Programming Languages: Communicating With Your Computer

COMPUTE!

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The Leading Magazine Of Home, Educational, And Recreational Computing

Amiga's Amazing Graphics

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72 Inexpensive Packages For Commodore, Atari, Apple, Macintosh, IBM

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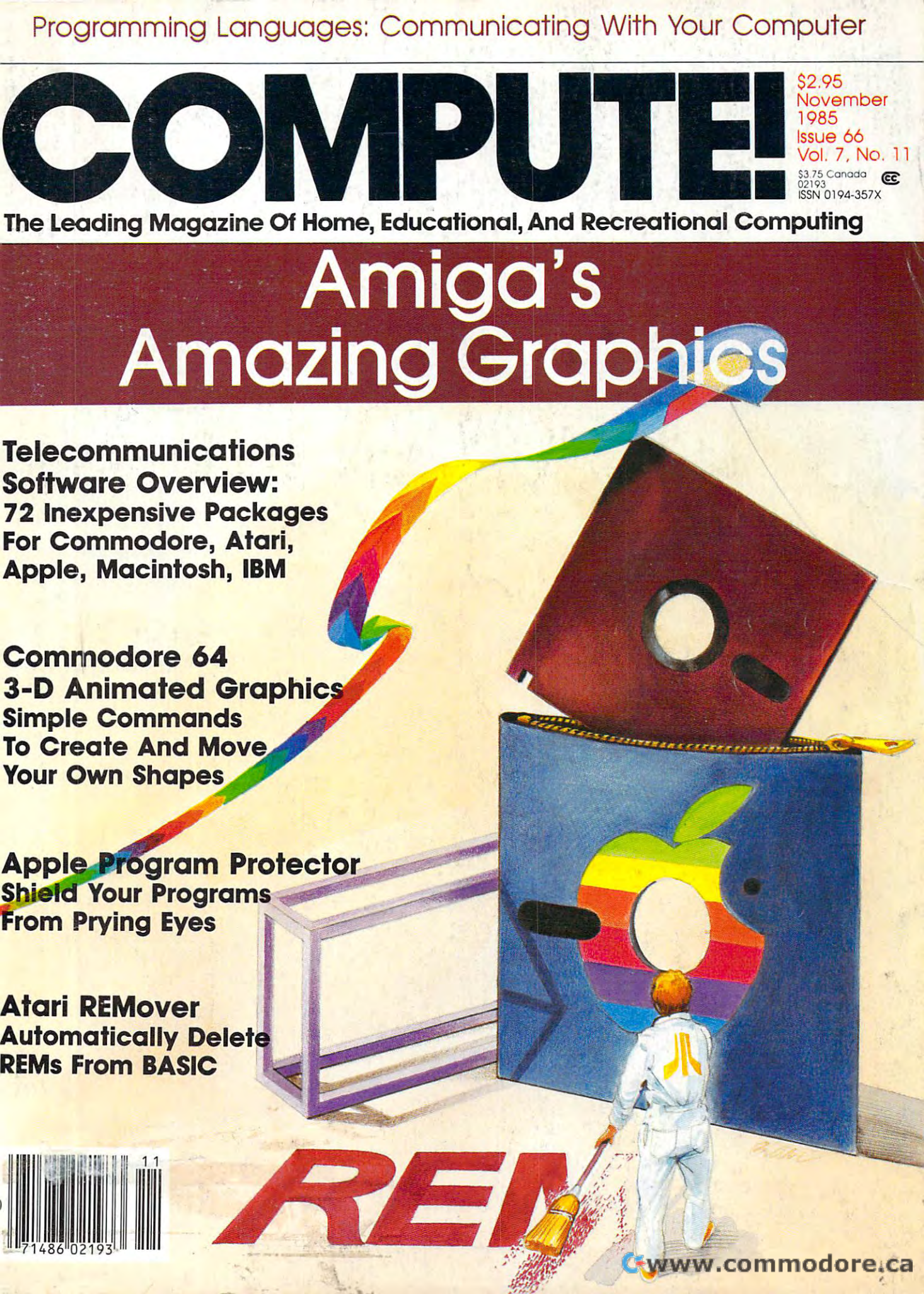

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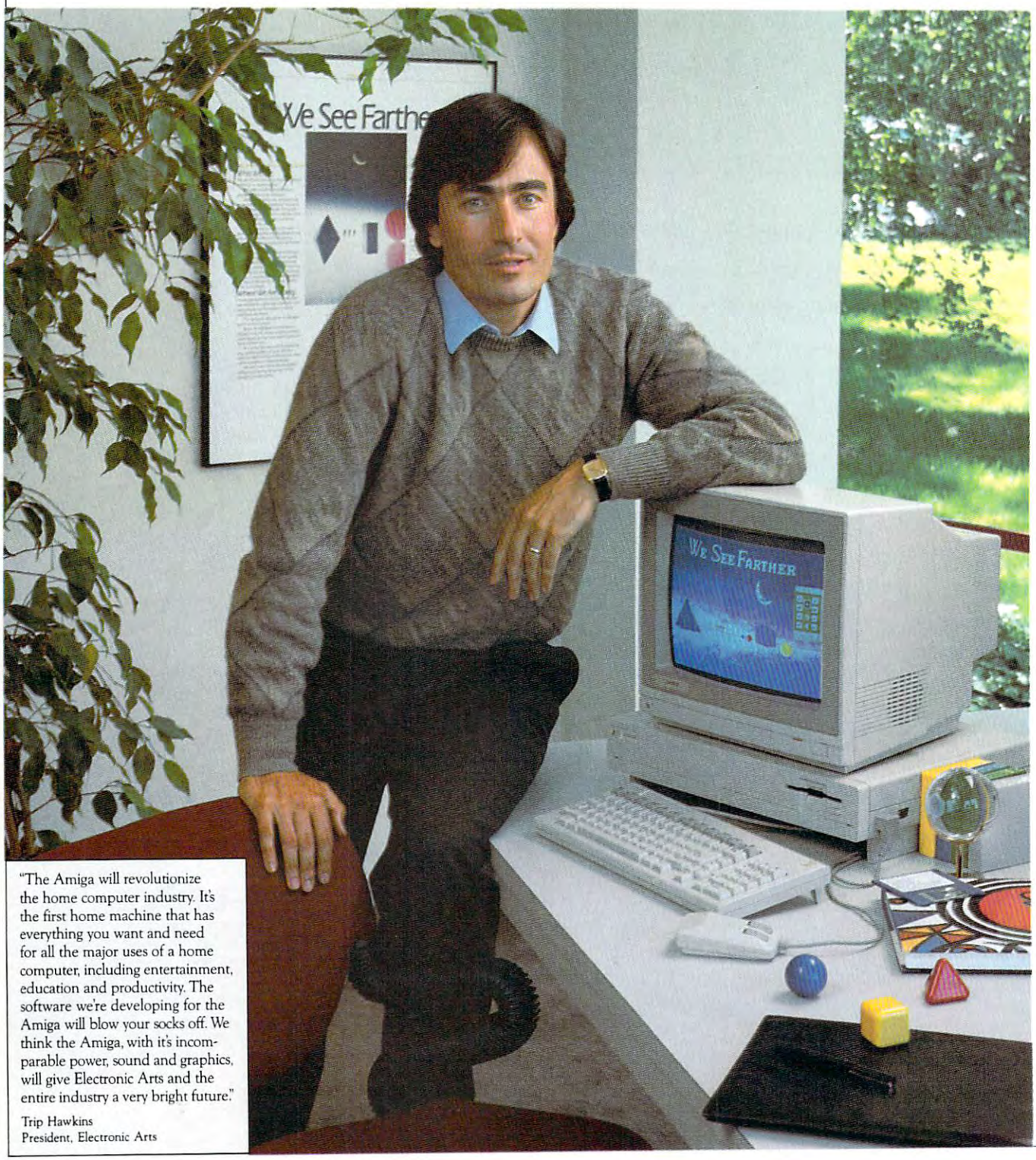
A message from a leading software publisher.

