude to the altitude of your opponent after the shot is fired.

The overall width of the canyon can be adjusted by pressing the numbers from 1 to 3. The higher the number picked, the narrower the canyon.

Once the options have been chosen, you can start the game by pressing both paddle buttons simultaneously. The planes are moved from left to right using the paddle. Altitude is changed using the keyboard. Player 1 can increase or decrease his altitude with the A and Z keys. Player 2 can make his plane climb using the semicolon and descend using the period. An altitude reading for each player is displayed at the bottom of the screen.

At any time during the game, you may fire a bomb at your opponent by pressing the paddle fire button. A countdown reading will appear at the bottom of the screen showing the time until impact.

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8210:233,008,133,225,133,227,209
8216:133,229,230,227,230,229,022
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8234:228,133,203,133,205,169,089
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8246:002,133,212,173,049,002,113
8252:133,213,160,003,169,102,072
8258:145,212,160,006,169,038,028
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8270:247,169,006,145,212,200,033
8276:192,029,208,249,169,007,170
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8372:169,002,141,160,006,169,059
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8498:141,160,006,160,177,173,099
8504:160,006,009,016,145,088,224
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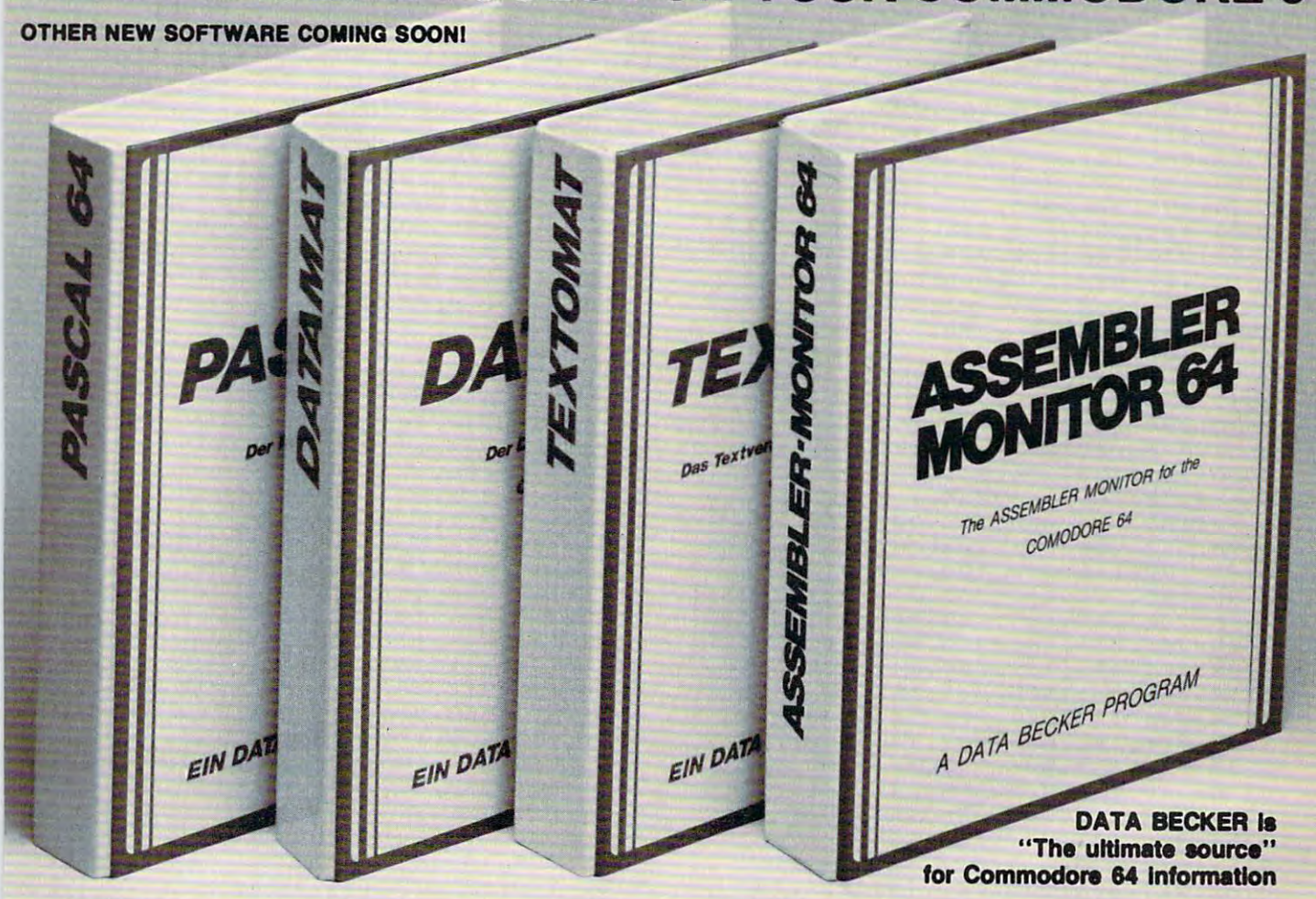

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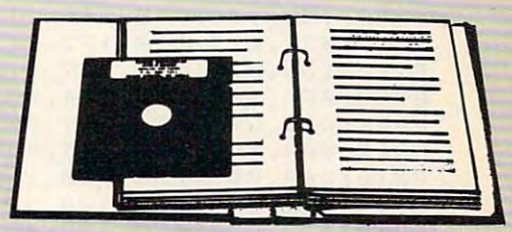

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Program 5: Canyon Runner, Apple ML

Version by Kevin Martin, Editorial Programmer

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6010- A9 A0 A0 85 A3 C9 C8 E5
6018- D0 CC C1 D9 C5 D2 A0 B1
6020- A0 A0 A0 C1 CC D4 A0 A0
6028- A0 A0 A0 A0 A0 A0 A0 A0
6030- A0 A0 C1 CC D4 A0 A0 A0
6038- D0 CC C1 D9 C5 D2 A0 B2
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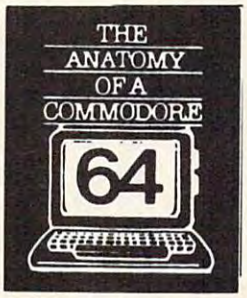

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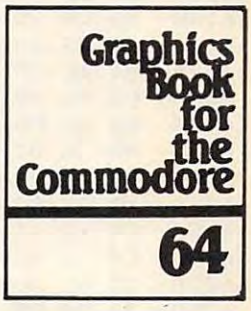

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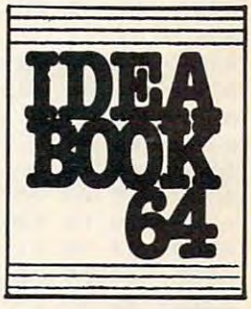

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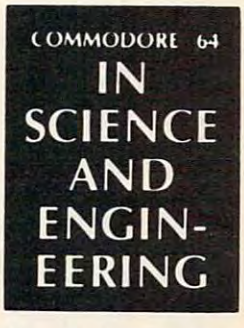

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6168- 20 15 64 20 45 63 4C 4C
6170- 61 20 E2 F3 AD F7 F6 20
6178- F4 F3 A9 14 85 22 20 58
6180- FC A9 01 8D 3F 03 A9 04
6188- 8D 3D 03 8D 3E 03 A9 50
6190- 8D 3C 03 A2 00 BD BA 60
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61B8- 38 D0 05 A9 B2 4C C2 61
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62D0- 60 A9 19 8D 07 60 A9 00
62D8- 8D 08 60 A9 A5 8D 09 60
62E0- A9 00 8D 0A 60 A9 01 85
62E8- E7 A9 70 85 E9 A9 00 85
62F0- E8 A9 0A 8D 0D 60 A9 00
62F8- 8D 0E 60 20 28 63 EE 0D
6300- 60 AD 0D 60 38 E9 0A CD
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6310- 60 A9 00 8D 0E 60 20 28
6318- 63 EE 0D 60 AD 0D 60 38
6320- E9 96 CD 3C 03 D0 EF 60
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6330- 0D 60 AC 0E 60 20 11 F4
6338- AD 0D 60 AE 0E 60 A0 AC
6340- 20 3A F5 60 60 AD 15 60
6348- 18 6D 16 60 C9 00 F0 0D
6350- A2 0F AD 30 C0 A9 04 20
6358- A8 FC CA D0 F5 60 A9 10
6360- 8D 17 60 A0 01 A2 01 A9
6368- 50 20 A8 FC AD 30 C0 E8
6370- D0 FD 88 D0 F0 CE 17 60
6378- D0 E9 60 AD 61 C0 30 6F
6380- AD 62 C0 30 7D AD 15 60
6388- F0 26 CE 15 60 D0 21 AD
6390- 13 60 CD 12 60 90 0A AD
6398- 13 60 38 ED 12 60 4C A8
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63A0- 63 AD 12 60 38 ED 13 60
63A8- CD 3D 03 B0 03 4C BD 65
63B0- AD 16 60 F0 26 CE 16 60
63B8- D0 21 AD 14 60 CD 11 60
63C0- 90 0A AD 14 60 38 ED 11
63C8- 60 4C D3 63 AD 11 60 38
63D0- ED 14 60 CD 3E 03 B0 03
63D8- 4C 7B 65 AD 3F 03 C9 03
63E0- D0 0C AD 11 60 8D 13 60
63E8- AD 12 60 8D 14 60 60 AD
63F0- 15 60 D0 8C A9 0A 8D 15
63F8- 60 AD 11 60 8D 13 60 4C
6400- 80 63 AD 16 60 D0 0B A9
6408- 0A 8D 16 60 AD 12 60 8D
6410- 14 60 4C 85 63 A9 15 85
6418- 25 20 22 FC A9 03 85 24
6420- AD 0F 60 18 69 B0 20 F0
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6438- FD A9 00 AE 11 60 20 24
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6460- 18 69 B0 20 F0 FD A9 8D
6468- 20 F0 FD A9 8D 20 F0 FD
6470- A9 0B 85 24 A9 00 AE 15
6478- 60 20 24 ED A9 A0 20 F0
6480- FD A9 25 85 24 A9 00 AE
6488- 16 60 20 24 ED A9 A0 20
6490- F0 FD 60 AD 00 C0 10 49
6498- 29 7F C9 41 F0 0F C9 5A
64A0- F0 18 C9 3B F0 21 C9 2E
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64D8- 01 F0 03 CE 12 60 2C 10
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64E8- 64 8E E2 64 A2 7F AD 70
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64F8- 6D E2 64 8D E2 64 AD 65
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6528- 46 90 17 C9 64 B0 03 4C
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6550- E3 64 C9 46 90 17 C9 64
6558- B0 03 4C 7A 65 A2 03 CE
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65A8- A4 1B A9 00 20 5D F6 A2
65B0- 00 88 D0 FD E8 E0 0A D0
65B8- F8 20 5E 63 60 68 68 AD
65C0- 10 60 C9 00 F0 09 CE 10
65C8- 60 20 D8 65 4C 38 61 20
65D0- D8 65 20 FF 65 4C 35 61
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65D8- A9 50 AE 09 60 AC 0A 60
65E0- 20 11 F4 A2 02 20 30 F7
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65F0- F6 A2 00 88 D0 BB E8 E0
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6628- 60 AC 08 60 20 11 F4 A2
6630- 01 20 30 F7 A6 1A A4 1B
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6660- 1B A9 00 20 5D F6 A5 EA
6668- C9 3A F0 03 4C BD 65 60
6670- A9 4B AE 07 60 AC 08 60
6678- 20 11 F4 A2 01 20 30 F7
6680- A6 1A A4 1B A9 00 20 5D
6688- F6 AD 3F 03 C9 01 F0 19
6690- A9 4B AE 09 60 AC 0A 60
6698- 20 11 F4 A2 01 20 30 F7
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66C8- 90 07 C9 AC B0 0E 4C E6
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6738- 3A F5 AD 05 60 18 69 96
6740- AA A0 00 AD 06 60 20 11
6748- F4 AC 06 60 AD 05 60 18
6750- 69 96 6D 3C 03 90 05 A2
6758- 01 4C 5E 67 A2 00 20 3A
6760- F5 EE 06 60 AC 06 60 C0
6768- AD D0 A7 60 A0 00 B9 A1
6770- 67 85 08 B9 62 68 85 09
6778- C8 C8 C8 C8 C8 B9 A1 67
6780- 85 06 B9 62 68 85 07 88
6788- 88 88 88 8C 03 60 A0 01
6790- B1 06 91 08 C8 C0 27 D0
6798- F7 AC 03 60 C0 AD D0 CE
67A0- 60 00 00 00 00 00 00 00
67A8- 00 80 80 80 80 80 80 80
67B0- 80 00 00 00 00 00 00 00
67B8- 00 80 80 80 80 80 80 80
67C0- 80 00 00 00 00 00 00 00
67C8- 00 80 80 80 80 80 80 80
67D0- 80 00 00 00 00 00 00 00
67D8- 00 80 80 80 80 80 80 80
67E0- 80 28 28 28 28 28 28 28
67E8- 28 A8 A8 A8 A8 A8 A8 A8
67F0- A8 28 28 28 28 28 28 28
67F8- 28 A8 A8 A8 A8 A8 A8 A8
6800- A8 28 28 28 28 28 28 28
6808- 28 A8 A8 A8 A8 A8 A8 A8
6810- A8 28 28 28 28 28 28 28
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6820- A8 50 50 50 50 50 50 50
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6868- 38 3C 20 24 28 2C 30 34
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6888- 3A 3E 22 26 2A 2E 32 36
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6898- 3B 3F 23 27 2B 2F 33 37
68A0- 3B 3F 20 24 28 2C 30 34
68A8- 38 3C 20 24 28 2C 30 34
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68E8- 38 3C 20 24 28 2C 30 34
68F0- 38 3C 21 25 29 2D 31 35
68F8- 39 3D 21 25 29 2D 31 35
6900- 39 3D 22 26 2A 2E 32 36
6908- 3A 3E 22 26 2A 2E 32 36
6910- 3A 3E 23 27 2B 2F 33 37
6918- 3B 3F 23 27 2B 2F 33 37
6920- 3B 3F 20 00
```

Program 6: Canyon Runner, Apple Loader

Version by Kevin Martin, Editorial Programmer

```
10  PRINT  CHR$ (4);"BLOAD CANYON.ML
    "
90 CK = 0
100  FOR I = 28672 TO 28761: READ A:
    CK = CK + A: POKE I,A: NEXT
104  IF CK <  > 4288 THEN  PRINT "ER
    ROR IN DATA": END
105 CK = 0
110  FOR I = 24576 TO 26915:CK = CK +
     PEEK (I): NEXT
120  IF CK <  > 265976 THEN  PRINT "
    ERROR IN MACHINE LANGUAGE"
130  CALL 24576
200  DATA  2,0,6,0,36,0,36,45
210  DATA  45,37,36,36,60,44,45,45
220  DATA  53,55,54,54,46,45,45,54
230  DATA  63,63,63,54,54,63,36,36
240  DATA  63,63,39,0,12,12,12,12
250  DATA  12,12,12,12,12,12,12,12
260  DATA  12,12,150,146,58,63,63,25
    5
270  DATA  63,63,63,4,64,24,64,24
280  DATA  21,21,21,21,21,21,149,201

290  DATA  14,14,14,14,14,14,223,219

300  DATA  35,36,36,36,32,36,36,36
310  DATA  0,255,0,0,255,255,0,0
```

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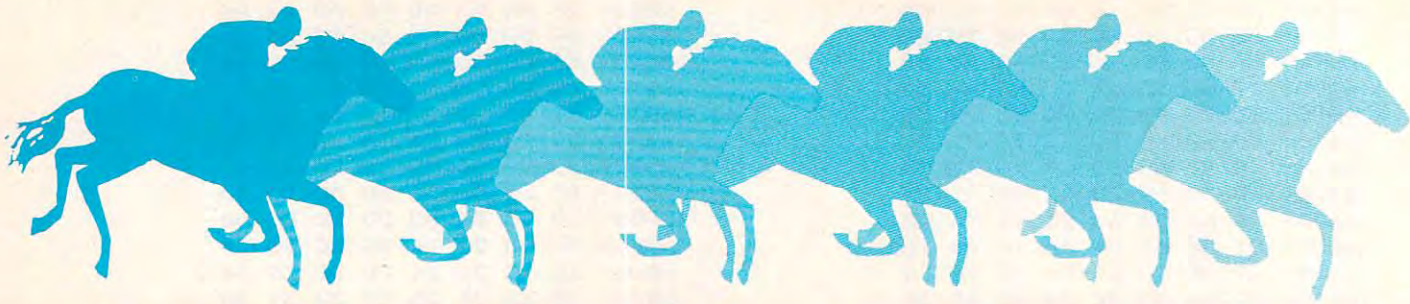

Horse Racing

Robert Onufer

Watch your favorite pony win (or lose) in this detailed, effective simulation of race-track betting. Versions included for the TI-99/4A with Extended BASIC, the Commodore 64, VIC-20, Apple II+/IIc/IIe, and IBM PC/PCjr.

"Horse Racing" is a multiplayer game in which you must wager on horses. Up to nine players may play the game, and each starts the game with $500. There are five races. The player with the greatest amount of money after the fifth race is the winner. To make the simulation more accurate, the program recalculates the odds at the beginning of each race. That means that the favorite will always pay lower odds. And you will always know these new odds because they are posted just before the race begins.

Some of the most exciting horse races occur when the track conditions vary. The reason for this is that long shots often have a better chance of winning on slippery tracks because the track could cause some of the better horses to fall or not get a good footing for speed. Horse Racing varies the track conditions from race to race and gives a slight advantage to one horse for each particular track condition. This advantage is taken into account when the initial odds are calculated, making a horse the favorite very often, but not always. In the TI version of Horse Racing, you can change the advantage by changing the value of AD(T) in line 1030. (For other versions, see "Programmer's Notes.")

Track Graphics

After the final odds are displayed, the track is drawn using custom characters. These are drawn on the screen transparently and then lit up all at once in either line 710 or line 720, depending on track conditions. Using the powerful graphics capabilities of TI Extended BASIC, the horses are magnified sprites drawn on a 16 × 16 grid. The animation effect is created by alternating each horse through two different patterns, making the horses appear to move. Speed is randomly updated in lines 750 through 790.

When the program determines that a horse has crossed the finish line, the position of each horse is checked. The victory is given to the horse furthest across the finish line. The track is then erased, payoffs are made or monies deducted, and a summary appears on the screen. After the last race, you may choose to play again by pressing the 1 key or to exit the game by pressing the 2 key.

Program 1: TI Horse Racing

Extended BASIC required.