WHY ELECTRONIC ARTS



"The Amiga will revolutionize the home computer industry. It's the first home machine that has everything you want and need for all the major uses of a home computer, including entertainment, education and productivity. The software we're developing for the Amiga will blow your socks off. We think the Amiga, with it's incomparable power, sound and graphics, will give Electronic Arts and the entire industry a very bright future."

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President, Electronic Arts

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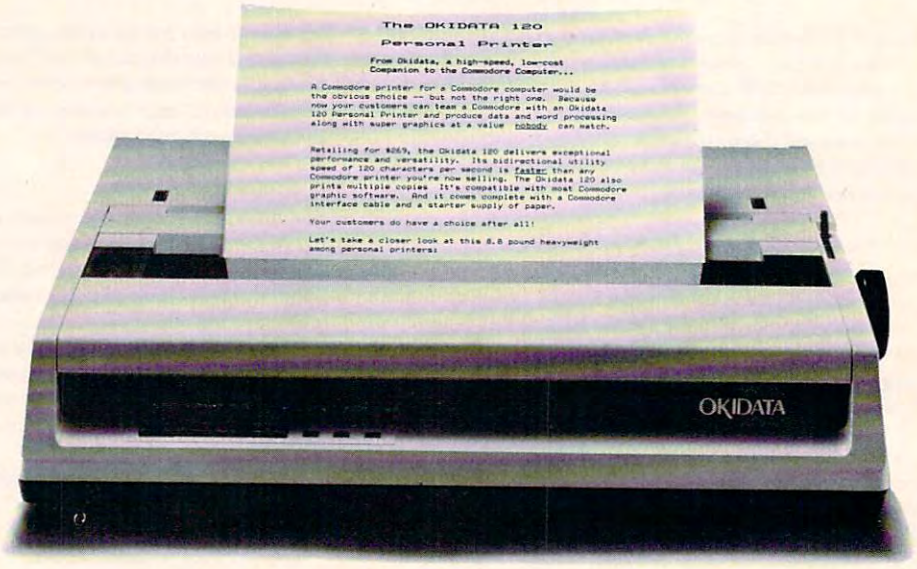
Left Brain.



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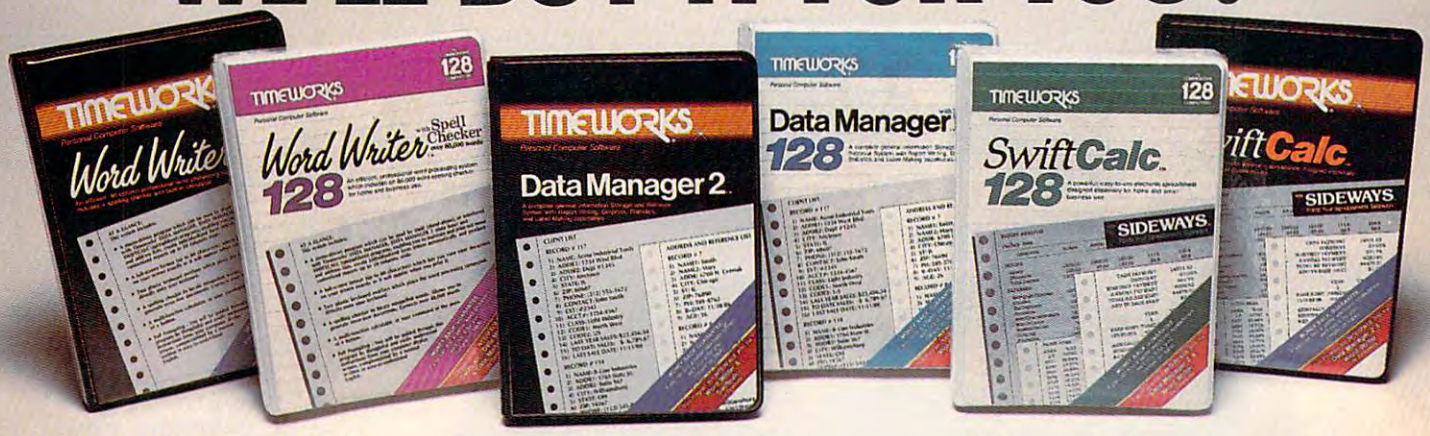

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NOTE: See page 139 before typing in programs.

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Editor's Notes

This month's Editor's Notes are written by Richard Mansfield, senior editor. We suggest that he does not mean to imply that "mouseketeers" are mousy; perhaps a rebuttal in the months ahead?

—Robert C. Lock, Editor in Chief

Ever since the Macintosh was introduced, the computing community has been debating about ease of learning versus ease of use: mice, menus, and icons are easy to learn, but typewriter keys, written commands, and control codes are often easier to use in the long run.

These two philosophies are represented rather neatly by two manufacturing giants, IBM and Apple. When you turn on an IBM, you are in the DOS environment. It's much like a programming language. There are dozens of words you can type which control the computer's behavior. Type DIR and you see a list of all the files on a disk. TIME will give you the time of day. CLS clears the screen. Beyond this, you can combine some of the commands: DIR > FILE sends a copy of the directory into a file named FILE. DIR | SORT will print a sorted directory. Essentially, you are given a rich language with which to communicate your particular instructions to your machine. But you pay a price for this richness—it takes longer to learn how to work with PC-DOS than it does to learn to use menu-driven systems like the Macintosh.

You may have seen the ads. A formidable tome crashes down next to a PC, graphically illustrating that running PC-DOS is a complicated affair. Then the Macintosh manual, light as a leaf, softly settles next to Apple's menu-driven computer. They're right, of course. You can be mousing around with the Macintosh within minutes, effortlessly deleting files, sorting directories, and activating applications programs.

Atari has chosen to configure its new ST computer quite like the Macintosh. The familiar elements are all in place. The ST displays icons (pictorial representations) so you can tell at a glance when something's a data file. It will look like a tablet with the edges of the pages turned up. On an IBM, by contrast, you must learn that filename extensions like .EXE or .COM signify a program that can be run. Extensions like .DOC indicate a data or text file.

On the IBM, you delete a file by typing DEL NAME. On the ST, it's a bit difficult to describe. You use the mouse controller to move a pointer on the screen to open a disk directory. Then you move the mouse to the target filename and click the mouse, highlighting the name. Then you click the mouse again and drag a picture of the filename until it's on top of a picture of a trash can. A warning window opens and asks you if you, in fact, *do* want to delete the file. You must either click the mouse in a box labeled CANCEL or in another box labeled OK. During this process, you must be able to *see* the filename and the trash can. Thus, if something is covered up, you must move it to some available space on the screen before you can access it. This can add steps to the above process. You might need to make some windows smaller or move them to a different part of the screen.

It sounds pretty intimidating, but skilled mouseketeers can fly around the screen, popping windows open and closed at quite a clip. You do need a fair amount of clear desk space to the side of the computer where you might otherwise have a book. But, one of the ideas behind windows, icons, and mice is that you won't need a book. Everything is on screen: windows covering older windows, menus popping out of other menus, "dialog" boxes appearing on top of menus. Your desktop is clean (for the mouse), but your screen can get pretty busy.

Although early STs are currently being shipped without software or documentation offering an alternative to the mouse environment, there is a command program which allows you to talk to the ST directly in the IBM style. In this mode, you can list a directory with the simple command LS. And you can quickly see everything in any data file via TYPE NAME. It's too early to tell whether or not this facility will be made part of the ultimate ST package. But that is the solution to the debate: offer both styles. For people who prefer not to type, offer mice. For people who don't like mice, offer command control. For people who prefer words like DEL, offer text-only screens. For people who prefer pictures, offer the trash can illustration.

Similarly, when you go to buy a word processor, one of the major factors in your decision will be whether you want a menu-driven or control-code-driven package. For example, some software pops up with a menu every time you want to change the margin: 1. Indent? 2. Flush right? 3. Single line? and you type the number signifying your choice. Additional menus might then appear asking how much you want to indent. Conversely, control-code style software requires that you memorize a pattern. To indent ten spaces, you might type CONTROL-I 10. This is a lot faster than responding to menus, but it is harder to learn and remember. If you indent often and are a good typist, however, you will likely prefer the efficiency of control codes. For one thing, your fingers don't leave the keyboard so commands to the word processor don't require that you look at the keys.

The best software offers the user a choice of either menus or control codes. Perhaps the best computers will offer optional mice, windows, and icons, but will provide a command-driven mode as well. When both styles are available, we can have the best of worlds.

Senior Editor

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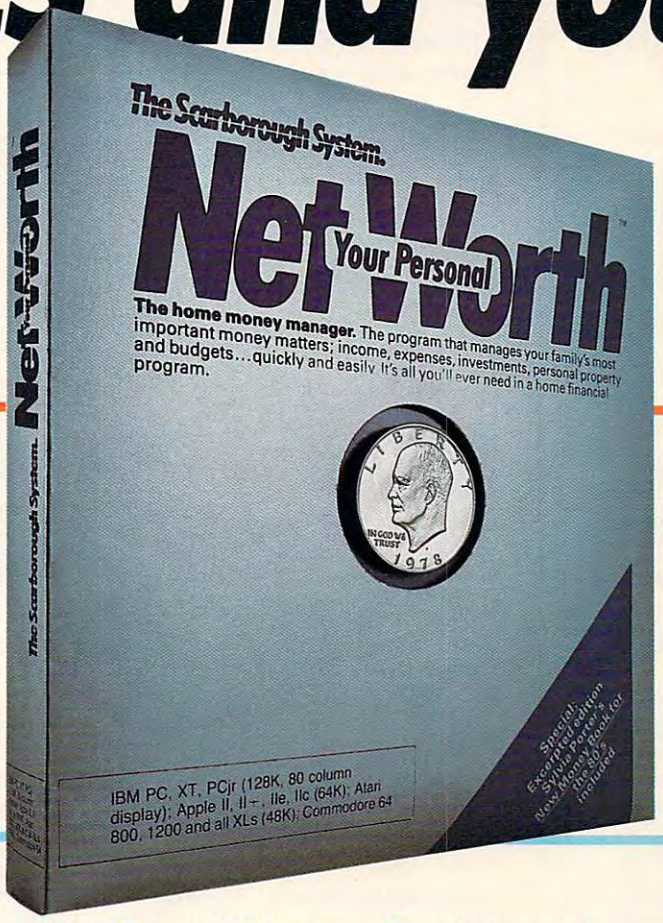

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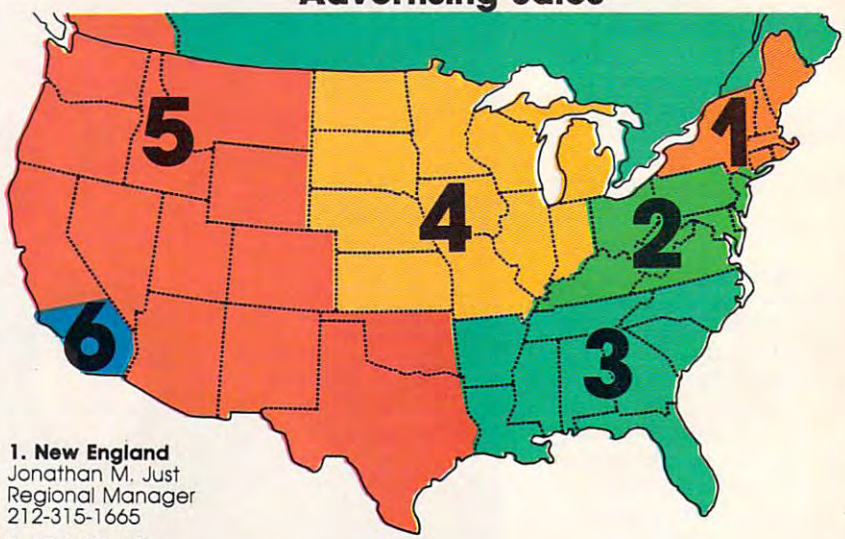

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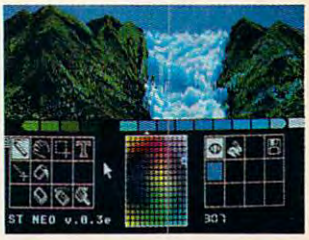

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If you have any questions, comments, or suggestions you would like to see addressed in this column, write to "Readers' Feedback," COMPUTE!, P.O. Box 5406, Greensboro, NC 27403. Due to the volume of mail we receive, we regret that we cannot provide personal answers to technical questions.