```
100 DIM NOTE(26),DUR(26)
110 FOR I=1 TO 26 :: READ NOTE(I)
    ,DUR(I):: NEXT I
120 DATA 294,30,392,30,494,30,587
    ,45,587,15,587,30,494,45,494,
    15,494,30
130 DATA 392,30,494,30,392,30,294
    ,90,294,30,392,30,494,30,587,
    45,587,15,587,30
140 DATA 494,45,494,15,494,30,294
    ,30,294,30,294,30,392,90
150 IMAGE HORSE ## : ### TO 1
160 A$="00000171 0F0F0F1820408000 0
    0000000589C3FF8E0C078442211 0
    000000000"
170 B$="00000171170F0F0E040201000
    0000000000589C3FF8F8F030101070
    0000000000"
180 C$="0000000000C0BFBF3F1019010
    0000000000046371FDE3E1C3C54D
    2300000000"
```


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```
190 CALL CHAR(128,A$)
200 CALL CHAR(132,B$)
210 CALL CHAR(136,C$)
220 CALL CLEAR :: CALL SCREEN(3)
    : DISPLAY AT(12,9):"HORSE RAC
    ING"
230 GOSUB 990 :: FOR DELAY=1 TO 3
    00 :: NEXT DELAY
240 CALL CLEAR :: CALL SCREEN(5)
    : K=0
250 FOR I=0 TO 14 :: CALL COLOR(I
    ,16,1):: NEXT I
260 DISPLAY AT(8,4):"NUMBER OF PL
    AYERS ?"
270 ACCEPT AT(8,25)SIZE(1)VALIDAT
    E(DIGIT)BEEP:N :: IF (N=0)THE
    N CALL HCHAR(8,28,32,2):: GOT
    O 270
280 FOR I=1 TO N :: CASH(I)=500 :
    : NEXT I
290 DISPLAY AT(10,1):"EACH PLAYER
     STARTS WITH $500"
300 DISPLAY AT(14,2):"HORSES ARE
    NUMBERED FROM"
310 DISPLAY AT(16,8):"BOTTOM TO T
    OP"
320 FOR D=1 TO 600 :: NEXT D
330 K=K+1
340 IF (K>5)+(FL=1)THEN FL=0 :: G
    OTO 1460
350 FOR I=1 TO 5 :: AD(I),AM(I)=0
    :: NEXT I
360 GOSUB 1000 !TRACK COND.
370 GOSUB 1080 !DETERMINE ODDS
380 GOSUB 1150 !PLACE BETS
390 CALL CLEAR
400 GOSUB 560 !DRAW TRACK
410 DISPLAY AT(4,9):"HANOVER DOWN
    S"
420 PAT=128 :: PAT2=132 :: PAT3=1
```

Programmer's Notes For VIC, 64, IBM, and Apple Versions

Patrick Parrish, Programming Supervisor

The VIC-20, Commodore 64, IBM, and Apple versions of "Horse Racing" are designed to capture the excitement of going to the races. As many as nine players can play the game by betting on one of five horses (six horses in the IBM version). Five hundred dollars is awarded to each player to start the game.

Winning odds are based on the wagers made before a race. When betting, bear in mind that each horse favors a different track condition. The advantage gained by a horse running under optimum conditions is determined by the variable AD(T) located in lines 50, 550, 730, and 380 in the VIC, 64, IBM, and Apple versions, respectively. If you want to add to the advantage given to a particular horse under specific track conditions, increase the value assigned to this variable.

The VIC version of Horse Racing runs on the unexpanded VIC with a few bytes to spare. The 64 version uses multicolor sprites to define the horse and riders. A short ML routine to move the sprites is loaded in from the DATA statements beginning at line 1350. The IBM version requires BASICA and a color/graphics adapter for the PC, or a PCjr with Cartridge BASIC. The race track is depicted on graphics screen 1 with the horse and riders drawn from DATA stored in lines 290–500.

The Apple version of Horse Racing runs on all Apple IIs with DOS 3.3 or ProDOS. Since the program uses the secondary text page (at 2048, where the BASIC program normally resides), a series of POKEs is required to relocate the BASIC program. These POKEs are done by Program 5, which serves as our loader program. It locates Program 6 (which must be saved as "HORSERACE") at location 24576 by POKEing 104 and 103 (the high- and low-byte pointers to the start of the BASIC program) with 96 and 0, respectively (256*96+0=24576).

Program 6 defines the horses as high-resolution shapes with shape table DATA stored from line 790 on. The movement of the horses is animated by use of a high-resolution page-flipping routine in lines 190–210. This routine lets you view the horses on one high-resolution screen while drawing them further along the track on a second high-resolution screen. After the shapes have been placed on the second screen, this screen is viewed and drawing is done on the first screen. This sequence continues until the race is won.

A series of POKEs enables us to page flip in Program 6. By alternately accessing locations −16300 and −16299, either high-resolution screen 1 or 2 is displayed. POKEing location 230 with 32 or 64 causes the shapes to be drawn on high-resolution screen 1 or 2, respectively.

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1501 1506 1533 1539 1607 1633 1637 1640 1707 1709
1710 1712 1722 1724 1743 1746 1748 1754 1840

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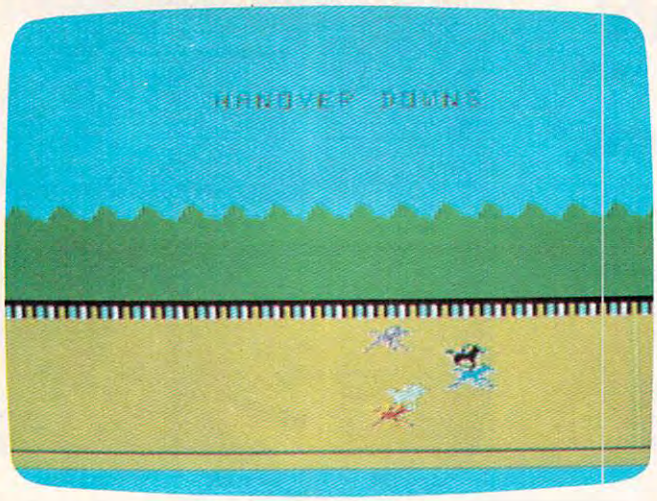

"Horse Racing" for the TI home computer.

```
    36 :: X=4 :: CALL SCREEN(8)
430 CALL MAGNIFY(3)
440 CALL SPRITE(#1,128,7,156,5,#2
    ,128,16,148,5,#3,128,5,140,5,
    #4,128,2,132,5,#5,128,14,124,
    5)
450 GOSUB 990 !OPENING SONG
460 CALL MOTION(#1,0,SP1,#2,0,SP2
    ,#3,0,SP3,#4,0,SP4,#5,0,SP5)
470 CALL POSITION(#1,Y1,X1,#2,Y2,
    X2,#3,Y3,X3,#4,Y4,X4,#5,Y5,X5
    )
480 IF X2>230 OR X1>230 THEN 810
490 IF X4>230 OR X3>230 THEN 810
500 IF X5>230 THEN 810
510 PAT=PAT+X :: PAT2=PAT2-X :: X
    =-X
520 CALL PATTERN(#1,PAT,#2,PAT2,#
    3,PAT,#4,PAT2,#5,PAT)
530 FOR DELAY=1 TO 8 :: NEXT DELA
    Y
540 GOSUB 740 !UPDATE MOTION
550 GOTO 460
560 CALL CHAR(97,"FF")!DRAW RACE
    TRACK
570 CALL CHAR(96,"FFFFFF666666666
    6")
580 CALL CHAR(120,"FFFFFFFFFFFFF
    FF")
590 FOR I=9 TO 12 :: CALL COLOR(I
    ,1,1):: NEXT I
600 CALL CHAR(104,"80800080800080
    80")
610 CALL CHAR(112,"0101030307CFEF
    FF")
620 CALL CHAR(114,"C0F0F8FCFCFFFF
    FF")
630 CALL CHAR(113,"FFFFFFFFFFFFF
    FF")
640 CALL HCHAR(15,1,96,32)
650 FOR I=16 TO 22 :: CALL HCHAR(
    I,1,120,32):: NEXT I
660 CALL HCHAR(23,1,97,32)
670 CALL VCHAR(16,31,104,7)
680 FOR I=11 TO 14 :: CALL HCHAR(
    I,1,113,32):: NEXT I
690 FOR I=1 TO 31 STEP 2 :: CALL
    HCHAR(10,I,112):: NEXT I
700 FOR I=2 TO 32 STEP 2 :: CALL
    HCHAR(10,I,114):: NEXT I
710 IF T<5 THEN CALL COLOR(9,2,12
    ,10,16,12,11,13,1,12,12,1)
720 IF T=5 THEN CALL COLOR(9,2,4,
    10,16,4,11,13,1,12,4,1)
730 RETURN
740 RANDOMIZE !SPEED OF HORSES
750 SP1=INT(5*RND+AD(1))
760 SP2=INT(5*RND+AD(2))
770 SP3=INT(5*RND+AD(3))
780 SP4=INT(5*RND+AD(4))
790 SP5=INT(5*RND+AD(5))
800 RETURN
810 ATEM=MAX(MAX(X1,X2),MAX(X3,X4
    ))
820 A=MAX(ATEM,X5)
830 IF A=X1 THEN WIN=1 :: GOTO 87
    0
840 IF A=X2 THEN WIN=2 :: GOTO 87
    0
850 IF A=X5 THEN WIN=5 :: GOTO 87
    0
860 IF A=X3 THEN WIN=3 ELSE WIN=4
870 FOR I=1 TO 5
880 IF I=WIN THEN 900
890 CALL DELSPRITE(#I)
900 NEXT I
910 CALL MAGNIFY(4)
920 CALL MOTION(#WIN,0,0):: CALL
    LOCATE(#WIN,150,124):: CALL P
    ATTERN(#WIN,PAT3):: FOR DELAY
    =1 TO 100 :: NEXT DELAY
930 DISPLAY AT(4,7):"THE WINNER I
    S #";WIN
940 CALL SOUND(1000,392,5)
950 CALL SOUND(1000,332,5)
960 CALL SOUND(1000,262,5)
970 GOSUB 1340 !PAYOFF
980 GOTO 330
990 FOR I=1 TO 26 :: CALL SOUND(D
    UR(I)*3.5,NOTE(I),5):: CALL S
    OUND(30,40000,5):: NEXT I ::
    RETURN
1000 RANDOMIZE !TRACK COND
1010 T=INT(5*RND)+1
1020 TR$(1)="FAST" :: TR$(2)="GOO
     D" :: TR$(3)="SLOW" :: TR$(4
     )="MUDDY" :: TR$(5)="TURF"
1030 AD(T)=.4 :: AM(T)=500
1040 CALL CLEAR :: CALL SCREEN(8)
1050 FOR I=0 TO 8 :: CALL COLOR(I
     ,2,1):: NEXT I
1060 DISPLAY AT(8,12):"RACE";K
1070 DISPLAY AT(12,3):"TRACK COND
     ITION:{3 SPACES}";TR$(T):: F
     OR DELAY=1 TO 300 :: NEXT DE
     LAY :: RETURN
1080 RANDOMIZE !INITIAL ODDS
1090 MT=0
1100 FOR I=1 TO 5 :: M(I)=INT(100
     0*RND)+0.1+AM(I):: MT=MT+M(I
     ):: NEXT I
```


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```
1110 FOR I=1 TO 5 :: OD(I)=INT(MT
     /M(I))
1120 IF OD(I)>20 THEN OD(I)=20
1130 NEXT I
1140 RETURN
1150 CALL CLEAR :: CALL SCREEN(7)
     !PLACE BETS
1160 DISPLAY AT(1-(N<5),9):"CURRE
     NT ODDS"
1170 FOR I=1 TO 5 :: DISPLAY AT(1
     +I-(N<5)*2,3):USING 150:I,OD
     (I):: NEXT I
1180 FOR I=2 TO 2*N STEP 2
1190 IF CASH(I/2)<1 THEN AMT(I/2)
     =0 :: GOTO 1270
1200 DISPLAY AT(5+I+(9-N)/2,3):"P
     LAYER";I/2;"BETS - HORSE?"
1210 ACCEPT AT(5+I+(9-N)/2,26)VAL
     IDATE(DIGIT)BEEP SIZE(1):H(I
     /2)
1220 IF H(I/2)>5 THEN CALL HCHAR(
     5+I+(9-N)/2,29,32,3):: GOTO
     1210
1230 DISPLAY AT(6+I+(9-N)/2,3):"A
     MOUNT?" :: ACCEPT AT(6+I+(9-
     N)/2,24)SIZE(3)VALIDATE(DIGI
     T)BEEP:AMT(I/2)
1240 IF AMT(I/2)>CASH(I/2)THEN 12
     30
1250 M(H(I/2))=M(H(I/2))+AMT(I/2)
1260 MT=MT+AMT(I/2)
1270 NEXT I
1280 CALL CLEAR :: CALL SCREEN(14
     )
1290 DISPLAY AT(5,11):"NEW ODDS"
1300 FOR I=1 TO 5 :: OD(I)=INT(MT
     /M(I))
1310 IF OD(I)>20 THEN OD(I)=20
1320 DISPLAY AT(7+I*2,4):USING 15
     0:I,OD(I):: NEXT I
1330 FOR DELAY=1 TO 1000 :: NEXT
     DELAY :: RETURN
1340 FOR I=1 TO N
1350 IF H(I)=WIN THEN CASH(I)=CAS
     H(I)+INT(AMT(I)*INT(MT/M(WIN
     )))
1360 IF H(I)<>WIN THEN CASH(I)=CA
     SH(I)-AMT(I)
1370 NEXT I
1380 CALL DELSPRITE(ALL):: CALL C
     LEAR
1390 DISPLAY AT(3,12):"SUMMARY"
1400 P$="RACES" :: IF K=1 THEN P$
     ="RACE"
1410 DISPLAY AT(5,9):"AFTER";K;P$
1420 FOR I=1 TO N :: DISPLAY AT(8
     +I,3):USING 1510:I,CASH(I):
      NEXT I
1430 FOR DELAY=1 TO 1500 :: NEXT
     DELAY
1440 FL=1 :: FOR I=1 TO N :: IF C
     ASH(I)>0 THEN I=N :: FL=0
1450 NEXT I :: RETURN
1460 CALL DELSPRITE(ALL):: CALL C
     LEAR :: CALL SCREEN(16)
1470 DISPLAY AT(12,10):"GAME OVER
     " :: DISPLAY AT(21,3):"PRESS
      1 TO PLAY AGAIN" :: DISPLAY
      AT(23,4):"PRESS 2 TO END GA
     ME"
1480 CALL KEY(0,KEY,S)
1490 IF KEY=49 THEN 240
1500 IF KEY<>50 THEN 1480
1510 IMAGE PLAYER ##:   $$$$$$$
1520 CALL CLEAR :: END
```

Program 2: 64 Horse Racing

Refer to the "Automatic Proofreader" article before typing this program in.

Translation by Jeff Hamdani, Editorial Programmer