Falling Through Trapdoors

I have a question about the placement of NEXT in a program. After typing in "Devastator" (COMPUTE!, August 1984) I made a few changes. In lines 1293–1294 (shown here) I tried moving the NEXT from line 1294 to the end of 1293. But now the program doesn't erase text the way it should. I thought it wouldn't make any difference which line the NEXT was on. Can you explain?

```
1293 FORT=1024TO1400:IF PEEK(T
     )<160THEN POKE T,32
1294 NEXT:GOSUB1300
```

Alfred Glasser, Jr.

The answer to your question applies to virtually every computer with BASIC. When the computer finds an IF statement, it immediately tests the expression after IF to determine whether it's true or false. If the expression is true, the computer performs whatever comes after THEN on that line. If the expression is false, the computer ignores everything after THEN and goes directly to the next program line. When an IF test proves false, it's as though a trapdoor opens at THEN. The computer immediately falls through *(proceeds) to the next program line and performs what it finds there.*

The lines shown here test screen memory locations 1024–1400. In plain English the part before GOSUB 1300 means "Check every location from 1024 to 1400. If a location doesn't contain a reverse space character (160), replace it with a blank (32). Otherwise ignore it." If the expression PEEK(T)<160 is true, the computer executes POKE T,32 before going to NEXT in line 1294. If the expression is false—if the location contains a reverse space—the computer skips the part after THEN and immediately falls through to 1294. Note that NEXT is always performed whether the IF statement is true or false. Moving NEXT to the end of 1293 causes it to be executed only when the IF test is true—clearly not what the programmer intended.

Because the computer falls through an IF-THEN statement when the test proves false, be careful what you add to IF lines. Don't add statements to the end of the line unless you want them to be performed only when the IF test is true. For similar reasons you shouldn't put anything on the same line after a GOTO statement (which immediately sends the computer somewhere else in the program). These two lines demonstrate the error: The GOTO in line 10 prevents NEVER from being printed.

```
10 GOTO 20:PRINT "NEVER"
20 PRINT "ALWAYS"
```

Atari Disk Speedup

I have a solution for Duyen Nguyen, who asked for a way to speed up his Atari disk drive ("Readers' Feedback," July 1985). Enter POKE 1913,80 to disable the verify function. Your drive will run faster.

Jim Noland

Thanks for pointing this out. This POKE dramatically speeds up write operations and has been widely used by Atari owners for years. In fact, some Disk Operating Systems, such as OS/A+ and DOS XL, incorporate this modification by default. The POKE works by modifying DOS to turn off the write-with-verify function. Normally, location 1913 contains the value 87, which tells DOS to verify each sector as it is written. This assures an error-free SAVE but also slows things down considerably. Disabling this function with POKE 1913,80 can make a noticeable difference. Although you might expect the modification to increase the likelihood of errors, in practice this is extremely rare. Atari programmers at COMPUTE! *have been using this technique for many years without problems.*

To save yourself the trouble of performing this POKE each time you boot your system, you can save the modified DOS on disk. After entering the POKE, type DOS. When the DOS menu appears, select option H, "Write DOS Files."

The new Atari DOS 2.5 disables write-with-verify by default. It also lets you change this function without making any POKEs. Simply run the DOS 2.5 utility file SETUP.COM and select the option "Change System Configuration." This is safer than POKEing around in DOS, because a mistyped POKE command could mess up something.

ProDOS Date And Time

I have numerous books covering my Apple IIc and the ProDOS operating system, but nowhere have I been able to find out how to set the ProDOS date and time. Can you help me with this?

Stanley Moody

ProDOS keeps information about the current date and time in its System Global Page, a 256-byte block of memory starting at location 48896 ($BF00). On an Apple IIe this information can be updated by a clock card. The Apple IIe User's Disk also has a utility to let you set these locations. The following program permits you to set date and time on the IIc.

```
99 10 REM SET TIME AND DATE
95 20 PRINT "TODAY'S DATE (MM/DD
      /YY) ->";: INPUT D$
0C 30 IF LEN (D$) < > 8 THEN GOS
      UB 1000: GOTO 20
2A 40 Y = VAL ( MID$ (D$,7)) * 2
      :M = VAL ( MID$ (D$,1,2)):
       IF M > 12 THEN GOSUB 1000
      : GOTO 20
68 50 IF M > 7 THEN Y = Y + 1:M
      = M - 8
B3 55 D = VAL ( MID$ (D$,4,2)):
      IF D > 31 THEN GOSUB 1000:
       GOTO 20
BC 60 D = D + M * 32
92 70 POKE 49041,Y: POKE 49040,D
19 80 PRINT "TIME TO STAMP ON FI
      LES (HH/MM) ->";: INPUT T$
C9 90 IF LEN (T$) < > 5 THEN GOS
      UB 1010: GOTO 80
4D 100 H = VAL ( MID$ (T$,1,2)):
        IF H > 24 THEN GOSUB 101
      0: GOTO 80
EF 110 M = VAL ( MID$ (T$,4,2)):
        IF M > 59 THEN GOSUB 101
      0: GOTO 80
CD 120 POKE 49043,H: POKE 49042,
      M
8F 130 END
CD 1000 PRINT "BAD FORMAT FOR DA
      TE": RETURN
D2 1010 PRINT "BAD FORMAT FOR TI
      ME": RETURN
```

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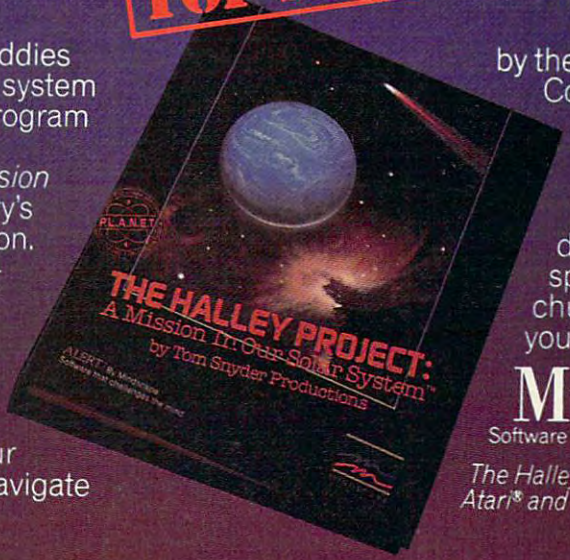

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Hi-Res Characters On The 64

I have written a program that draws charts and graphs on the Commodore 64's high-resolution screen, but have trouble putting numbers and letters on the screen. Plotting every character pixel by pixel takes much too long. Is there any easy way to do this?

Sean Wood

One solution is to copy the character definitions directly from the ROM (Read Only Memory) character set into the bitmap. The following program demonstrates the technique. Lines 10–30 enter hi-res mode, lines 100–180 contain the character plotting routine, and line 40 shows how to call the routine. Define the message you want to print as A$. Variables X and Y determine the row and column where printing begins. Keep X within the range 0–39 and Y in the range 0–24. DX controls the direction of printing. If DX=1, the string prints from left to right; if DX=40, it prints from top to bottom. Other values can be used to print diagonally, from bottom to top, and so on. BK and CH set the background color and character color, respectively. After these variables are defined, GOSUB 100 puts the string on the screen.

Another solution is to look up the article "64 Multicolor Graphics Made Easy" in the October issue of COMPUTE!. *It includes a program called "Color Plotter 64" that adds 14 commands to Commodore BASIC for drawing multicolor hi-res graphics and text.*

```
10 POKE53265,PEEK(53265)OR32
20 POKE 53272,PEEK(53272)OR8:P
   RINT"{CLR}"
30 BASE=8192:FORA=BASETOBASE+8
   192:POKEA,0:NEXT:REM CLEAR
   {SPACE}HIRES SCREEN
40 A$="ABCDEFGHIJKLMNOPQRSTUVW
   XYZ1234567890":X=0:Y=0:DX=1
   :BK=1:CH=6:GOSUB100
50 WAIT198,1:POKE53272,21:POKE
   53265,27:PRINT"{CLR}":END
100 S=X*8+Y*320+BASE:D=1024+X+
    40*Y
110 FOR A=1 TO LEN(A$):B=ASC(M
    ID$(A$,A,1))
120 IF B>63 AND B<96 THEN B=B-
    64:GOTO 140
130 IF B>95 THEN B=B-32
140 C=B*8+53248:POKE56334,0:PO
    KE1,51:POKED,BK+16*CH
150 FORQ=0TO7:POKES+Q,PEEK(C+Q
    ):NEXT
160 POKE1,55:POKE56334,1
170 S=S+DX*8:D=D+DX:NEXT
180 RETURN
```

Commodore Screen Splitting

Is there any way to split the Commodore 64's screen between multicolor bitmapping on the top and uppercase text on the bottom?

Brian Sullivan

The picture on your TV or monitor is composed of many horizontal lines called raster lines. *The 64 permits you to set up an interrupt at any raster line. When the computer reaches that line, it stops what it's doing and performs a special machine language routine (which you must have prepared in advance). This technique, known as raster interrupt programming, is covered thoroughly in* COMPUTE!'s First Book Of Commodore 64 *and* Mapping The 64. *Here's a program that puts a multicolor bitmap display at the top of the screen and uppercase text at the bottom. POKE location 2 with the number of the raster line where you want the change to occur (only lines 50–249 are visible on the screen).*

```
10 FORA=828TO913:READB:POKEA,B
   :C=C+B:NEXT:IFC<>9673THENPR
   INT"{CLR}DATA ERROR":STOP
15 SYS828
20 DATA 120,169,88,141,20,3,16
   9,3,141,21
30 DATA 3,169,1,141,26,208,169
   ,27,141,17
40 DATA 208,88,169,127,141,13,
   220,96,169,1
50 DATA 141,25,208,162,59,160,
   216,173,18,208
60 DATA 197,2,176,9,169,29,141
   ,24,208,165
70 DATA 2,208,11,162,27,160,20
   0,169,21,141
80 DATA 24,208,169,0,142,17,20
   8,140,22,208
90 DATA 141,18,208,173,13,220,
   41,1,240,3
100 DATA 76,49,234,76,188,254
```

Commodore Countdown

I am writing a Commodore program and want to add a timer that counts down in minutes and seconds. My problem is that when the timer reaches 0 it flips to 99 instead of 59. Can you help?

Chaiyos Gosolsatit

*In many cases it's easiest to treat time as seconds rather than minutes and seconds. Then you have only one number to worry about. When you need to display the time, convert the number of seconds into appropriate minute and second values. For instance, if TM represents the number of seconds, the statements MN=INT (TM/60) and SE=TM−60*INT (TM/60) calculate the minutes and seconds, respectively.*

The following routine demonstrates a simple countdown timer that should work on any Commodore computer. Line 10 sets the computer's internal clock to 000000. The reserved variable TI$ returns the time (in hours/minutes/seconds format) elapsed since reset. As shown, the example provides a countdown of three minutes (180 seconds). To modify this, change the value of SS (line 10) to the desired number of seconds.

```
10 TI$="000000":SS=180
20 T$=TI$:TM=SS-(VAL(MID$(T$,3
   ,2))*60+VAL(MID$(T$,5,2)))
30 MN=INT(TM/60):SE=TM-MN*60
40 PRINT"{HOME}"MN"{LEFT}"SE"
   {LEFT} ":GOTO20
```

Atari Cartridge Dilemma Solved

Like many other Atari owners, after suffering from the bugs in revision B BASIC, I ordered the new revision C BASIC cartridge for my 800XL. However, with the BASIC cartridge in place I can't use the *Monkey Wrench II* cartridge (a useful BASIC editing aid). My solution is this program, which copies the old BASIC from ROM into underlying RAM with a fast machine language routine, then changes rev B into rev C (only 12 bytes are different). This program runs so fast that it's almost as convenient as plugging in a cartridge, and now I can use my editing cartridge along with the new BASIC. Pressing RESET switches ROM BASIC back in; enter POKE 54017,255 to go back to rev C BASIC in RAM.