```
10 POKE53280,6:DIMHF(28),LF(28),DR(28)
                                    :rem 71
20 PRINT"{CLR}{9 DOWN}"TAB(14)"{YEL}{RVS}
   HORSE RACING{OFF}{WHT}"          :rem 172
30 PRINT"{9 DOWN}{WHT}"TAB(5)"LOADING DAT
   A.......PLEASE WAIT":V=53248    :rem 143
40 FORI=12288TO12414:READA:POKEI,A:NEXT:P
   OKEV+28,31                       :rem 136
50 POKEV+37,0:POKEV+38,9:FORI=1TO5:POKE20
   39+I,192:POKEV+38+I,6-I:NEXT    :rem 210
60 FORI=0TO8STEP2:READA:POKEV+I+1,A:NEXT:
   FORI=1TO5:READCR(I):NEXT          :rem 6
70 FORI=1TO26:READHF(I),LF(I),DR(I):NEXT:
   I=0:CT=0                         :rem 233
80 IFPEEK(49523)=212ANDPEEK(49524)=96THEN
   120                               :rem 5
90 I=I+1:READA:CT=CT+A:IFA=256THEN110
                                    :rem 225
100 POKE49151+I,A:GOTO90           :rem 129
110 IFCT<>45269THENPRINT"{CLR}ERROR IN RE
    ADING DATA IN.":END            :rem 218
120 PRINT"{CLR}":S=54272:FORL=STOS+24:POK
    EL,0:NEXT                      :rem 211
130 POKES+24,15:POKES+5,18:POKES+6,245
                                   :rem 206
140 POKE53280,15:POKE53281,15:PRINT"
    {10 DOWN}{BLU}"TAB(14)"HORSE RACING":
    GOSUB1060                      :rem 177
150 PRINT"{3 DOWN}"TAB(7)"NUMBER OF PLAYE
    RS (1-9)? ";:HR=0              :rem 94
160 GETZ$:N=VAL(Z$):IF(N<1ORN>9)THEN160
                                   :rem 109
170 PRINTZ$:FORI=1TO200:NEXT:FORI=1TON:CH
    (I)=500:NEXT:PRINT"{CLR}{7 DOWN}"
                                   :rem 177
180 PRINTTAB(6)"EACH PLAYER STARTS WITH $
    500."                          :rem 170
190 PRINTTAB(3)"{DOWN}WHEN A PLAYER LOSES
     ALL OF HIS/HER"               :rem 253
200 PRINTTAB(10)"{DOWN}MONEY, THE GAME EN
    DS."                            :rem 4
210 PRINT"{2 DOWN}HORSES ARE NUMBERED FRO
    M BOTTOM TO TOP."              :rem 81
220 FORI=1TO4000:NEXT              :rem 18
230 HR=HR+1                        :rem 98
240 FORI=1TON:AD(I)=0:AM(I)=0:NEXT:rem 51
250 GOSUB530:REM TRACK CONDITION   :rem 233
260 GOSUB590:REM CALCULATE ODDS    :rem 140
270 GOSUB630:REM PLACE BETS        :rem 99
280 GOSUB400:REM DRAW TRACK        :rem 111
290 POKES+5,17:POKES+6,24:POKES+2,4:POKES
    +3,5:POKEV+(2*T-2),24+AD(T):SYS49152
                                   :rem 35
300 FORI=0TO8STEP2:A=PEEK(V+I):IFA=65THEN
    WN=(I+2)/2                     :rem 140
```


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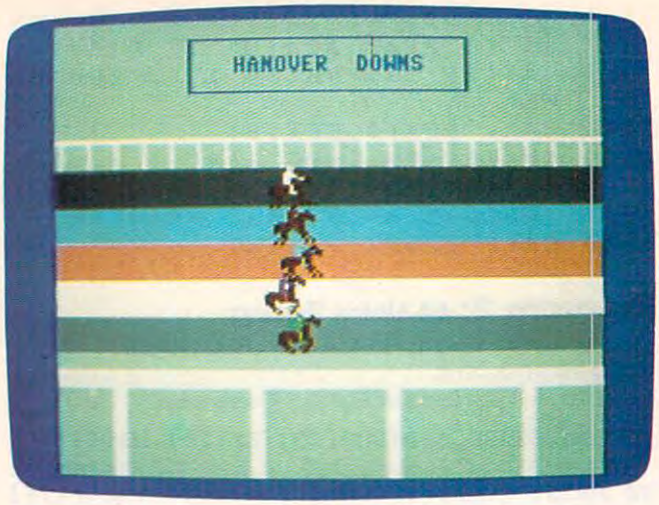

Horse-racing action in the Commodore 64 version of "Horse Racing."

```
310 NEXT:POKEV+21,2↑(WN-1):POKEV+16,0:POK
    EV+(2*WN-2),0                    :rem 212
320 POKE53280,(PEEK(1664-80*(WN-1)+S))AND
    15:J=192                         :rem 177
330 FORI=1TO15:PRINT"{HOME}{5 DOWN}"TAB(8
    )"THE WINNER IS HORSE #";WN:GOSUB380
                                     :rem 125
340 IF(I/2)=INT(I/2)THENJ=193        :rem 151
350 POKEV+(2*WN-2),15+(I+8):POKE2039+WN,J
    :FORK=1TO150:NEXT                :rem 188
360 PRINT"{HOME}{5 DOWN}"TAB(8)"
    {23 SPACES}":FORK=1TO150:NEXT:J=192:N
    EXT                              :rem 216
370 POKEV+21,0:GOTO880               :rem 28
380 POKES+1,(RND(0)*40)+40:POKES,200:POKE
    S+4,17:POKES+4,16:RETURN         :rem 105
390 REM DRAW TRACKS                  :rem 118
400 POKE53280,6:POKE53281,13:SP=160
                                     :rem 212
410 A$="{RVS}{40 SPACES}{OFF}"       :rem 31
420 PRINT"{CLR}{6 DOWN}{WHT}{R}{C}{R}{C}{R}{C
    }{R}{C}{R}{C}{R}{C}{R}{C}{R}{C}{R}{C}{R}{C
    }{R}{C}{R}{C}{R}{C}{R}{C}{R}{C}{R}{C}{R}{C}
    {R}{C}{R}{C}{R}{C}{R}{C}{R}{C}{R}{C}{R}{C}";
                                     :rem 196
430 PRINT"{WHT}B B B B B B B B B B B B B
    {SPACE}B B B B B B B";           :rem 208
440 PRINT"{HOME}{7 DOWN}":FORI=1TO5:FORJ=
    1TO2:PRINTCHR$(CR(I))A$;:NEXTJ,I
                                     :rem 113
450 PRINT"{HOME}{19 DOWN}{WHT}"MID$(A$,1,
    LEN(A$)-2)                       :rem 246
460 FORI=1TO4:FORJ=4TO34STEP10:PRINTTAB(J
    )"{WHT}{RVS} {OFF}{9 SPACES}";:NEXTJ:
    NEXTI                            :rem 120
470 POKE1823,SP:POKE1823+S,1:FORI=1988TO2
    018STEP10:POKEI,SP:POKEI+S,1:NEXT
                                     :rem 140
480 PRINT"{HOME}{BLU}{DOWN}"TAB(9)"{M}
    {20 T}{G}"                       :rem 93
490 PRINTTAB(9)"{M}{3 SPACES}HANOVER
    {2 SPACES}DOWNS{3 SPACES}{G}":rem 185
500 PRINTTAB(9)"{M}{20 @}{G}"        :rem 227
510 FORI=0TO8STEP2:POKEV+I,24:NEXT:POKEV+
    21,31:RETURN                     :rem 177
520 REM DETERMINE TRACK CONDITION    :rem 52
530 T=INT(5*RND(0))+1                :rem 133
540 TR$(1)="FAST":TR$(2)="GOOD":TR$(3)="S
    LOW":TR$(4)="MUDDY":TR$(5)="TURF"
                                     :rem 236
550 AD(T)=3:AM(T)=500                :rem 115
560 PRINT"{CLR}{8 DOWN}"TAB(17)"RACE";HR:
    A$="TRACK CONDITION: ":TB=LEN(A$+TR$(
    T))                              :rem 253
570 PRINT"{4 DOWN}"TAB(INT(TB/2)-1);A$+TR
    $(T):FORD=1TO1000:NEXT:RETURN:rem 110
580 REM DETERMINE ODDS               :rem 72
590 MT=0:FORI=1TO5:M(I)=INT(1000*RND(0))+
    .1+AM(I):MT=MT+M(I):NEXT         :rem 103
600 FORI=1TO5:OD(I)=INT(MT/M(I)):IFOD(I)>
    20THENOD(I)=20                   :rem 52
610 NEXT:RETURN                      :rem 240
620 REM PLACE BETS                   :rem 15
630 PRINT"{CLR}{DOWN}"TAB(15)"{RVS}CURREN
    T ODDS{OFF}{DOWN}"               :rem 226
640 PRINTTAB(11)"{DOWN}HORSE #"SPC(7)"ODD
    S{DOWN}"                         :rem 151
650 FORI=1TO5:PRINTTAB(13)I;TAB(23);OD(I)
    ;"TO 1":NEXT:PRINT"{2 DOWN}":RW=13
                                     :rem 90
660 FORI=2TO2*NSTEP2:CN=35:IFCH(I/2)<=0TH
    ENA1(I/2)=0:GOTO790              :rem 122
670 PRINT"PLAYER";I/2;"BETS   HORSE? ";
                                     :rem 245
680 GETZ$:M=VAL(Z$):IFM<1ORM>5THEN680
                                     :rem 35
690 PRINTZ$;:H(I/2)=M:PRINTSPC(3)"AMOUNT
    {SPACE}$ ":A$=""                 :rem 121
700 GETZ$:IF Z$=""THEN700            :rem 131
710 IFASC(Z$)=13THEN770              :rem 59
720 IFASC(Z$)=20THEN760              :rem 57
730 IFASC(Z$)<48ORASC(Z$)>57THEN700
                                     :rem 46
740 IFCN=39THEN700                   :rem 42
750 A$=A$+Z$:POKE214,RW:PRINT:POKE211,CN:
    PRINTZ$:CN=CN+1:GOTO700          :rem 230
760 POKE214,RW:PRINT:POKE211,35:PRINT"
    {4 SPACES}";:CN=35:A$="":GOTO700
                                     :rem 112
770 IFVAL(A$)=0ORVAL(A$)>CH(I/2)THEN760
                                     :rem 253
780 A1(I/2)=VAL(A$):M(H(I/2))=M(H(I/2))+A
    1(I/2):MT=MT+A1(I/2):RW=RW+1     :rem 41
790 NEXT                             :rem 223
800 PRINT"{CLR}{5 DOWN}"TAB(17)"{RVS}NEW
    {SPACE}ODDS{OFF}{2 DOWN}"        :rem 255
810 PRINTTAB(11)"HORSE #"SPC(7)"ODDS
    {DOWN}"                          :rem 133
820 FORI=1TO5:OD(I)=INT(MT/M(I)):IFOD(I)>
    20THENOD(I)=20                   :rem 56
830 PRINTTAB(13);I;TAB(23);OD(I)"TO 1":NE
    XT                               :rem 249
840 PRINT"{2 DOWN}"TAB(12)"PRESS {RVS}B
    {OFF} TO BEGIN"                  :rem 217
850 GETZ$:IFZ$<>"B"THEN850           :rem 14
860 RETURN                           :rem 126
870 REM DETERMINE WINNER(S)          :rem 151
880 FORI=1TON                        :rem 47
890 IFH(I)=WNTHENCH(I)=CH(I)+INT(A1(I)*IN
    T(MT/M(WN))):GOTO910             :rem 163
900 CH(I)=CH(I)-A1(I)                :rem 89
910 NEXT                             :rem 217
920 POKE53280,15:POKE53281,15:PRINT"{CLR}
    "TAB(17)"{RVS}SUMMARY{OFF}"      :rem 160
930 P$="RACES":IFHR=1THENP$="RACE":rem 15
940 PRINT"{2 DOWN}"TAB(14)"AFTER";HR;P$
                                     :rem 87
950 PRINT"{3 DOWN}"TAB(5)"PLAYER #"TAB(29
    )"AMOUNT"                        :rem 222
960 PRINTTAB(5)"{8 T}"TAB(29)"{6 T}{DOWN}
    "                                :rem 159
```


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```
970 FL=1:FORI=1TON:IFCH(I)>0THENI=N:FL=0
                                    :rem 1
980 NEXTI:FORI=1TON                :rem 242
990 PRINTTAB(8);I;TAB(29);"$";CH(I):NEXTI
                                   :rem 166
1000 IFFL=1ORHR=5THEN1020          :rem 239
1010 FORX=1TO3000:NEXT:GOTO230      :rem 86
1020 PRINTTAB(15);"{2 DOWN}GAME OVER":PRI
     NT"{6 RIGHT}{DOWN}DO YOU WISH TO PLA
     Y AGAIN ?"                    :rem 226
1030 GETZ$:IFZ$<>"Y"ANDZ$<>"N"THEN1030
                                   :rem 208
1040 IFZ$="Y"THENPOKE53281,6:RUN :rem 158
1050 END                           :rem 157
1060 FORI=1TO26:POKES+1,HF(I):POKES,LF(I)
     :POKES+4,33:FOR T= 1TO 40:NEXT:rem 0
1070 POKES+4,32:FORJ=1TODR(I)*3.7:NEXT:NE
     XT:RETURN                     :rem 180
1080 DATA0,0,0,0,0,0,0,0           :rem 151
1090 DATA0,0,32,0,0,40,0,0          :rem 1
1100 DATA32,0,0,168,16,0,170,124   :rem 58
1110 DATA0,161,173,0,167,247,0,175
                                   :rem 172
1120 DATA195,63,251,192,127,251,192,127
                                   :rem 182
1130 DATA251,192,127,202,192,79,3,240
                                    :rem 74
1140 DATA15,0,240,15,0,204,51,0     :rem 2
1150 DATA51,204,0,51,204,0,0,0     :rem 205
1160 DATA0,0,0,0,0,0,0,0           :rem 150
1170 DATA0,0,32,0,0,40,16,0         :rem 55
1180 DATA32,124,0,169,253,0,170,135
                                   :rem 223
1190 DATA0,161,227,0,163,192,0,175
                                   :rem 175
1200 DATA192,63,235,192,127,251,192,127
                                   :rem 180
1210 DATA251,192,127,251,240,124,250,240
                                   :rem 210
1220 DATA124,0,48,60,3,240,15,12   :rem 62
1230 DATA192,12,195,192,3,195,0    :rem 36
1240 DATA173,156,141,126,110       :rem 137
1250 DATA 151,159,150,5,152:REM CR(I)
                                   :rem 120
1260 DATA 18,209,30,25,30,30,31,165,30
                                    :rem 58
1270 DATA 37,162,45,37,162,15,37,162,30
                                   :rem 127
1280 DATA 31,165,45,31,165,15,31,165,30
                                   :rem 119
1290 DATA 25,30,30,31,165,30,25,30,30
                                     :rem 3
1300 DATA 18,209,100               :rem 203
1310 DATA 18,209,30,25,30,30,31,165,30
                                    :rem 54
1320 DATA 37,162,45,37,162,15,37,162,30
                                   :rem 123
1330 DATA 31,165,45,31,165,15,31,165,30
                                   :rem 115
1340 DATA 18,209,30,18,209,30,18,209,30,2
     5,30,110                       :rem 87
1350 DATA 169,150,141,15,212,169:REM ML C
     ODE                           :rem 248
1360 DATA 129,141,18,212,32,40     :rem 185
1370 DATA 192,238,0,208,238,2      :rem 147
1380 DATA 208,238,4,208,238,6      :rem 154
1390 DATA 208,238,8,208,32,237     :rem 205
1400 DATA 192,32,40,193,32,84      :rem 142
1410 DATA 193,76,10,192,173,16     :rem 197
1420 DATA 208,41,1,240,10,172      :rem 126
1430 DATA 0,208,192,65,208,23      :rem 142
1440 DATA 76,81,193,172,0,208      :rem 150
1450 DATA 192,255,208,13,173,16    :rem 248
1460 DATA 208,9,1,141,16,208        :rem 92
1470 DATA 169,0,141,0,208,173      :rem 141
1480 DATA 16,208,41,2,240,10        :rem 82
1490 DATA 172,2,208,192,65,208     :rem 203
1500 DATA 23,76,81,193,172,2        :rem 96
1510 DATA 208,192,255,208,13,173   :rem 140
1520 DATA 16,208,9,2,141,16         :rem 39
1530 DATA 208,169,0,141,2,208      :rem 139
1540 DATA 173,16,208,41,4,240      :rem 139
1550 DATA 10,172,4,208,192,65      :rem 145
1560 DATA 208,23,76,81,193,172     :rem 206
1570 DATA 4,208,192,255,208,13     :rem 199
1580 DATA 173,16,208,9,4,141        :rem 99
1590 DATA 16,208,169,0,141,4        :rem 96
1600 DATA 208,173,16,208,41,8      :rem 144
1610 DATA 240,10,172,6,208,192     :rem 187
1620 DATA 65,208,23,76,81,193      :rem 156
1630 DATA 172,6,208,192,255,208    :rem 252
1640 DATA 13,173,16,208,9,8         :rem 50
1650 DATA 141,16,208,169,0,141     :rem 191
1660 DATA 6,208,173,16,208,41      :rem 148
1670 DATA 16,240,10,172,8,208      :rem 142
1680 DATA 192,65,208,23,76,81      :rem 161
1690 DATA 193,172,8,208,192,255      :rem 7
1700 DATA 208,13,173,16,208,9      :rem 145
1710 DATA 16,141,16,208,169,0      :rem 141
1720 DATA 141,8,208,96,173,27      :rem 155
1730 DATA 212,56,233,5,176,252     :rem 197
1740 DATA 105,6,96,32,226,192      :rem 152
1750 DATA 168,192,1,208,7,32       :rem 101
1760 DATA 40,192,238,0,208,96      :rem 154
1770 DATA 192,2,208,7,32,40         :rem 45
1780 DATA 192,238,2,208,96,192     :rem 214
1790 DATA 3,208,7,32,40,192         :rem 48
1800 DATA 238,4,208,96,192,4       :rem 105
1810 DATA 208,7,32,40,192,238      :rem 147
1820 DATA 6,208,96,192,5,208       :rem 107
1830 DATA 6,32,40,192,238,8         :rem 50
1840 DATA 208,96,162,0,189,248     :rem 213
1850 DATA 7,201,192,208,8,169      :rem 156
1860 DATA 193,157,248,7,76,62      :rem 169
1870 DATA 193,169,192,157,248,7     :rem 17
1880 DATA 32,71,193,232,224,5      :rem 149
1890 DATA 208,228,96,165,162,24      :rem 8
1900 DATA 105,1,197,162,208,252    :rem 244
1910 DATA 96,104,104,96,169,6      :rem 159
1920 DATA 141,1,212,169,10,141     :rem 181
1930 DATA 0,212,169,65,141,4        :rem 93
1940 DATA 212,162,0,160,0,200      :rem 123
1950 DATA 208,253,232,224,50,208    :rem 39
1960 DATA 246,169,64,141,4,212     :rem 203
1970 DATA 96,256                    :rem 35
```

Program 3: VIC Horse Racing

Refer to the "Automatic Proofreader" article before typing this program in.