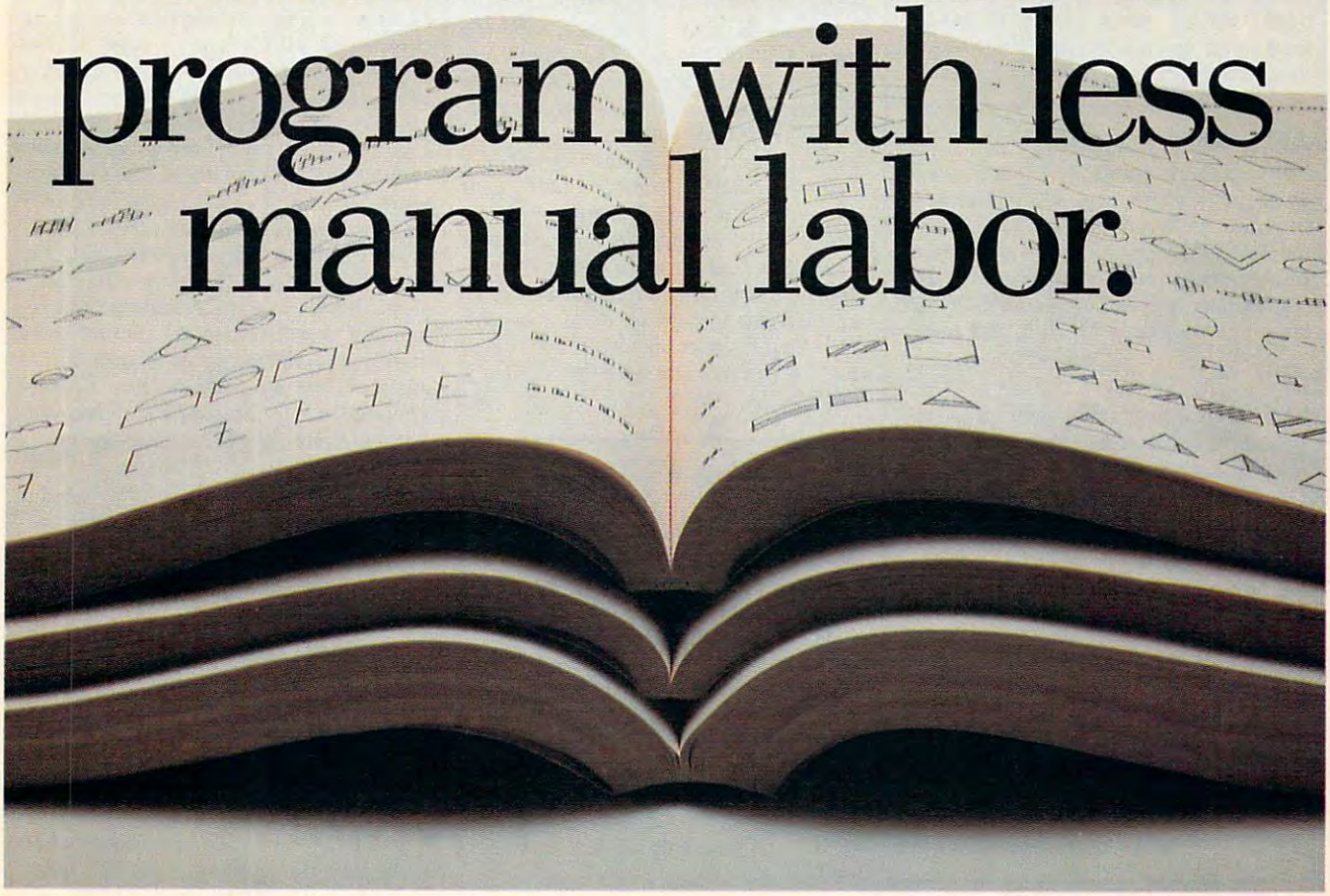
```
1 FOR I=0 TO 43:READ A:PO
  KE 16384+I,A:NEXT I:A=U
  SR(16384)
2 DATA 104,169,0,133,203,
  169,160,133,204,162,32,
  160,0,177,203,72
3 DATA 169,255,141,1,211,
  104,145,203,169,253,141
  ,1,211,136,208,237
4 DATA 230,204,202,48,6,2
  08,230,160,0,208,226,96
5 FOR J=1 TO 13:READ A,B:
  POKE A,B:NEXT J
6 DATA 54017,255,43231,23
  4,43232,240,43233,17
7 DATA 43234,234,47913,0,
  49139,0,49140,0,49141,0
8 DATA 49142,0,49143,0,49
  144,0,49145,0
9 PRINT "BASIC VERSION C
  ACTIVATED":PRINT "POKE
  54017,255 TO REACTIVATE
  "
```

Gregory Latta

Thanks for the program, which should prove useful to Atari owners who wish to use other cartridges with the new BASIC. The revision B bugs, found in the BASIC built into the 600XL and 800XL, are familiar to many Atari users by now. See Bill Wilkinson's "INSIGHT: Atari" column in June 1985 COMPUTE! *for a demonstration of the bug that mangles strings. To demonstrate the bug that adds 16 bytes to a program when you load it, run the program above, then enter POKE 54017,253 (or press RESET) to switch the ROM BASIC back in. Now type in and run the following program (a disk drive is required):*

```
1 ? "PROGRAM ENDS AT ";PE
  EK(140)+256*PEEK(141):?
   "# OF BYTES FREE ";FRE
  (0)
```

Choose the SAT program with less manual labor.



The idea behind choosing a computerized SAT program over a manual is to save you from piles of paperwork. But surprisingly, two of the best-known programs come with big, fat manuals and only 2 or 3 double-sided disks.

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Why not buy a computer program that's really a computer program? Buy The Perfect Score from Mindscape for just $69.95.*

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Now, if this cold logic fails to convince you, perhaps an emotional appeal to your sense of patriotism and social consciousness will. Your choice is this. Either you buy their SAT, which kills innocent trees to make all that paper. Or you buy our SAT with 6 disks and Save America's Trees.

The Perfect Score, $69.95, from Mindscape

MINDSCAPE INC

*Suggested retail price. Available for Apple, Commodore 64 and IBM. The Perfect Score: Computer Preparation for the SAT. © 1984 Mindscape, Inc. All rights reserved.

```
2 SAVE "D:EXPANDER":IF PE
  EK(53279)<>6 THEN RUN "
  D:EXPANDER"
```

The program saves, reloads and runs itself over and over, growing 16 bytes longer every time when rev B BASIC is present. Press the START key when you've seen enough. Now enter POKE 54017,255 (to switch in rev C BASIC), then run it again to confirm that it saves and reloads without changing in size.

Atari ML Addresses

I own an Atari 800XL and was interested in the "Commodore ML Addresses" program in "Readers' Feedback," September 1985. Do you have a program for Atari computers that finds the starting and ending addresses of machine language programs on disk and tape?

Adam Mercadante

This program prints the starting and ending addresses of most machine language files. Be sure to include the C: prefix (for tape) or D: prefix (for disk) when entering the filename.

```
10 DIM A$(14)
20 PRINT "ENTER FILENAME
   (INCLUDE C: OR D:)":IN
   PUT A$
30 OPEN #1,4,0,A$:GET #1,
   A:GET #1,A
40 GET #1,SLB:GET #1,SHB
50 GET #1,ELB:GET #1,EHB
60 PRINT "START ADDRESS =
   ";SLB+256*SHB
70 PRINT "  END ADDRESS =
   ";ELB+256*EHB
80 CLOSE #1
```

IBM Compatible Coverage

Now that the PCjr has died, I begin to worry anew about what little support and information has been forthcoming for the IBM-compatible home computers. (I define that as an MS-DOS-based 8088 chip computer which can be purchased for less than an Apple IIe system.) So far I have been able to run all the PCjr programs in COMPUTE! on my Tandy 1000. And all the programs in your book *Easy BASIC Programs for the IBM PC and PCjr* run beautifully on my Tandy. I recently bought your machine language book for the PCjr and have not run into problems yet. But now I fear for the future of those books; you might be tempted to pull them off the shelves before they even become available. Please don't. I appeal to your business sense to broaden the spectrum of your coverage and pay some attention to the market so strikingly similar to the IBM market you already cover. Why not change your PCjr coverage into PC/MS-DOS coverage? This surely requires only a minimum of effort and I think it will pay off.

Christopher L. Herd

Our home-oriented IBM coverage in COMPUTE! *already is directed toward compatibles as well as both the PC and PCjr. If your "IBM-compatible" computer is truly compatible, it should run the programs we publish for the PC and PCjr without modifications—as your experience with the Tandy 1000 bears out. The Tandy has proven to be highly compatible with IBM computers. But not all so-called compatibles are created equal. If a program doesn't run, there's almost certainly a slight compatibility problem with your computer, BASIC, or DOS. Since there are dozens of IBM compatibles on the market, it isn't practical for us to test every program on every system. Instead, we design the programs to work on what is considered the common denominator in the IBM-compatible world—the IBM PC itself.*

Commodore ML Keyboard Input

I'm writing a Commodore 64 machine language program that requires input from the keyboard to be printed on the screen. Neither the CHRIN routine ($FFCF) nor GETIN ($FFE4) seem to work properly, and after several weeks of work I'm stumped. The bug in question occurs only when I call the CHROUT routine with JSR $FFD2. When I JSR to $F1CA (the address $FFD2 jumps to), my program works fine. What's the difference between calling CHROUT at $F1CA instead of $FFD2?

Jerry Ford

Under normal circumstances it makes no difference which address you use. Since the Kernal call at $FFD2 simply performs JMP ($0326) to get to $F1CA, the result is the same unless you've disturbed the vector at $0326–0327. We can't debug your program without seeing the code, but you should know that CHRIN and GETIN handle keyboard input quite differently. Here are two brief examples that do the job you describe and show how the two routines differ. You'll need a machine language assembler to type them in (the comments are optional).

```
        LDX #0          ;Set counter
        STX TEMP        ;at zero.
LINE    JSR $FFCF       ;Input line/char.
        CMP #13         ;RETURN
                        character
        BEQ EXIT        ;terminates.
STORE   LDX TEMP        ;Get counter.
        STA BUFFER,X    ;Store char.
        INC TEMP        ;Bump counter.
        BNE LINE        ;Always branch.
EXIT    RTS
TEMP    .BYTE 0
BUFFER  = *
```

This routine puts the input string in memory starting at BUFFER and records its length in the variable TEMP. The code may look confusing unless you understand that CHRIN performs two different functions depending on when it's called. The first time you call CHRIN, the computer simply lets you enter a logical line (up to two screen lines). It displays a blinking cursor and allows you to type on the screen, waiting until you press RETURN. When CHRIN terminates, the accumulator holds the first character from the input line. At this point, the routine falls through to STORE to put the first character in BUFFER. BNE LINE goes back to do another JSR $FFCF, but this time CHRIN doesn't input a line. Instead it puts the second character in the accumulator. Subsequent calls to CHRIN retrieve the remaining characters, so the routine keeps storing and branching back until a carriage return appears. Calling CHRIN after the whole input line has been retrieved starts the process over again.

```
        LDX #0
        STX TEMP
GETIT   JSR $FFE4       ;Get character.
        BEQ GETIT       ;Ignore nulls.
        CMP #13
        BEQ EXIT
        JSR $FFD2
        LDX TEMP
        STA BUF-
        FER,X
        INC TEMP
        BNE GETIT
EXIT    RTS
TEMP    .BYTE 0
BUFFER  = *
```

GETIN does nothing but pull a character from the keyboard buffer and return it in the accumulator. Thus, if you want a cursor or editing keys, your program must provide them (we don't have space for a complete example here).

At first, CHRIN seems more useful than GETIN because it provides so many features (cursor, editing keys, etc.) automatically. But you pay a price for all that convenience. The first call to CHRIN traps you in the ROM routine until RETURN is pressed. If you type only what the program expects, all is well. But there's nothing to prevent a user from moving the cursor to the wrong line, clearing or scrolling the screen, typing graphics garbage rather than letters, or wreaking other sorts of havoc. To avoid such problems, it's often preferable to write a custom input routine with GETIN, adding code to handle editing keys, screening out unwanted characters, and displaying a cursor. The commented source code in SpeedScript: The Word Processor for the Commodore 64 and VIC-20 *(published by* COMPUTE! *Books) includes two fairly elaborate keyboard routines built around GETIN.* ©

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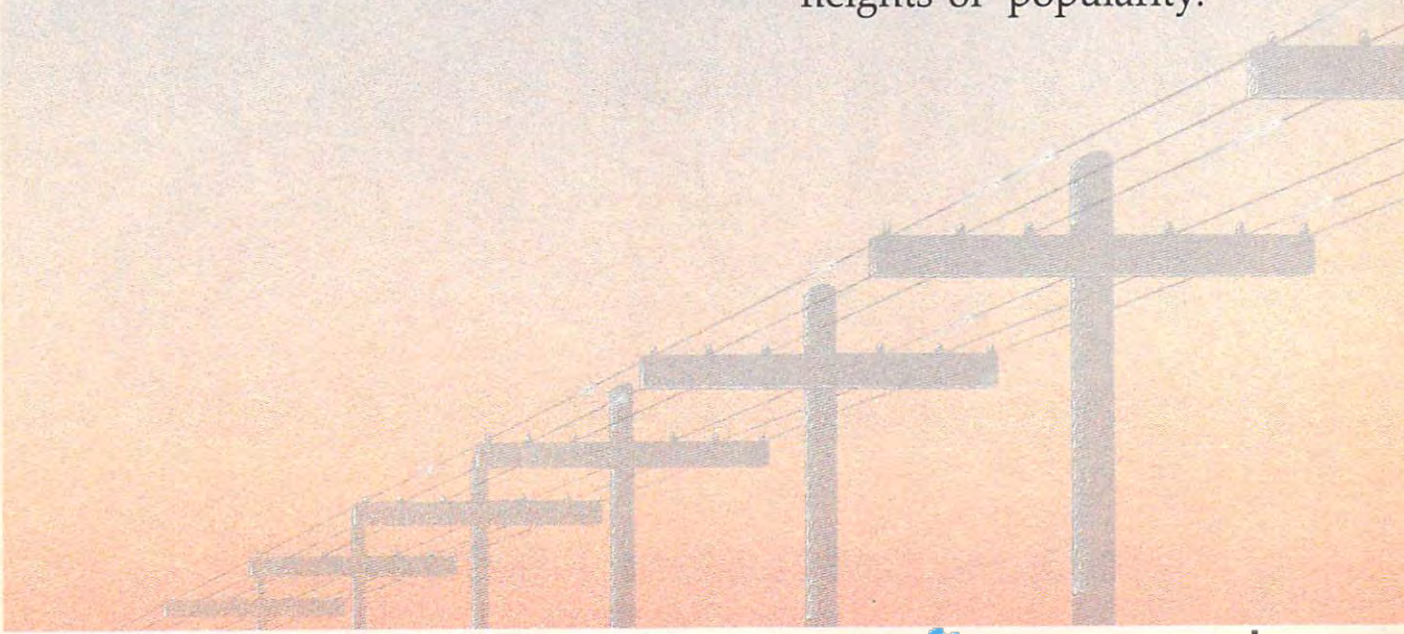
Trends in Telecomputing

If you're a telecomputing enthusiast, how would you like to dial all the long-distance calls you want for only a modest monthly fee? Or access an online information service with color graphics for pennies a day? These and similar experiments may soon boost personal telecomputing to new heights of popularity.