Translation by Jeff Hamdani, Editorial Programmer

```
2 POKE36879,110:PRINT"{CLR}{9 DOWN}
  {5 RIGHT}{WHT}HORSE RACING"      :rem 50
4 POKE52,28:POKE56,28:CLR:FORI=7168TO7679
  :POKEI,PEEK(I+25600):NEXT        :rem 32
6 FORI=1TO3:READA:FORJ=ATOA+7:READB:POKEJ
  ,B:NEXTJ,I:POKE36869,255        :rem 162
8 V=36878:S=36874:CL=30720        :rem 179
10 INPUT"{CLR}{10 DOWN}{WHT}# OF PLAYERS
   {SPACE}(1-9) ";N:IFN<1ORN>9THEN10
                                   :rem 58
```


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```
12 FORI=1TON:CH(I)=500:NEXT:R=0:FORY=9TO1
   7STEP2:PN((Y-7)/2)=7680+22*Y:NEXT
                                    :rem 51
14 FORI=1TO5:AM(I)=0:AD(I)=0:NEXT:POKE368
   79,110:GOSUB48:GOSUB54:GOSUB60:rem 138
16 DEFFNL(I)=PN(I)+X(I):HR=0:WN=0:GOSUB36
                                    :rem 242
18 FORI=1TO5:X(I)=1:POKEFNL(I)+CL,2+I:POK
   EFNL(I),HR:NEXT:HR=33            :rem 129
20 FORI=1TO5:Z=RND(0)/2:POKEFNL(I),32:X(I
   )=X(I)+1+AD(I)+Z:POKEFNL(I)-1-AD(I)-Z,
   32                               :rem 14
22 POKEFNL(I)+CL,2+I:POKEFNL(I),HR:GOSUB3
   4:NEXT                           :rem 220
24 G=0:FORI=1TO5:IFX(I)>=19THENG=1:rem 78
26 NEXT:IFG=0THENHR=33-HR:GOTO20    :rem 44
28 H=0:FORI=0TO4:IFX(I+1)>HTHENH=X(I+1):W
   N=I+1                            :rem 45
30 NEXT:POKEFNL(WN),32:X(WN)=X(WN)+1:POKE
   FNL(WN)+CL,2+WN:POKEFNL(WN),HR   :rem 13
32 PRINT"{HOME}{20 DOWN}{2 SPACES}WINNER
   {SPACE}IS HORSE #";WN:FORD=1TO3000:NEX
   T:GOTO80                         :rem 29
34 POKEV,15:POKES,INT(RND(0)*8)+200:POKEV
   ,0:RETURN                        :rem 91
36 A$="&&&&&&&&&&&&&&&&&&&&&&":B$="------
   ----------------":PRINT"{CLR}{7 DOWN}"
                                    :rem 167
38 POKE36879,26                     :rem 63
40 FORI=1TO6:PRINT"{BLK}"B$"{DOWN}";:NEXT
   :PRINT"{WHT}"A$;:PRINTSPC(3)"&"SPC(7)"
   &"SPC(6)"&"                      :rem 223
42 POKE8167,38:POKE8167+CL,1:POKE8175,38:
   POKE8175+CL,1:POKE8182,38:POKE8182+CL,
   1                                :rem 168
44 PRINT"{HOME}"TAB(3)"{2 DOWN}{BLK}*****
   ************":PRINTTAB(3)"* {RED}HANOV
   ER DOWNS {BLK}*"                 :rem 107
46 PRINTTAB(3)"{BLK}*****************
   {BLU}":RETURN                    :rem 41
48 T=INT(5*RND(0))+1:TR$(1)="FAST":TR$(2)
   ="GOOD":TR$(3)="SLOW":TR$(4)="MUDDY"
                                    :rem 154
50 TR$(5)="TURF":AD(T)=.08:AM(T)=500:R=R+
   1:PRINT"{CLR}{8 DOWN}{WHT}"TAB(8)"RACE
   ";R                              :rem 219
52 PRINT"{2 DOWN}TRACK CONDITION: ";TR$(T
   ):FORI=1TO2000:NEXT:RETURN       :rem 42
54 MT=0:FORI=1TO5:M(I)=INT(1000*RND(0))+.
   1+AM(I):MT=MT+M(I):NEXT          :rem 50
56 FORI=1TO5:OD(I)=INT(MT/M(I)):IFOD(I)>2
   0THENOD(I)=20                     :rem 9
58 NEXT:RETURN                      :rem 198
60 FORI=1TON                        :rem 245
62 IFCH(I)<1THENA1(I)=0:GOTO74      :rem 15
64 PRINT"{CLR}{5 DOWN}"TAB(5)"CURRENT ODD
   S{DOWN}":FORJ=1TO5:PRINTTAB(2)"HORSE"J
   ,OD(J)"TO 1":NEXT                :rem 238
66 PRINT"{2 DOWN}PLAYER #";I;"BETS-HORSE"
                                    :rem 46
68 INPUTH(I):IFH(I)<1ORH(I)>5THEN68
                                    :rem 139
70 INPUT"{DOWN}AMOUNT$";A1(I):IFA1(I)>CH(
   I)ORINT(A1(I))<>A1(I)ORA1(I)<=0THEN64
                                    :rem 33
72 M(H(I))=M(H(I))+A1(I):MT=MT+A1(I)
                                    :rem 205
74 NEXT:PRINT"{CLR}{6 DOWN}"TAB(7)"NEW OD
   DS{DOWN}"                        :rem 118
76 FORI=1TO5:OD(I)=INT(MT/M(I)):IFOD(I)>2
   0THENOD(I)=20                    :rem 11
78 PRINT"{2 SPACES}HORSE"I,OD(I)"TO 1
   {DOWN}":NEXT:FORDL=1TO3000:NEXT:RETURN
                                    :rem 29
80 FORI=1TON:IFH(I)=WNTHENCH(I)=CH(I)+INT
   (A1(I)*INT(MT/M(WN))):GOTO84     :rem 5
82 CH(I)=CH(I)-A1(I)                :rem 42
84 NEXT:PRINT"{CLR}{DOWN}{7 RIGHT}SUMMARY
   {2 DOWN}":PRINTTAB(5)"AFTER";R;"RACES
   {DOWN}"                          :rem 218
86 FL=1:FORI=1TON:IFCH(I)>0THENFL=0
                                    :rem 193
88 NEXT:PRINT"{2 SPACES}PLAYERS"SPC(5)"AM
   OUNT":FORI=1TON:PRINTTAB(4)I,SPC(3)"$"
   CH(I):NEXT                       :rem 47
90 IFFL=1ORR=5THEN94                :rem 249
92 FORK=1TO2500:NEXT:GOTO 14        :rem 198
94 PRINTTAB(6)"{DOWN}GAME OVER":PRINT"
   {2 DOWN}{2 SPACES}PLAY AGAIN (Y/N)?"
                                    :rem 44
96 GETZ$:IFZ$=""OR(Z$<>"Y"ANDZ$<>"N")THEN
   96                               :rem 23
98 IFZ$="Y"THENRUN                  :rem 124
100 POKE36869,240:END               :rem 163
102 DATA7168,4,10,11,126,254,106,66,129
                                    :rem 173
104 DATA7432,20,22,45,126,254,202,66,36
                                    :rem 171
106 DATA7472,255,255,255,255,255,255,255,
    255,255                         :rem 141
```

Program 4: IBM PC/PCjr Horse Racing

Translation by Gregg Peele, Assistant Programming Supervisor

```
10 DEFINT O:DEFINT T:CLS:DEF SEG = 0:POK
E 1047,0
20 SCREEN 1,0:COLOR 1,1,0 :KEY OFF
30 CLS:DIM XO (150):WA =0
40 READ X,Y:E=(4+INT((X+7)/8)*Y)/2:DIM O
(E):O(0)=X:O(1)=Y:FOR I=2 TO E:READ O(I)
:NEXT
50 READ X1,Y1:E1=(4+INT((X1+7)/8)*Y1)/2:
DIM O1(E1):O1(0)=X1:O1(1)=Y1:FOR I=2 TO
E1:READ O1(I):NEXT:GOSUB 620
60  IF K>5 THEN 1080
70 CLS:LOCATE 12,10,0:COLOR 1,1,0:PRINT"
PRESS ANY KEY TO START":WE$ = ""
80 WE$= INKEY$ : IF WE$= "" THEN A= RND(
1): GOTO 80:ELSE CLS:WA=0:GOSUB 570
90 GOSUB 670:REM TRACK CONDITIONS
100 GOSUB 760: REM DETERMINE ODDS
110 GOSUB 790:COLOR BACK,-(BACK=2)
120 FOR TI = 1 TO 175 STEP 25:LINE (0,TI
+26)-(286,TI+26),8-BACK: NEXT
130 LINE (288,27)-(288,176),9-BACK,,&HAA
AA:LOCATE 1,12:PRINT "Hanover Downs"
140 LOCATE 1,35:PRINT"Lane":FOR E=1 TO 6
:LOCATE (E*3.2)+2,38:PRINT E:NEXT
150 WHILE WA = 0
160 FOR SLOT = 0 TO 125 STEP 25
170 PUT (XO(SLOT),SLOT+30),0,PSET
180 NEXT: GOSUB 260
190 FOR SLOT =0 TO 125 STEP 25:IF XO(SLO
T)>318 -O(0) THEN WA = 1:WINNER = INT(SL
OT/25)+1
200 XO(SLOT)=XO(SLOT)+ RND(1)*3+AD(SLOT/
25+1)
210 NEXT
220 FOR SLOT = 0 TO 125 STEP 25
```


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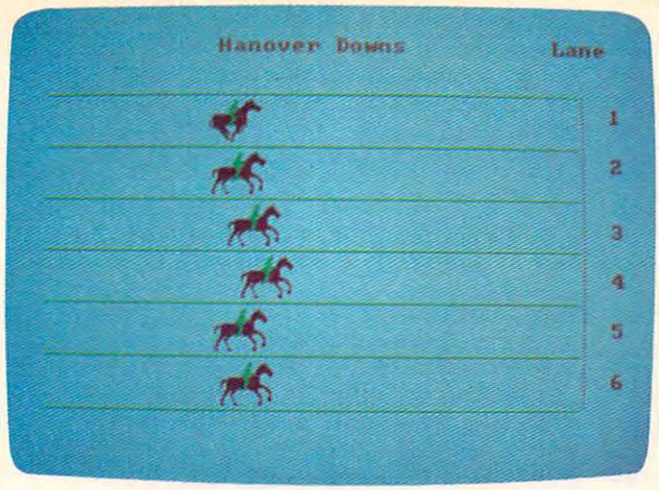

Six horses racing for victory in the IBM version of "Horse Racing."

```
230 PUT (XO(SLOT),SLOT+30),01,PSET
240 NEXT:GOSUB 260
250 WEND:FOR SLOT = 0 TO 1:NEXT:GOTO 270

260 SOUND 32767,1:RETURN
270 LOCATE 23,14:PRINT "HORSE";WINNER; "
WINS"
280 FOR DELAY = 1 TO 5000:NEXT :GOTO 100
0
290 DATA &H40,&H14,&H0,&H0,&H4001,&H2,&H
0,&H0
300 DATA &H4005,&H802A,&H0,&H0,&H5,&H60A
A,&H0,&H0
310 DATA &H215,&HA8AA,&H0,&H0,&H215,&HAA
AA,&H0,&H0
320 DATA &H5A55,&H2AA0,&H0,&H100,&HAA54,
&H880,&H0,&HAAAA
330 DATA &HAA56,&H80,&H2A00,&HAAAA,&HAA9
6,&H80,&HA200,&HAAAA
340 DATA &HAA96,&H80,&H8200,&HAAAA,&HAA5
A,&HA8,&H8200,&HAAAA
350 DATA &HAA5A,&H80AA,&H200,&HA1AA,&HAA
62,&HA000,&HA00,&H18A
360 DATA &HA00,&H2800,&HA00,&H28,&H200,&
H880,&H2800,&H20
370 DATA &H0,&H8A0,&H2000,&H8,&H0,&H2820
,&HA000,&H8
380 DATA &H0,&H2820,&H8000,&H2,&H0,&HA0,
&HA000,&H8002
390 DATA &H0,&HA0,&H0
400 DATA &H40,&H14,&H0,&H0,&H14,&H28,&H0
,&H0
410 DATA &H214,&HAA,&H0,&H0,&HA50,&H80A9
,&H0,&H100
420 DATA &H2A50,&HA8AA,&H0,&H500,&HAA56,
&HAAAA,&H0,&H500
430 DATA &HAA4A,&H2880,&H0,&H500,&HAA6A,
&H0,&HA00,&HA9AA
440 DATA &HAA6A,&H0,&H2A00,&HAAAA,&HAA5A
,&H0,&H2A00,&HAAAA
450 DATA &HAA5A,&H0,&H8A00,&HA9AA,&HAA6A
,&H0,&H8A00,&HA5AA
460 DATA &HAAAA,&H0,&H8A00,&H85AA,&HA20A
,&H0,&H2200,&H80AA
470 DATA &H880A,&H0,&H0,&HA02A,&H200A,&H
0,&H0,&HA80A
480 DATA &H802A,&H0,&H0,&H8802,&HA0,&H0,
&H0,&HA000
490 DATA &H80,&H0,&H0,&H2800,&H80,&H0,&H
0,&H200
500 DATA &H80,&H0,&H0
510 DATA 293,30,392,30,494,30,587,45,587
,15,587,30
520 DATA 494,45,494,15,494,30
530 DATA 392,30,494,30,392,30,294,90
540 DATA 293,30,392,30,494,30,587,45,587
,15,587,30
550 DATA 494,45,494,15,494,30
560 DATA 294,30,294,30,294,30,392,90,-1,
-1
570 RESTORE 510
580 READ PITCH,DUR:IF PITCH =-1 THEN 610

590 SOUND PITCH,DUR/16:SOUND 32767,1
600 GOTO 580
610 FOR SLOT = 0 TO 125 STEP 25:XO (SLOT
) = 0 :NEXT :RETURN
620 CLS: LOCATE 10,14:PRINT "Horse Racin
g":LOCATE 14,11 :INPUT "NUMBER OF PLAYER
S";NP$:N= VAL(NP$)
630 IF N>9 OR N<1 THEN 620
640 FOR I= 0 TO N
650 CASH(I)= 500
660 NEXT:RETURN
670 IF K=0 THEN LOCATE 10,6:PRINT"EACH P
LAYER STARTS WITH $500."
680 LOCATE 12,8:PRINT"HORSES ARE NUMBERE
D FROM"
690 LOCATE 14,13:PRINT"TOP TO BOTTOM."
700 FOR TI= 1 TO 1000:NEXT:K=K+1
720 T= ABS(RND(1)*5)+1:TR$(1)= "FAST":TR
$(2) = "GOOD": TR$(3) = "SLOW":TR$(4)="M
UDDY": TR$(5) = "TURF":TR$(6) ="SWAMPY":
BACK = 7:IF T= 5 THEN BACK = 2
730 AD(T)=.08:AM(T)=500
740 LOCATE 16,10:PRINT"TRACK CONDITION:
";TR$(T)
750 FOR I=1 TO 10000:NEXT:RETURN
760 MT =0:FOR I = 1 TO 6 : M(I) =INT(100
0*RND(1)+1+AM(I)):MT=MT+M(I):NEXT
770 FOR I =1 TO 6:OD(I)=INT(MT/M(I)):IF
OD(I)>20 THEN OD(I)=20
780 NEXT I:RETURN
790 CLS : LOCATE 9,16:PRINT"CURRENT ODDS
"
800 FOR I = 1 TO 6
810 LOCATE 10+I,12:PRINT "HORSE";I:LOCAT
E 10+I,20:PRINT OD(I);" TO 1":NEXT I
820 FOR I= 2 TO 2*N STEP 2
830 IF  CASH(I/2)<1 THEN AMT(I/2)=0:CASH
(I/2)=0:GOTO 910
840 LOCATE 18,9:PRINT"PLAYER";I/2;:INPUT
 "BETS HORSE";H(I/2)
850 IF H(I/2)<1 OR H(I/2)>6 THEN LOCATE
18,28:PRINT STRING$(6,32):GOTO 840
860 LOCATE 20,12:INPUT "AMOUNT";AMT(I/2)
:IF AMT(I/2)>CASH(I/2) THEN LOCATE 20,12
:PRINT STRING$(20,32):AMT(I/2)=0:GOTO 86
0
870 M(H(I/2))=M(H(I/2))+AMT(I/2)
880 MT=MT+AMT(I/2)
890 LOCATE 18,9:PRINT STRING$(20,32)
900 LOCATE 20,12:PRINT STRING$(20,32)
910 NEXT I
920 CLS
930 LOCATE 9,16:PRINT"NEW ODDS"
940 FOR I= 1 TO 6
950 OD(I)=INT(MT/M(I))
```


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```
960 IF OD(I)>20 THEN OD(I)=20
970 LOCATE 10+I,12:PRINT"HORSE";I;:LOCAT
E 10+I,20:PRINT OD(I);" TO 1"
980 NEXT I
990 FOR I= 1 TO 10000:NEXT:CLS:RETURN
1000 FOR I= 1 TO N
1010 IF H(I)= WINNER THEN CASH(I)= CASH(
I)+INT (AMT(I)*INT(MT/M(WINNER)))ELSE CA
SH(I)=CASH(I)-AMT(I):IF CASH(I)<0 THEN C
ASH(I)=0
1020 NEXT I
1030 IF K=1 THEN RD$=""ELSE RD$="S"
1040 CLS:RC$="RACE":LOCATE 9,9:PRINT"SUM
MARY AFTER";K;RC$+RD$
1050 FOR I= 1 TO N:LOCATE 10+I,12:PRINT
"PLAYER";I;"$";CASH(I):NEXT
1060 W=0:FOR I=1 TO N :W=W+CASH(I):NEXT:
IF W=0 THEN 1080
1070 FOR DELAY = 1 TO 10000:NEXT:GOTO 60

1080 FOR DELAY = 1 TO 10000:NEXT:CLS:LOC
ATE 12,15:PRINT"Game Over"
1090 LOCATE 14,9:PRINT"Play again Yes or
 No?":AS$= ""
1100 POKE 1047,1
1110 AS$ = INKEY$:IF LEFT$(AS$,1)<>"Y"AN
D LEFT$(AS$,1)<> "N" THEN 1110
1120 IF LEFT$(AS$,1)= "Y" THEN RUN ELSE
SCREEN 0 :END
```

Program 5: Horse Racing, Apple Loader Program

Translation by Patrick Parrish, Programming Supervisor

```
100  REM  HORSERACE LOADER PROGRAM
105  POKE 104,96: POKE 103,0: PRINT
      CHR$ (4);"RUN HORSERACE"
```

Program 6: Horse Racing, Apple Main Program

```
10   DIM P(25),D(25): HOME : VTAB 11:
      HTAB 9: INVERSE : PRINT "H O R
      S E    R A C I N G": NORMAL : GOSUB
      720: GOSUB 770: GOSUB 780
20   FOR I = 1 TO 5:Y(I) = 19 + 27 *
      (I - 1): NEXT I:OF(1) = 1:OF(4)
       = 1
30 J0 = 0:J1 = 1:J2 = 2:J3 = 3:J5 =
      5:V = 230:V3 =  - 16300:V4 = 32
      :V5 = 64:D3 = 240:D5 = 400
40   HOME : VTAB 9: HTAB 10: PRINT "N
      UMBER OF PLAYERS ":K = 0
50   VTAB 9: HTAB 28: INPUT A$:N =  VAL
      (A$): IF N < 1 OR N > 9 THEN  HTAB
      28: VTAB 9: PRINT "         ": GOTO
      50
60   FOR I = 1 TO N:CASH(I) = 500: NEXT
      I: VTAB 13: HTAB 5: PRINT "EACH
       PLAYER STARTS WITH $500.": VTAB
      15: HTAB 8: PRINT "HORSES ARE N
      UMBERED FROM": VTAB 17: HTAB 13
      : PRINT "TOP TO BOTTOM."
70   FOR J = 2640 TO 3064 STEP 128: FOR
      I = J TO J + 39: POKE I,160: NEXT
      I: NEXT J: FOR I = 1 TO 14: POKE
      2780 + I, ASC ( MID$ ("HANOVER
       DOWNS",I,1)) + 128: NEXT I: FOR
      I = 1 TO 1500: NEXT
80 K = K + 1
90   IF (K > 5) OR (FL = 1) THEN FL =
      0: GOTO 680
100  FOR I = 1 TO 5:AD(I) = 0:AM(I) =
      0: NEXT
110  GOSUB 360: REM  TRACK CONDITION
     S
120  GOSUB 400: REM  DETERMINE ODDS
130  GOSUB 440: REM  PLACE BETS
140  HOME : GOSUB 260: REM  DRAW TRA
     CK
150  POKE 232,J0: POKE 233,12: SCALE=
      J1: ROT= J0: FOR I = J1 TO J5:C
      (I) = I: IF I > J3 THEN C(I) =
      I + J1
160 X(I) = OF(I):XO(J0,I) = X(I):XO(
      J1,I) = X(I): NEXT I
170  FOR I = J1 TO J5: HCOLOR= C(I):
       DRAW J1 AT X(I),Y(I): NEXT I
180  POKE V3,J0: POKE V,V5: GOSUB 77
     0:B = J2
190  FOR Q = J1 TO D5: FOR J = J0 TO
      J1:E =  PEEK (V) = V5: FOR I =
      J1 TO J5:X(I) = X(I) +  INT ( RND
      (J1) * J5 + AD(I)) * J2
200  HCOLOR= J0: DRAW B AT XO(E,I),Y
      (I): HCOLOR= C(I): DRAW B AT X(
      I),Y(I): IF X(I) > D3 + OF(I) THEN
      W = I:I = J5:J = J1:Q = D5
210 XO(E,I) = X(I): NEXT I: POKE V3 +
      E,J0: POKE V,V4 + (V4 * ( PEEK
      (V) = V4)):B = J3 - B: NEXT J: NEXT
      Q
220 B$ = "THE WINNER IS HORSE # " +
       STR$ (W) + ".": IF  PEEK (V) =
      V5 THEN  VTAB 24: HTAB (9): PRINT
      B$;: GOTO 240
230  FOR I = 1 TO 24: POKE I + 3031,
       ASC ( MID$ (B$,I,1)) + 128: NEXT
      I
240  FOR I = 1 TO 2000: NEXT I
250  GOSUB 590: GOTO 70: REM  PAYOFF

260  FOR J = J0 TO J1: POKE V,V4 + J
      * V4: CALL 62450: NEXT J: HGR
     : HGR2
270  FOR J = J0 TO J1: POKE V,V4 + J
      * V4: HCOLOR= J3
280  HPLOT 0,5 TO 279,5: FOR I = 1 TO
     14: HPLOT  - 10 + 20 * I,6 TO  -
     10 + 20 * I,15: NEXT
290  FOR I = 1 TO 14: HPLOT  - 10 +
     20 * I,6 TO  - 15 + 20 * I,11: NEXT
     I
300  HPLOT 0,150 TO 279,150: FOR I =
     1 TO 14: HPLOT  - 10 + 20 * I,1
     51 TO  - 10 + 20 * I,159: NEXT

310  HCOLOR= 5: FOR I = 1 TO 4: HPLOT
     0,15 + I * 27 TO 279,15 + I * 2
     7: NEXT I
320  HCOLOR= 6: HPLOT 260,16 TO 260,
     155
330  POKE  - 16301,J0: IF J = J0 THEN
      VTAB 22: HTAB 14: PRINT "HANOV
     ER  DOWNS"
340  POKE V3 + J,J0: NEXT J
350  POKE V,V4: RETURN
360 T =  INT (5 *  RND (1)) + 1
370 TR$(1) = "FAST":TR$(2) = "GOOD":
     TR$(3) = "SLOW":TR$(4) = "MUDDY
     ":TR$(5) = "TURF"
380 AD(T) = .4:AM(T) = 500
390  HOME : VTAB 10: HTAB 17: PRINT
```


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```
     "RACE ";K: VTAB 13: HTAB 8: PRINT
     "TRACK CONDITIONS:  ";TR$(T): FOR
     I = 1 TO 2500: NEXT : RETURN
400 MT = 0: FOR I = 1 TO 5:M(I) =  INT
     (1000 *  RND (1)) + .1 + AM(I):
     MT = MT + M(I): NEXT I
410  FOR I = 1 TO 5:OD(I) =  INT (MT
      / M(I))
420  IF OD(I) > 20 THEN OD(I) = 20
430  NEXT I: RETURN
440  HOME : HTAB 15: VTAB 1 + (N < 5
     ): PRINT "CURRENT ODDS"
450  FOR I = 1 TO 5: HTAB 13: VTAB 1
      + I + (N < 5) * 2: PRINT "HORS
     E ";I;" : ";OD(I);" TO 1": NEXT
     I
460  FOR I = 2 TO 2 * N STEP 2: IF C
     ASH(I / 2) < 1 THEN A1(I / 2) =
     0: GOTO 530
470  HTAB 8: VTAB 5 + I + (9 - N) /
     2: PRINT "PLAYER ";I / 2;" BETS
      - HORSE ";
480  INPUT H(I / 2): IF (H(I / 2) <
     1) OR (H(I / 2) > 5) THEN  VTAB
     5 + I + (9 - N) / 2: HTAB 31: PRINT
     "       ": GOTO 470
490  VTAB 6 + I + (9 - N) / 2: HTAB
     8: PRINT "AMOUNT ";
500  INPUT A1(I / 2): IF A1(I / 2) >
     CASH(I / 2) THEN  VTAB 6 + I +
     (9 - N) / 2: HTAB 16: PRINT "
          ": GOTO 490
510 M(H(I / 2)) = M(H(I / 2)) + A1(I
      / 2)
520 MT = MT + A1(I / 2)
530  NEXT I
540  HOME : VTAB 5: HTAB 17: PRINT "
     NEW ODDS": HTAB 17: PRINT "---
     ----"
550  FOR I = 1 TO 5:OD(I) =  INT (MT
      / M(I))
560  IF OD(I) > 20 THEN OD(I) = 20
570  VTAB 7 + I * 2: HTAB 12: PRINT
     "HORSE ";I;" : ";OD(I);" TO 1":
      NEXT I
580  FOR I = 1 TO 6000: NEXT : RETURN

590  FOR I = 1 TO N: IF H(I) = W THEN
     CASH(I) = CASH(I) +  INT (A1(I)
      *  INT (MT / M(W))): GOTO 610
600 CASH(I) = CASH(I) - A1(I)
610  NEXT I
620  HOME : TEXT : VTAB 5: HTAB 17: PRINT
     "SUMMARY": HTAB 17: PRINT "----
     ---"
630 P$ = "RACES": IF K = 1 THEN P$ =
     "RACE"
640  VTAB 9: HTAB 15: PRINT "AFTER "
     ;K;" ";P$
650  VTAB 12: FOR I = 1 TO N: HTAB 1
     3: PRINT "PLAYER # ";I;": $"CAS
     H(I): NEXT I
660  FOR I = 1 TO 3000: NEXT :FL = 1
     : FOR I = 1 TO N: IF CASH(I) >
     0 THEN I = N:FL = 0
670  NEXT I: RETURN
680  HOME : VTAB 11: HTAB 15: PRINT
     "GAME OVER": VTAB 16: HTAB 10: PRINT
     "PLAY AGAIN (Y/N) ";
690  INPUT A$: IF A$ <  > "Y" AND A$
      <  > "N" THEN 690
700  IF A$ = "Y" THEN 40
710  END
720  FOR LOC = 770 TO 790: READ BYTE
     : POKE LOC,BYTE: NEXT : FOR I =
     1 TO 25: READ P(I),D(I): NEXT I
     : RETURN : REM  ML MUSIC ROUTIN
     E
730  DATA 173,48,192,136,208,5,206,1
     ,3,240,9,202,208,245,174,0,3,76
     ,2,3,96
740  REM  MUSICAL TUNE DATA
750  DATA 128,60,96,60,76,60,64,90,6
     4,30,64,60,76,90,76,30,76,60,96
     ,60,76,60,96,60,128,255,128,60,
     96,60,76,60,64,90,64,30,64,60
760  DATA 76,60,96,60,128,90,128,30,
     128,60,96,255
770  FOR I = 1 TO 25: POKE 768,P(I):
      POKE 769,D(I): CALL 770: NEXT
     I: RETURN
780 CKSUM = 0: FOR I = 3072 TO 3427:
      READ A:CKSUM = CKSUM + A: POKE
     I,A: NEXT : RETURN : REM  CHECK
     SUM CKSUM SHOULD BE 16204
790  DATA  2,0,6,0,181,0,73,73
800  DATA  73,73,73,73,17,27,27,27
810  DATA  27,27,27,27,27,27,83,73
820  DATA  73,73,73,73,73,26,27,27
830  DATA  27,27,27,27,27,27,27,74
840  DATA  73,73,73,105,73,9,26,27
850  DATA  31,27,27,27,27,27,27,27
860  DATA  74,73,73,73,45,13,45,45
870  DATA  26,27,59,31,59,27,27,27
880  DATA  27,27,74,73,73,9,77,45
890  DATA  77,17,27,27,59,63,63,63
900  DATA  63,63,63,83,73,41,45,45
910  DATA  45,45,77,9,26,27,27,63
920  DATA  63,63,63,63,27,27,74,9
930  DATA  45,77,9,45,77,73,26,27
940  DATA  27,63,31,27,27,59,31,27
950  DATA  74,41,77,73,73,41,77,17
960  DATA  27,59,27,27,27,27,27,27
970  DATA  59,83,77,73,73,73,73,105
980  DATA  26,27,27,27,27,27,27,27
990  DATA  27,27,74,73,73,73,73,73
1000  DATA  9,26,27,27,27,27,27,27
1010  DATA  27,27,27,2,0,73,73,73
1020  DATA  73,73,73,17,27,27,27,27
1030  DATA  27,27,27,27,27,83,73,73
1040  DATA  73,73,73,73,26,27,27,27
1050  DATA  31,27,27,27,27,27,74,73
1060  DATA  73,73,73,9,77,26,63,63
1070  DATA  27,63,27,27,27,27,27,74
1080  DATA  73,73,73,77,109,9,26,27
1090  DATA  59,63,59,27,27,27,27,27
1100  DATA  74,73,45,45,45,45,45,77
1110  DATA  17,27,27,63,63,63,63,63
1120  DATA  59,27,83,9,77,45,45,45
1130  DATA  45,77,9,26,27,27,63,63
1140  DATA  27,63,31,27,31,74,73,9
1150  DATA  109,73,77,73,26,27,27,27

1160  DATA  31,27,63,27,27,27,74,73
1170  DATA  73,109,105,73,9,26,27,27

1180  DATA  27,59,59,27,27,27,27,74
1190  DATA  73,73,9,77,73,73,26,27
1200  DATA  27,27,59,59,27,27,27,27
1210  DATA  74,73,73,73,73,73,9,26
1220  DATA  27,27,27,27,27,27,27,27
1230  DATA  27,2,0,0,255,255,0,0
```

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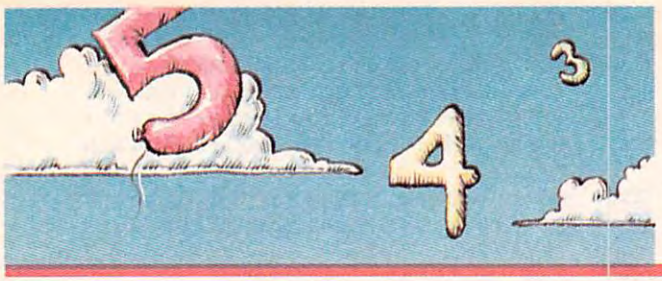
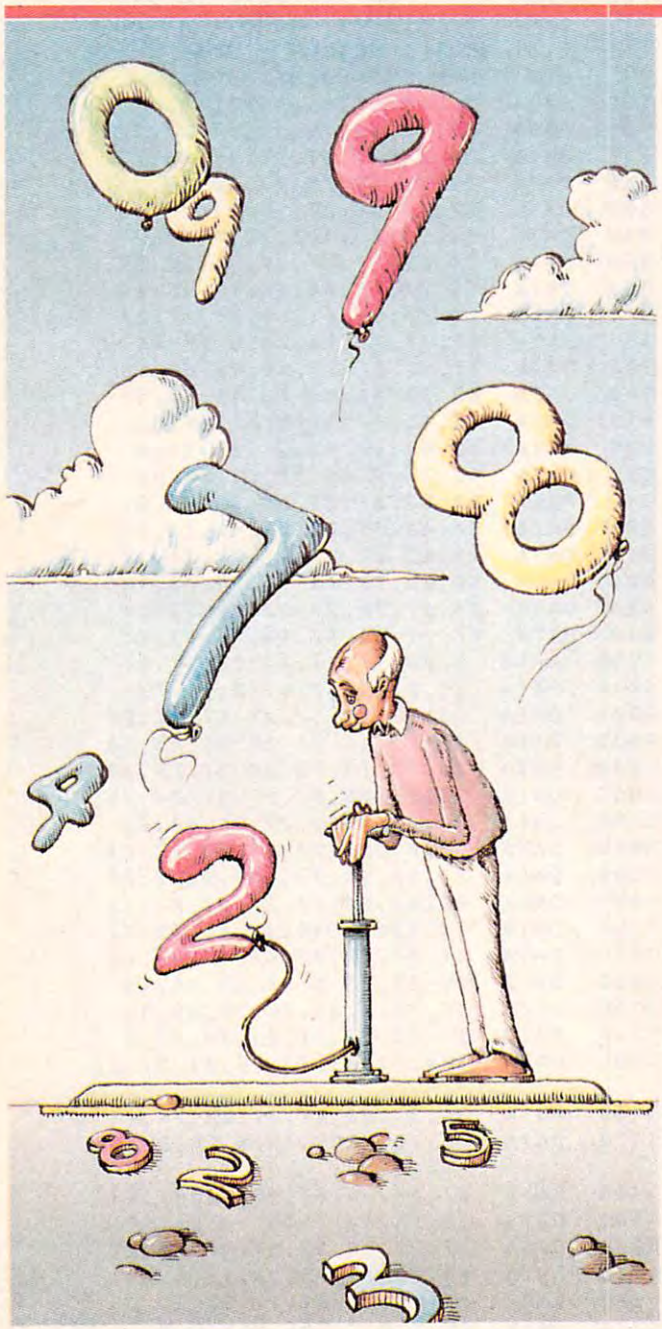


Software for children often benefits from large display characters and numbers. Here's a method for creating big numbers on the TI-99/4A, with a simple example program—a number recognition game which uses the larger digits. Includes versions for Commodore VIC and 64, Atari, Apple, IBM PC/PCjr, and the Color Computer.

The Number Game

Lou Tylee



The built-in number characters on the Texas Instruments 99/4A Home Computer are too small to really grab a child's attention. Using the character definition capabilities of the 99/4A, representations of the numbers 0 through 9 can be developed which are three times taller and wider than these built-in digits. And these larger number characters can be used in your own programs.

Magnifying The Numbers

In the May 1983 issue of COMPUTE!, C. Regena wrote a tutorial on the use of TI graphics ("Programming The TI: Graphics"). Regena explains that each character on the display screen is an 8 × 8 grid of 64 dots. When you press a number key on the TI keyboard, that number is displayed using one such character. By employing the CALL CHAR statement in TI BASIC to turn dots on and off within a particular 8 × 8 grid, custom characters can be defined. The larger numbers here each use 9 custom characters in a 3 × 3 array. The figure shows these numbers and corresponding hexadecimal codes for defining characters.

Examining the figure, you may wonder if these numbers could perhaps be defined in a simpler manner. For example, it is possible to represent each number by straight line segments only, such as are used on digital watches. Certainly, this would work, but it may not be advisable for teaching young children, because children learn numbers for the first time in a pattern recognition mode, trying to match similar objects. Hence, the numbers in the figure are designed to mimic (as closely as possible) the TI keyboard depictions of the numbers. For older children, who are used to seeing numbers written in different ways, the digital watch approach to number display would be fine.

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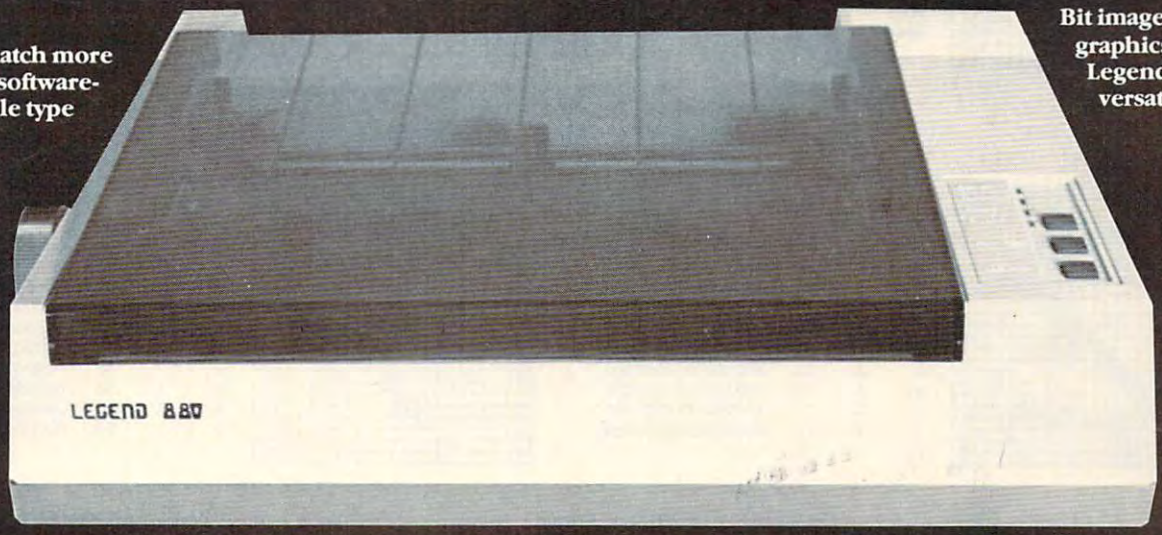

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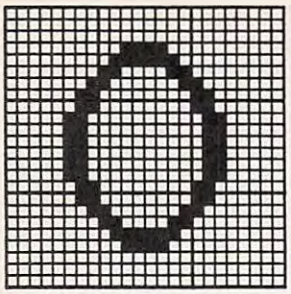
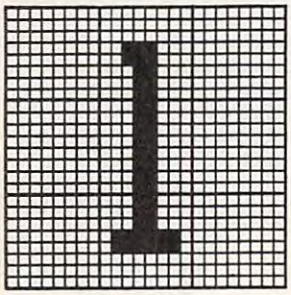
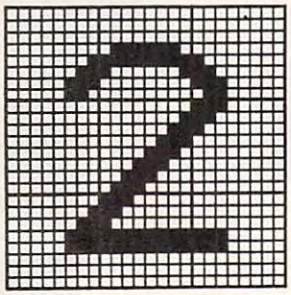


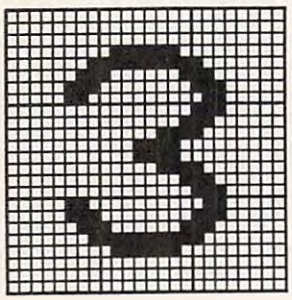
Row	Column	Index	Hex Code
1	1	0	00000000000000103
1	2	1	0000003C7EC38100
1	3	2	00000000000080C0
2	1	3	0306060606060603
2	2	53	0000000000000000
2	3	4	C0606060606060C0
3	1	5	0301000000000000
3	2	6	0081C37E3C000000
3	3	7	C080000000000000



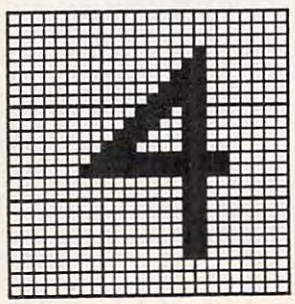
Row	Column	Index	Hex Code
1	1	53	0000000000000000
1	2	8	0000003838181818
1	3	53	0000000000000000
2	1	53	0000000000000000
2	2	9	1818181818181818
2	3	53	0000000000000000
3	1	53	0000000000000000
3	2	10	1818187E7E000000
3	3	53	0000000000000000



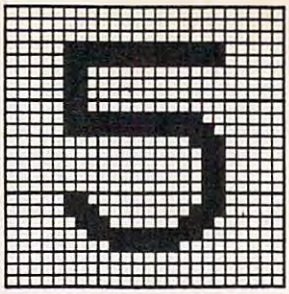
Row	Column	Index	Hex Code
1	1	45	0000000001030706
1	2	46	0000007EFF810000
1	3	47	000000080C0E060
2	1	53	0000000000000000
2	2	11	000103070E1C3870
2	3	12	E0C0800000000000
3	1	13	0001030707000000
3	2	14	E0C080FFFF000000
3	3	15	000000E0E0000000



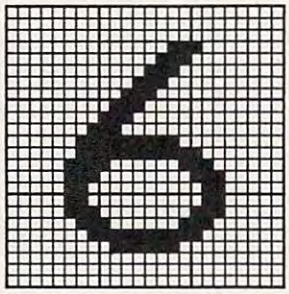
Row	Column	Index	Hex Code
1	1	45	0000000001030706
1	2	46	0000007EFF810000
1	3	47	000000080C0E060
2	1	53	0000000000000000
2	2	16	0001071E1E070100
2	3	42	E0C080000080C0E0
3	1	48	0607030100000000
3	2	43	000081FF7E000000
3	3	44	60E0C08000000000



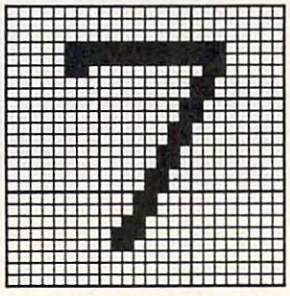
Row	Column	Index	Hex Code
1	1	53	0000000000000000
1	2	17	000000000103C70F
1	3	18	0000008080808080
2	1	19	0000000001030000
2	2	20	1D3971E1FFFF0101
2	3	21	80808080E0E08080
3	1	53	0000000000000000
3	2	22	0101010101000000
3	3	23	8080808080000000



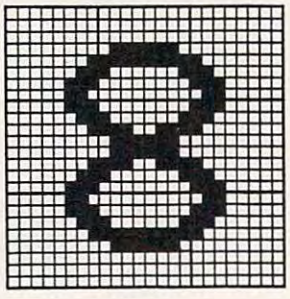
Row	Column	Index	Hex Code
1	1	24	0000000707060606
1	2	35	000000FFFF000000
1	3	25	000000E0E0000000
2	1	26	0607070000000000
2	2	27	00FFFF0000000000
2	3	28	0080C0E060606060
3	1	48	0607030100000000
3	2	43	000081FF7E000000
3	3	44	60E0C08000000000



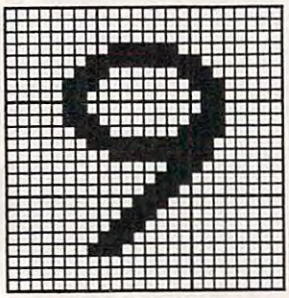
Row	Column	Index	Hex Code
1	1	53	0000000000000000
1	2	29	00000003070E1C38
1	3	30	0000008000000000
2	1	31	0000010303070706
2	2	32	70E0C0FEFF810000
2	3	33	0000000080C0E060
3	1	48	0607030100000000
3	2	43	000081FF7E000000
3	3	44	60E0C08000000000



Row	Column	Index	Hex Code
1	1	34	0000000707060000
1	2	35	000000FFFF000000
1	3	36	000000E0E060C0C0
2	1	53	0000000000000000
2	2	37	0101030306060C0C
2	3	38	8080000000000000
3	1	53	0000000000000000
3	2	39	1818307060000000
3	3	53	0000000000000000



Row	Column	Index	Hex Code
1	1	45	0000000001030706
1	2	46	0000007EFF810000
1	3	47	000000080C0E060
2	1	40	0703010000010307
2	2	41	0081E77E7EE78100
2	3	42	E0C080000080C0E0
3	1	48	0607030100000000
3	2	43	000081FF7E000000
3	3	44	60E0C08000000000



Row	Column	Index	Hex Code
1	1	45	0000000001030706
1	2	46	0000007EFF810000
1	3	47	000000080C0E060
2	1	48	0607030100000000
2	2	49	000081FF7F03070E
2	3	50	60E0E0C0C0800000
3	1	51	0000000001000000
3	2	52	1C3870E0C0000000
3	3	53	0000000000000000

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Using The Magnified Numbers

Now that we have the character definitions, we need to efficiently incorporate them into a program. Ten digits, defined by nine characters each, is a total of 90 characters. Of these 90 characters, however, only 54 are distinct. Lines 150–290 of Program 1 assign each of these distinct characters to an index number in the array CI$. These 54 character indices fill an array N which is used to define the ten large digits. In lines 310–480 of Program 1, I is character N's row and J is character N's column within the 3 × 3 array used to define digit K. For example, character 17 (000000000103070F) defines the first row and second column of the number 4 (see the figure). So we can write N(4,1,2)=17.

Next, we need to relate the two arrays CI$ and N to allow drawing large numbers on the display screen. One way to accomplish this is to load each of the 54 distinct characters into character codes 106 through 159 using CALL CHAR:

```
FOR I=0 TO 53
CALL CHAR(I+106,CI$(I))
NEXT I
```

An alternative which eliminates the need for a CI$ array, is to read the character definitions directly from DATA statements

```
FOR I=0 TO 53
READ C$
CALL CHAR(I+106,C$)
NEXT I
DATA ...
DATA ...
```

where the DATA statements are identical to those used earlier to define CI$. Then, to draw digit K starting at row R and column C on the screen, we use:

```
FOR I=R TO R+2
FOR J=C TO C+2
CALL HCHAR(I,J,106+N(K,I-R+1,J-C+1))
NEXT J
NEXT I
```

This will work fine, yet it has one drawback. It requires the use of 54 custom characters. This does not leave many characters available for other graphics use. We can use another technique that only requires, at most, nine characters for each digit to be displayed on the screen at one time. So, if our application only displays two digits at any one time, just 18 characters must be defined.

Dynamic Character Definition

That technique, used in Program 1, can be called dynamic character definition. That is, character codes are redefined and reused as each number is displayed. Lines 1500–1580 draw digit K starting at row R, column C, and character code CC. This approach requires that the contents of the CI$ array have already been assigned, as shown in lines 150–290. If we are using two digits at most, good choices for starting character codes are CC=126 for one digit and CC=135 for the other. This leaves many codes available for other graphics. As long as we require six or fewer different digits to be displayed, this method of dynamic character definition uses fewer character codes than the previous method.

The large numbers developed here have many applications. Math flash card drills, counting games, and guess-the-number games are just a few. As a sample application, the programs provide a preschool game to teach number recognition. In Program 1, which runs in either TI console BASIC or Extended BASIC, the computer randomly picks a number from 0 to 9 and displays it at the center of the screen. The child is then asked to find that number on the keyboard and press it. A correct response wins a snappy tune and a like number of blocks are drawn. An incorrect answer gets an "uh-oh" and the child is asked to try again. Since this program displays only one number at a time, dynamic character definition (CC=135) is employed for display.

Program 1: TI Number Game

```
100 RANDOMIZE
110 CALL CLEAR
120 CALL SCREEN(8)
130 PRINT TAB(8);"...PLEASE WAIT"
140 REM LOAD CHARACTER CODE ARRAY
150 DIM CI$(53)
160 FOR I=0 TO 53
170 READ CI$(I)
180 NEXT I
190 DATA 000000000000103,000003C7
    EC381,000000000000080C,030606060
    6060603,C060606060606
200 DATA 0301,0081C37E3C,C08,000000
    3838181818,1818181818181818
210 DATA 1818187E7E,000103070E1C387
    ,E0C08,0001030707,E0C080FFFF
220 DATA 000000E0E,0001071E1E0701,0
    00000000103070F,0000000808080808
    ,000000000103
230 DATA 1D3971E1FFFF0101,808080800E
    0E0808,0101010101,8080808080,000
    0000707060606
240 DATA 000000E0E,060707,00FFFF,00
    80C0E060606606,0000000307070E1C38
250 DATA 0000008,0000010303070706,7
    0E0C0FEFF81,0000000080C0E06,000
    000070706
260 DATA 000000FFFF,000000E0E060C0C
    ,0101030306060C0C,808,181830706
270 DATA 0703010000010307,0081E77E7
    EE781,E0C0800000080C0E,000081FF7
    E,60E0C08
280 DATA 0000000001030706,0000007EF
    F81,000000008C0E06,0607030l,00
    0081FF7F03070E
```


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```
290 DATA 60E0E0C0C08,0000000001,1C3
    870E0C,
300 REM LOAD CHARACTER INDEX ARRAY
310 DIM N(9,3,3)
320 FOR K=0 TO 9
330 FOR I=1 TO 3
340 FOR J=1 TO 3
350 READ N(K,I,J)
360 NEXT J
370 NEXT I
380 NEXT K
390 DATA 0,1,2,3,53,4,5,6,7
400 DATA 53,8,53,53,9,53,53,10,53
410 DATA 45,46,47,53,11,12,13,14,15
420 DATA 45,46,47,53,16,42,48,43,44
430 DATA 53,17,18,19,20,21,53,22,23
440 DATA 24,35,25,26,27,28,48,43,44
450 DATA 53,29,30,31,32,33,48,43,44
460 DATA 34,35,36,53,37,38,53,39,53
470 DATA 45,46,47,40,41,42,48,43,44
480 DATA 45,46,47,48,49,50,51,52,53
490 REM DEFINE BLOCK CHARACTER
500 CALL CHAR(119,"")
510 CALL COLOR(11,16,16)
520 REM TITLE SCREEN
530 CALL CLEAR
540 CALL SCREEN(12)
550 PRINT TAB(6);"LEARN THE NUMBERS
    ": :
560 GOSUB 1320
570 PRINT "THIS IS A PRE-SCHOOL NUM
    BER"
580 PRINT "RECOGNITION GAME. THE CO
    MPU-"
590 PRINT "TER DISPLAYS A NUMBER AN
    D"
600 PRINT "YOU MUST FIND AND PRESS
    THAT"
610 PRINT "KEY ON YOUR KEYBOARD.":
    :
620 PRINT "IF CORRECT, THAT NUMBER
    OF"
630 PRINT "BLOCKS IS DRAWN AND YOU
    ARE"
640 PRINT "GIVEN ANOTHER NUMBER. IF
     NOT"
650 PRINT "CORRECT, THE COMPUTER WI
    LL"
660 PRINT "ASK YOU FOR ANOTHER ANSW
    ER.": :
670 PRINT "TO STOP THE GAME, PRESS
    THE"
680 PRINT "SPACE BAR WHEN ASKED FOR
     AN"
690 PRINT "ANSWER.": : :
700 PRINT "PRESS ANY KEY TO PLAY."
710 CALL KEY(0,KEY,S)
720 IF S=0 THEN 710
730 CALL SOUND(100,1000,3)
740 REM PLAY GAME
750 CALL CLEAR
760 CALL SCREEN(14)
770 M$="LEARN THE NUMBERS"
780 XM=8
790 YM=3
800 GOSUB 1440
810 RANDOMIZE
820 K=INT(RND*10)
830 IF TM=K THEN 820
840 TM=K
850 CC=135
860 R=8
870 C=15
880 GOSUB 1500
890 M$="PRESS THIS NUMBER .."
900 XM=6
910 YM=13
920 GOSUB 1440
930 REM CHECK ANSWER
940 CALL KEY(0,KEY,S)
950 IF S=0 THEN 940
960 IF ((KEY<48)+(KEY>57))*(KEY<>32
    )THEN 940
970 CALL SOUND(100,1000,3)
980 IF KEY=32 THEN 1000 ELSE 1020
990 REM GAME ENDS
1000 CALL CLEAR
1010 STOP
1020 CALL HCHAR(13,27,KEY)
1030 IF (KEY-48)<>K THEN 1270
1040 REM CORRECT ANSWER
1050 GOSUB 1320
1060 M$=STR$(K)&" BLOCKS:"
1070 IF K<>1 THEN 1090
1080 M$="1 BLOCK:"
1090 XM=6
1100 YM=15
1110 GOSUB 1440
1120 IF K=0 THEN 1220
1130 BC=4
1140 FOR NB=1 TO K
1150 CALL HCHAR(18,BC,119,2)
1160 CALL HCHAR(19,BC,119,2)
1170 CALL SOUND(100,330,3)
1180 FOR D=1 TO 200
1190 NEXT D
1200 BC=BC+3
1210 NEXT NB
1220 FOR D=1 TO 2000
1230 NEXT D
1240 CALL HCHAR(8,15,32,370)
1250 GOTO 810
1260 REM INCORRECT ANSWER
1270 CALL SOUND(100,392,3)
1280 CALL SOUND(100,330,2)
1290 CALL HCHAR(13,27,32)
1300 GOTO 940
1310 REM PLAY TUNE
1320 FOR I=1 TO 2
1330 CALL SOUND(300,349,3,262,3,220
     ,3)
1340 CALL SOUND(150,349,3)
1350 CALL SOUND(150,349,3)
1360 NEXT I
1370 CALL SOUND(300,440,3,349,3,262
     ,3)
1380 CALL SOUND(150,523,3)
1390 CALL SOUND(150,523,3)
1400 CALL SOUND(300,440,3,349,3,262
     ,3)
1410 CALL SOUND(300,349,3,262,3,220
     ,3)
1420 RETURN
1430 REM TEXT PRINT SUBROUTINE
1440 FOR I=1 TO LEN(M$)
1450 C=ASC(SEG$(M$,I,1))
1460 CALL HCHAR(YM,XM+I-1,C)
1470 NEXT I
1480 RETURN
```


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```
1490 REM NUMBER DRAWING SUBROUTINE
1500 L=CC
1510 FOR I=R TO R+2
1520 FOR J=C TO C+2
1530 CI=N(K,I-R+1,J-C+1)
1540 CALL CHAR(L,CI$(CI))
1550 CALL HCHAR(I,J,L)
1560 L=L+1
1570 NEXT J
1580 NEXT I
1590 RETURN
```

Program 2: 64 Number Game

Refer to the "Automatic Proofreader" article before typing this program in.

```
10 POKE53281,1:FORI=1TO12:READA:NEXT:GOSU
   B980                                  :rem 57
20 POKE53281,1:CO=2:LL=54272:FORI=LLTOLL+
   24:POKEI,0:NEXTI                      :rem 26
30 POKELL+5,1:POKELL+6,241:POKELL+24,15
                                         :rem 48
40 L8=INT(RND(1)*10)+47                  :rem 232
50 GOSUB 430                             :rem 124
60 GOSUB 140                             :rem 123
70 POKE198,0                             :rem 148
80 GET A$:IFA$=""THEN80                  :rem 243
90 IFA$=" "THENPOKE198,0:SYS198          :rem 21
100 IFASC(A$)<>L8THENGOSUB940:GOTO80
                                         :rem 210
110 GOSUB 330                            :rem 168
120 GOSUB 1100                           :rem 213
130 FORI=1TO3000:NEXT:GOTO40             :rem 232
140 RESTORE:FORI=7TO27STEP5              :rem 20
150 CO=CO+1:IFCO>15THENCO=2              :rem 130
160 PRINT"{HOME}{11 DOWN}"               :rem 54
170 POKE646,CO                           :rem 37
180 POKE249,I:READA:POKE250,A            :rem 224
190 SYS828:PRINT"{UP}":NEXT              :rem 80
200 FORI=10TO25STEP5                     :rem 219
210 CO=CO+1:IFCO>15THENCO=2              :rem 127
220 PRINT"{HOME}{15 DOWN}"               :rem 119
230 POKE646,CO                           :rem 34
240 POKE249,I:READA:POKE250,A            :rem 221
250 SYS828:PRINT"{UP}":NEXT              :rem 77
260 FORI=12TO22STEP5                     :rem 224
270 CO=CO+1:IFCO>15THENCO=2              :rem 133
280 PRINT"{HOME}{19 DOWN}"               :rem 193
290 POKE646,CO                           :rem 40
300 POKE249,I:READA:POKE250,A            :rem 218
310 SYS828:PRINT"{UP}":NEXT:RETURN
                                         :rem 100
320 DATA 16,18,5,19,19,20,8,9,19,11,5,25
                                         :rem 167
330 LL=54272:FORI=LLTOLL+24:POKEI,0:NEXT
                                         :rem 1
340 POKELL+24,15:POKELL+5,36:POKELL+6,132
                                         :rem 155
350 POKE54284,129:POKE54285,132          :rem 201
360 FORI=1TO8:READLB,HB                  :rem 172
370 POKELL,LB:POKELL+1,HB:POKELL+4,33
                                         :rem 32
380 POKE54279,LB:POKE54280,HB:POKE54283,3
    3                                    :rem 178
390 FORK=1TO275:NEXT:POKELL+4,32:POKE5428
    3,32                                 :rem 231
400 FORL=1TO15:NEXT:NEXT                 :rem 48
410 DATA 152,5,152,5,152,5,152,5,12,7,48,
    4,12,7,152,5                         :rem 24
420 RETURN                               :rem 118
430 PRINT"{CLR}";:POKE56334,PEEK(56334)AN
    D254:POKE1,PEEK(1)AND251             :rem 145
440 CO=CO+1:IFCO>15THENCO=2              :rem 132
450 POKE646,CO:L8=L8+1:M=53247+8*L8
                                         :rem 219
460 FORM1=M+1TOM+7:X=PEEK(M1):FORL=1TO7:C
    =146:X=X*2                           :rem 135
470 POKE1,PEEK(1)OR4:POKE56334,PEEK(56334
    )OR1                                 :rem 138
480 POKELL+4,16:Q=INT(RND(1)*40):POKELL+1
    ,Q+(M1-M)*8                          :rem 253
490 IFX>255THENX=X-256:C=18:POKELL+4,17
                                         :rem 91
500 PRINTTAB(16)CHR$(C)CHR$(32);         :rem 56
510 POKE56334,PEEK(56334)AND254:POKE1,PEE
    K(1)AND251:NEXT:PRINT:NEXT           :rem 112
520 POKE1,PEEK(1)OR4:POKE56334,PEEK(56334
    )OR1                                 :rem 134
530 POKELL+4,16:RETURN                   :rem 107
540 POKE646,CO:PRINTTAB(16)CHR$(C);
                                         :rem 76
550 PRINT"{DOWN}{10 SPACES}PLEASE WAIT A
    {SPACE}MOMENT"                       :rem 124
560 T=0:FORJ=688TO703:READK:T=T+K:POKEJ,K
    :NEXT                                :rem 192
570 IFT<>3078THENPRINT"ERROR IN DATA STAT
    EMENTS":STOP                         :rem 142
580 T=0:FORJ=828TO1006:READK:T=T+K:POKEJ,
    K:NEXT                               :rem 235
590 IFT<>20306THENPRINT"ERROR IN DATA STA
    TEMENTS":STOP                        :rem 185
600 POKE249,0:RETURN                     :rem 218
610 DATA32,188,190,226,172,225,191,251
                                         :rem 133
620 DATA187,255,161,236,162,254,252,96
                                         :rem 145
630 DATA 169,208,133,004,173,024         :rem 37
640 DATA 208,41,2,240,4,169              :rem 43
650 DATA 216,133,4,169,0,162             :rem 94
660 DATA 3,6,250,42,202,208              :rem 38
670 DATA 250,24,101,4,133,4              :rem 33
680 DATA 165,250,133,3,173,14            :rem 145
690 DATA 220,41,254,141,14,220           :rem 184
700 DATA 165,1,41,251,133,1              :rem 31
710 DATA 169,0,133,250,169,5             :rem 97
720 DATA 133,2,160,0,177,3               :rem 241
730 DATA 133,5,230,3,177,3               :rem 246
740 DATA 133,6,230,3,198,2               :rem 250
750 DATA 240,28,162,04,169,0             :rem 95
760 DATA 6,6,42,6,6,42                   :rem 55
770 DATA 6,5,42,6,5,42                   :rem 54
780 DATA 164,250,153,48,2,230            :rem 147
790 DATA 250,202,208,232,240,210         :rem 27
800 DATA 165,1,9,4,133,1                 :rem 144
810 DATA 173,14,220,9,1,141              :rem 35
820 DATA 14,220,160,0,166,249            :rem 140
830 DATA 240,8,169,29                    :rem 18
840 DATA 32,210                          :rem 218
850 DATA 255,202,208,250,169,4           :rem 200
860 DATA 133,6,185,48,2,170              :rem 53
870 DATA 189,176,2,133,5,41              :rem 56
880 DATA 64,240,5,169,18,32              :rem 57
890 DATA 210,255,165,5,41,191            :rem 151
900 DATA 32,210,255,169,146,32           :rem 195
910 DATA 210,255,200,198,6,208           :rem 195
920 DATA 221,169,13,32,210,255           :rem 190
930 DATA 192,16,208,196,96               :rem 18
940 POKELL+4,33:POKELL+1,10:POKELL,143
                                         :rem 4
```


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```
950 FORI=1TO500:NEXTI                    :rem 54
960 POKELL+4,32:FORI=1TO250:NEXTI        :rem 42
970 POKELL+4,8:RETURN                    :rem 68
980 PRINT"{CLR}{BLU}{DOWN}{11 SPACES}LEAR
    N THE NUMBERS{2 DOWN}"               :rem 198
990 PRINT"{2 SPACES}THIS IS A PRE-SCHOOL
    {SPACE}NUMBER{11 SPACES}RECOGNITION G
    AME.";                               :rem 241
1000 PRINT" THE COMPUTER DISPLAYS A NUMBE
     R AND";                             :rem 99
1010 PRINT" YOU MUST FIND AND PRESS
     {4 SPACES}THAT KEY ON YOUR KEYBOARD.
     "                                   :rem 223
1020 PRINT"{DOWN}{2 SPACES}IF CORRECT, TH
     AT NUMBER OF BLOCKS IS{2 SPACES}DRAW
     N AND YOU ARE";                     :rem 186
1030 PRINT" GIVEN ANOTHER NUMBER. IF NOT
     {SPACE}CORRECT, THE";               :rem 240
1040 PRINT" COMPUTER WILL ASK{3 SPACES}FO
     R ANOTHER ANSWER."                  :rem 18
1050 PRINT"{DOWN}{2 SPACES}TO STOP THE GA
     ME, PRESS THE SPACE BAR WHEN ASKED F
     OR AN ANSWER."                      :rem 117
1060 GOSUB330:GOSUB550                   :rem 49
1070 PRINT"{3 DOWN}{10 SPACES}HIT ANY KEY
      TO PLAY."                          :rem 137
1080 GET A$:IF A$=""THEN1080             :rem 181
1090 PRINT"{CLR}":RETURN                 :rem 72
1100 IFL8=48THENRETURN                   :rem 141
1110 FORI=2TO(4*(L8-49))+2STEP4          :rem 240
1120 CO=CO+1:IFCO>15THENCO=2             :rem 176
1130 PRINT"{HOME}{7 DOWN}"               :rem 32
1140 POKE646,CO                          :rem 83
1150 POKE249,I:POKE250,250               :rem 205
1160 SYS828:PRINT"{UP}":NEXT             :rem 126
1170 RETURN                              :rem 169
```

Program 3: VIC Number Game

Refer to the "Automatic Proofreader" article before typing this program in.

```
10 POKE36878,15:S=36875:CO=2:DIMB(10),C(1
   0):CV=36878                           :rem 141
20 GOSUB 320:GOSUB220                    :rem 197
30 GOSUB 380:GOSUB 530:PRINT"{CLR}":SYS82
   8                                     :rem 73
40 L8=INT(RND(1)*10)+48                  :rem 233
50 IFL8=LOTHEN40                         :rem 227
60 LO=L8                                 :rem 194
70 GOSUB 160                             :rem 126
80 POKE198,0                             :rem 149
90 PRINT"{HOME}{12 DOWN}{2 RIGHT}{BLU}PRE
   SS{RIGHT}THIS{RIGHT}NUMBER"           :rem 58
100 GET A$:IFA$=""THEN100                :rem 69
110 IF A$=" "THEN POKE890,0:SYS890:rem 60
120 IFASC(A$)<>L8THENGOSUB590:GOTO100
                                         :rem 254
130 GOSUB 330                            :rem 170
140 GOSUB 630                            :rem 174
150 GOTO 40                              :rem 51
160 PRINT"{CLR}";:M=34816+8*L8:IFL8-48>9T
    HEN65535                             :rem 165
170 FORM1=MTOM+6:X=PEEK(M1):FORL=1TO7:C=3
    2:X=X*2                              :rem 242
180 IFX>255THENX=X-256:C=113:CO=CO+1:IFCO
    >7THENCO=2                           :rem 134
190 POKE646,CO:POKES,128+CO*4            :rem 197
200 PRINTTAB(7)"";CHR$(C);:NEXT:PRINT"":N
    EXT                                  :rem 202
210 POKES,0:RETURN                       :rem 139
220 PRINT"{CLR}{2 SPACES}THIS IS A PRE-SC
    HOOLNUMBER RECOGNITION{4 SPACES}GAME.
     THE COMPUTER"                       :rem 139
230 PRINT"DISPLAYS A NUMBER AND"         :rem 172
240 PRINT"YOU MUST FIND AND{5 SPACES}PRES
    S THAT KEY ON YOURKEYBOARD."         :rem 179
250 PRINT"{DOWN}{2 SPACES}IF CORRECT, THA
    T{4 SPACES}NUMBER OF BLOCKS IS
    {3 SPACES}DRAWN AND YOU ARE"         :rem 83
260 PRINT"GIVEN ANOTHER NUMBER. IF NOT CO
    RRECT, THE"                          :rem 137
270 PRINT"COMPUTER WILL ASK FOR ANOTHER A
    NSWER."                              :rem 230
280 PRINT"{DOWN}{2 SPACES}TO STOP THE GAM
    E,{3 SPACES}PRESS THE SPACE BAR
    {3 SPACES}WHEN ASKED FOR AN{5 SPACES}
    ANSWER."                             :rem 73
290 PRINT"{DOWN} HIT ANY KEY TO PLAY."
                                         :rem 58
300 GET A$:IF A$=""THEN300               :rem 73
310 PRINT"{CLR}":RETURN                  :rem 18
320 PRINT"{CLR}{4 DOWN} LEARNING THE NUMB
    ERS"                                 :rem 138
330 RESTORE                              :rem 186
340 FOR X=1TO8:READ C(X),B(X):POKE CV-2,C
    (X):POKECV-3,B(X):FORD=1TO 350:NEXT
                                         :rem 241
350 POKE CV-2,0:POKE CV-3,0:NEXT         :rem 82
360 RETURN                               :rem 121
370 DATA 195,207,195,207,195,207,195,207,
    207,215,215,225,207,215,195,207
                                         :rem 243
380 PRINT"{2 SPACES}ONE MOMENT PLEASE"
                                         :rem 216
390 I=828                                :rem 196
400 READ A:IF A=256 THEN RETURN          :rem 228
410 POKE I,A:I=I+1:GOTO 400              :rem 230
420 DATA 120,169,3,141,21,3,169          :rem 234
430 DATA 73,141,20,3,88,96,162           :rem 198
440 DATA 1,240,21,206,74,3,169           :rem 186
450 DATA 47,141,3,144,169,255,141        :rem 90
460 DATA 5,144,169,25,141,15,144         :rem 38
470 DATA 76,21,235,173,4,144,208         :rem 41
480 DATA 251,169,32,141,37,145,169
                                         :rem 149
490 DATA 185,141,36,145,238,74,3         :rem 49
500 DATA 169,46,141,3,144,169,240        :rem 89
510 DATA 141,5,144,169,8,141,15          :rem 240
520 DATA 144,76,191,234,0,256            :rem 148
530 POKE56,28:CH=32776                   :rem 211
540 FOR X=7184TO7600 STEP 2:              :rem 1
550 POKE X,PEEK(CH):POKE X+1,PEEK(CH)
                                         :rem 152
560 CH=CH+1:NEXTX                         :rem 27
570 POKE36879,25:POKE36869,255:POKE36867,
    47                                   :rem 190
580 RETURN                               :rem 125
590 POKES-1,128                           :rem 69
600 FORI=1TO500:NEXTI                     :rem 46
610 POKES-1,0                            :rem 211
620 RETURN                               :rem 120
630 IFL8-48=0THENRETURN                  :rem 193
640 FORI=1TO(L8-48)*2STEP2                :rem 19
650 POKES,140+I*6                        :rem 178
660 POKE646,CO:CO=CO+1:IFCO>7THENCO=2
                                         :rem 32
670 PRINT"{HOME}{8 DOWN}"TAB(I)"{RVS} "
                                         :rem 208
680 PRINTTAB(I)"{RVS} "                  :rem 242
690 FORQ=1TO200:NEXT:POKES,0              :rem 11
700 NEXT                                 :rem 214
```


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```
710 FORI=1TO500*(L8-48):NEXTI      :rem 200
720 RETURN                         :rem 121
```

Program 4: Atari Number Game

Refer to the "Automatic Proofreader" article before typing this program in.

```
KB 10  W=1.5:POKE 559,0:GOSUB 420:W=1
       .3
IF 20  POKE 752,1:OPEN #1,4,4,"K:":PO
       KE 82,0:GOSUB 290
OH 30  GRAPHICS 3
II 40  ? "{CLEAR}":DL=PEEK(560)+256*P
       EEK(561)+4:POKE DL+21,70:SETCO
       LOR 3,4,8:SETCOLOR 2,0,0:POKE
       752,1
NE 50  FOR I=24 TO 26:POKE DL+I,6:NEX
       T I
LJ 60  R=INT(RND(1)*10)+48
PJ 70  IF R=OLD THEN 60
NG 80  OLD=R
KJ 90  Q=USR(1536,R,1,2,3)
NA 100 PRINT "{3 SPACES}Press this k
       ey."
DD 110 GET #1,A
MG 120 IF A=32 THEN GRAPHICS 0:END
KO 130 IF A<>R THEN SOUND 0,93,12,12
       :FOR I=1 TO 250:NEXT I:SOUND
       0,0,0,0:GOTO 110
KL 140 GOSUB 420
KO 150 GOSUB 170
DE 160 GOTO 40
DB 170 IF R=48 THEN RETURN
DP 180 COLOR 2:CO=1:X=1:Y=R-48
CJ 190 FOR I=X TO Y STEP CO
BI 200 PLOT I*4,15:PLOT I*4+1,15
BH 210 PLOT I*4,14:PLOT I*4+1,14
CH 220 SOUND 0,100-I*10,10,12
AN 230 FOR Q=1 TO 50:NEXT Q
CF 240 NEXT I:SOUND 0,0,0,0
GC 250 IF CO=-1 THEN RETURN
JH 260 FOR I=1 TO 600*(R-48):NEXT I
GK 270 CO=-1:COLOR 0:X=R-48:Y=1
GN 280 GOTO 190
FM 290 ? "{CLEAR}":POSITION 11,2:? "
       LEARN THE NUMBER":?
MB 300 ? "  THIS IS A PRE-SCHOOL NUM
       BER RECOGNI-  TION GAME. ";
MJ 310 ? "THE COMPUTER DISPLAYS A
       {6 SPACES}NUMBER AND YOU MUST
        FIND AND PRESS THAT KEY";
ID 320 ? " ON YOUR KEYBOARD."
EI 330 ? :? "  IF CORRECT, THAT NUMB
       ER OF BLOCKS IS"
CG 340 ? "DRAWN, AND YOU ARE GIVEN A
       NOTHER NUMBER.";
DG 350 ? "IF NOT CORRECT, THE COMPUT
       ER WILL ASK{3 SPACES}FOR ANOT
       HER ANSWER."
GC 360 ? :? "  TO STOP THE GAME, PRE
       SS THE SPACE BAR WHEN ASKED F
       OR AN ANSWER."
KC 370 POKE 559,34:IF PEEK(1536)=104
        THEN 400
LB 380 GOSUB 510
LJ 390 ? "{10 SPACES}ONE MOMENT PLEAS
       E."
HM 400 ? :? "{7 SPACES}HIT ANY KEY T
       O CONTINUE."
FA 410 GET #1,A:RETURN
LK 420 RESTORE
BA 430 FOR I=1 TO 8
CI 440 READ A:SOUND 0,A,10,10:SOUND
       1,A+5,10,10:SOUND 2,A-5,10,10
IL 450 FOR J=1 TO 75*W:NEXT J
HI 460 SOUND 0,0,0,0:SOUND 1,0,0,0:S
       OUND 2,0,0,0
IH 470 FOR J=1 TO 15*W:NEXT J
CE 480 NEXT I
HN 490 RETURN
LF 500 DATA 182,182,182,182,144,243,
       144,182
KE 510 ML=1536:FOR I=0 TO 252:READ A
       :POKE ML+I,A:NEXT I:RETURN
HG 520 DATA 104,240,10,201,4,240
OA 530 DATA 11,170,104,104,202,208
AF 540 DATA 251,169,253,76,164,246
BO 550 DATA 104,133,195,104,201,128
JO 560 DATA 144,4,41,127,198,195
JE 570 DATA 170,141,250,6,224,96
JO 580 DATA 176,15,169,64,224,32
JH 590 DATA 144,2,169,224,24,109
FB 600 DATA 250,6,141,250,6,104
LA 610 DATA 104,141,251,6,104,104
CH 620 DATA 141,252,6,14,252,6
LG 630 DATA 104,104,141,253,6,133
NE 640 DATA 186,166,87,169,10,224
CM 650 DATA 3,240,8,169,20,224
CK 660 DATA 5,240,2,169,40,133
AG 670 DATA 207,133,187,165,88,133
MI 680 DATA 203,165,89,133,204,32
DH 690 DATA 228,6,24,173,252,6
KL 700 DATA 101,203,133,203,144,2
OC 710 DATA 230,204,24,165,203,101
BE 720 DATA 212,133,203,165,204,101
LL 730 DATA 213,133,204,173,250,6
NG 740 DATA 133,187,169,8,133,186
JB 750 DATA 32,228,6,165,212,133
LJ 760 DATA 205,173,244,2,101,213
FL 770 DATA 133,206,160,0,162,8
MI 780 DATA 169,0,133,208,133,209
NI 790 DATA 177,205,69,195,72,104
CK 800 DATA 10,72,144,8,24,173
FN 810 DATA 251,6,5,208,133,208
PH 820 DATA 224,1,240,8,6,208
GN 830 DATA 38,209,6,208,38,209
PC 840 DATA 202,208,228,104,152,72
MA 850 DATA 160,0,165,209,145,203
CA 860 DATA 200,165,208,145,203,104
PG 870 DATA 168,24,165,203,101,207
LI 880 DATA 133,203,144,2,230,204
KC 890 DATA 200,192,8,208,183,96
FM 900 DATA 169,0,133,212,162,8
FK 910 DATA 70,186,144,3,24,101
BO 920 DATA 187,106,102,212,202,208
CI 930 DATA 243,133,213,96,0,1
CB 940 DATA 28
```

Program 5: Apple Number Game

```
10  FOR I = 1 TO 8: READ A: NEXT
20  DIM A(10,6): HOME : GOSUB 310
30  GR : COLOR= 1
40  HOME : PRINT  TAB( 13)"PRESS THI
    S KEY"
50 P =  INT ( RND (1) * 10): IF P =
    OLD THEN 50
60 OLD = P
70  GOSUB 450
```


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```
80  POKE  - 16368,0
90  IF  PEEK ( - 16384) < 128 THEN 90
100  GET A$
110  IF A$ = " " THEN  TEXT : HOME :
     END
120  IF P + 48 <  >  ASC (A$) THEN  FOR
     I = 1 TO 75:S =  PEEK ( - 16336
     ): NEXT : GOTO 80
130  GOSUB 540
140  GOTO 50
150  RESTORE
160  FOR I = 1 TO 8
170  READ F: POKE 769,F: POKE 768,5
180  CALL 770: NEXT I: RETURN
190  DATA  133,133,133,133,162,179,1
     62,133
200  FOR I = 0 TO 9: FOR J = 1 TO 6:
     READ B:A(I,J) = B: NEXT J,I: RETURN

210  DATA  60,102,110,118,102,60
220  DATA  24,56,24,24,24,126
230  DATA  60,102,12,24,48,126
240  DATA  126,12,24,12,102,60
250  DATA  12,28,60,108,126,12
260  DATA  126,96,124,6,102,60
270  DATA  60,96,124,102,102,60
280  DATA  126,6,12,24,48,48
290  DATA  60,102,60,102,102,60
300  DATA  60,102,62,6,12,56
310  PRINT : PRINT "              LEARN
     THE NUMBERS": PRINT
320  PRINT : PRINT "  THIS IS A PRE-
     SCHOOL NUMBER RECOGNI-  TION GA
     ME.";
330  PRINT "  THE COMPUTER DISPLAYS
     A     NUMBER, AND YOU MUST FIND
      AND PRESS THAT";
340  PRINT "KEY ON YOUR KEYBOARD."
350  PRINT : PRINT "  IF CORRECT, TH
     AT NUMBER OF BLOCKS IS  DRAWN,
     AND YOU ARE GIVEN ";
360  PRINT "ANOTHER NUMBER.IF NOT CO
     RRECT, THE COMPUTER WILL ASK
     YOU FOR ANOTHER ANSWER."
370  PRINT : PRINT "  TO STOP THE GA
     ME, PRESS THE SPACE BAR WHEN AS
     KED FOR AN ANSWER."
380  PRINT : PRINT  TAB( 11)"ONE MIN
     UTE PLEASE": GOSUB 200: GOSUB 6
     60
390  GOSUB 150
400  PRINT : PRINT : PRINT "
     HIT ANY KEY TO CONTINUE."
410  POKE  - 16368,0
420  IF  PEEK ( - 16384) < 128 THEN
     420
430  GET A$
440  RETURN
450 Q = Q + 1: IF Q > 15 THEN Q = 2
460  FOR I = 1 TO 6
470 X = A(P,I)
480  FOR J = 1 TO 8
490  COLOR= 0:X = X * 2
500  IF X > 255 THEN X = X - 256: COLOR=
     Q: POKE 768,1: POKE 769,X: CALL
     770
510  PLOT 16 + J,4 + I
520  NEXT J,I
530  RETURN
540  IF P = 0 THEN  RETURN
550 Q1 = 1:X = 1:X1 = 1:X2 = P
560  FOR I = X10 TO X2 STEP X
570 Q = Q + 1: IF Q = 16 THEN Q = 2
580  COLOR= Q * Q1
590  VLIN 30,33 AT I * 4 - 2: VLIN 3
     0,33 AT I * 4 - 1: VLIN 30,33 AT
     I * 4
600  POKE 768,5: POKE 769,I * 25: CALL
     770
610  NEXT I
620  IF Q1 = 0 THEN  RETURN
630  FOR I = 1 TO 700 * P: NEXT I
640 Q1 = 0:X =  - 1:X1 = P:X2 = 1
650  GOTO 560
660  FOR I = 770 TO 795: READ M: POKE
     I,M: NEXT I
670  DATA  172,01,03,174,01,03,169,0
     4,32,168,252,173,48,192,232,208
     ,253,136,208,239,206,0,03,208,2
     31,96
680  RETURN
```

Program 6: Color Computer Number Game

```
100 REM TITLE SCREEN
110 CLS 7:PRINT @231,"LEARN THE NUM
    BERS";:Y=2:GOSUB 370:CLS 1
120 PRINT:PRINT " THIS IS A PRE-SCH
    OOL NUMBER":PRINT " RECOGNITION
     GAME. THE COMPUTER":PRINT" DIS
    PLAYS A NUMBER AND YOU MUST"
130 PRINT" FIND AND PRESS THAT KEY
    ON":PRINT" ON YOUR KEYBOARD.":P
    RINT
140 PRINT " IF CORRECT, THAT NUMBER
     OF":PRINT" BLOCKS IS DRAWN AND
     YOU ARE":PRINT" GIVEN ANOTHER
    NUMBER. IF NOT"
150 PRINT " CORRECT, THE COMPUTER W
    ILL ASK":PRINT" YOU FOR ANOTHER
     ANSWER. TO":PRINT" STOP THE GA
    ME, PRESS THE SPACE";"
160 PRINT " BAR WHEN ASKED FOR AN A
    NSWER.":PRINT:PRINT "
    (4 SPACES)PRESS ANY KEY TO PLAY
    .";
170 A$=INKEY$:IFA$=""THEN 170 ELSE
    SOUND 225,1
180 REM PLAY THE GAME
190 CLS 3:PRINT @39,"LEARN THE NUMB
    ERS";
200 K=INT(RND(0)*10):IF K=TM THEN 2
    00 ELSE TM=K:GOSUB 400
210 PRINT @260,"PRESS THIS NUMBER .
    .. ";
220 A$=INKEY$:IF A$="" THEN 220
230 IF ASC(A$)=32 THEN CLS:END
240 IF ASC(A$)<48 OR ASC(A$)>57 THE
    N 220
250 PRINT @282,A$;
260 IF K<>ASC(A$)-48 THEN SOUND 20,
    10:GOTO 220
270 REM CORRECT ANSWER
280 Y=1:GOSUB 370:PRINT @363,STR$(K
    );:B$=" BLOCKS: ":IF K=1 THEN B
    $=" BLOCK: "
290 PRINT B$;:FOR I=1 TO 500:NEXT I
300 IF K=0 THEN 350
310 FOR I=1 TO K
320 V=RND(8):IF V=3 THEN 320
```


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