Selby Bateman, Features Editor

Many companies are betting that telecommunications holds the key to the future of personal computing. Some of these companies are now experimenting with innovative ideas and lower prices.

For example, when you log onto an electronic bulletin board or online information service, minutes have traditionally been measured in dollars and cents. In effect, a meter is running for every moment you spend on the long-distance telephone line or carrier systems such as Telenet, Tymnet, and Uninet.

But now one of those carriers, GTE Telenet, is experimenting in a dozen major cities with a system that could drastically change the telecomputing landscape. For the first time, people in those cities will be able to call bulletin boards, other computer users, and noncommercial databases over the Telenet system for a flat monthly fee of $25. Without flat-rate billing, many telecomputing fans can amass $25 in charges in just one evening. The new service is called PC Pursuit.

There are limits to this experiment, however. PC Pursuit is available only during evenings and weekends, and cannot be used to access the commercial online services which have direct links with Telenet, such as CompuServe, The Source, Dow Jones, and others. Those systems have their own hourly rates which include access through Telenet and other long-distance carriers.

Still, PC Pursuit is a significant development for those who frequently call local bulletin boards and fellow computerists. The experiment is now under way in Atlanta, Boston, Chicago, Dallas, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, San Francisco, and Washington, D.C. Whether or not PC Pursuit expands into a national service depends on how much interest is generated.

Measuring Demand

"We've seen this as a need, but whether the potential market is great enough, we weren't sure—we still aren't totally sure," says Claudia Houston, a GTE Telenet spokesperson. "We're the first ones to have done this, so there's no proof."

Telenet's primary business is not the evening and weekend access which it makes available to consumers, Houston says. "The reason we're able to offer a rate like this is because we have the Telenet data network in place, a major value-added network service supplying business customers during the day. We're able to handle a billion packets of data a month, equivalent to about 28 million typed pages. So when business closes up at the end of the day, there's plenty of room for other uses."

To use PC Pursuit, you first call the local Telenet number, then enter your name and phone number. Next you enter the name of the city you're calling and the phone number, then hang up. PC Pursuit makes the contacts and calls you back with the connection already established. The service prevents illegal use of the long-distance network for voice connection. Each month, PC Pursuit customers are billed automatically on their Visa or MasterCard accounts.

GTE Telenet is eager to hear

from people who are interested in PC Pursuit, even if you don't live in one of the 12 cities involved in the experiment. A toll-free bulletin board has been set up to distribute more information, and you can also leave a private message about PC Pursuit for Telenet's ongoing market research. The bulletin board number is 1-800-835-3001. For voice phone inquiries between 8 a.m. and 5 p.m. Eastern time, call 1-800-368-4215.

If PC Pursuit catches on, it can be easily extended to other metropolitan areas, Houston adds. In one form or another, the idea behind PC Pursuit will eventually be established, agree observers: easier, cheaper access for nonbusiness personal telecomputing.

The Quantum Connection

People who use computers at home are beginning to wake up to the possibilities of telecommunications, says Owen Davies, co-editor of *The Omni Online Database Directory,* an annual compendium of more than a thousand electronic databases. Business people may now make up the bulk of the traffic, but individuals are finding new applications almost every day. Davies, who closely watches the telecomputing field, has seen plenty of growth during the past year: new online databases in many different areas of interest, easier access for home users, and telecomputing software that's simpler to learn.

Another innovative experiment is QuantumLink, a new telecommunications network to be operated jointly by Commodore International and Control Video Corporation. The official launch date for QuantumLink was scheduled for October 1, although testing has been going on for several months.

"What we'll be doing, initially for the Commodore 64 and 128, is offering a set of services, mostly on a flat-fee basis for $9.95 a month," says Stephen Case, vice president of marketing for Quantum Computer Services. QuantumLink's offerings will include previews of commercial software that can be downloaded, bulletin boards, a computer information center, news, teleshopping, and interactive telegaming with full-color graphics, says Case. "The $9.95 a month includes communications charges for some of the services—like the encyclopedia, for example. You can use it [Grolier's *American Academic Encyclopedia*] all you want and there's no extra charge."

Some services, such as software downloading and the Chat feature—an interactive online conversation—cost an extra six cents a minute. QuantumLink can be accessed through the Uninet carrier network.

Computer owners who register for QuantumLink before the end of 1985 will get Quantum's special terminal software without charge plus a free month of access. After January 1, the signup fee will be $25, says Case. The special software is necessary because QuantumLink has a graphics interface similar to that of the Macintosh, and telegames such as chess, backgammon, and hangman—which feature full-color graphics and sound—are stored on the disk. (To register online for a free trial, call 1-800-833-9400.)

Online Previews

Commercial programs are not the only products that can now be previewed online. On CompuServe, science fiction fans can read chapters from new books published by Baen Books. There's no charge other than the usual CompuServe connect fees. CompuServe subscribers can reach the Science Fiction and Fantasy Forum by typing GO HOM 29. Baen Books is currently in the forum's Data Library 3 (although that may change by the time you read this). To enter that library, type DL3 and hit RETURN or ENTER. Then type BRO to browse through the various filenames. Subcommands let you retrieve and read a file. You can even comment on what you've read by leaving a message for Baen Books via its CompuServe user number: 70307,541.

The Baen Books files can be read, copied, and distributed freely, as long as they aren't altered or sold. Local bulletin boards can retrieve the files from CompuServe and offer them to their members without charge.

These experiments and others are changing the ways in which people use their personal computers. In two particular areas—immediate acquisition of information and communication among like-minded individuals—telecomputing is becoming easier every day, says Matthew Lesko, an authority on the use of electronic databases and president of Information U.S.A., a database information company.

"Now I can hook up my computer terminal and be on the floor of the stock market even 5,000 miles away. That's a wonderful application."

Immediate communication among members of different professions has already become a commonplace event, reaping extraordinary results, Lesko adds. "It's like-minded people communicating, getting together and talking. It's how our society takes leaps and bounds."

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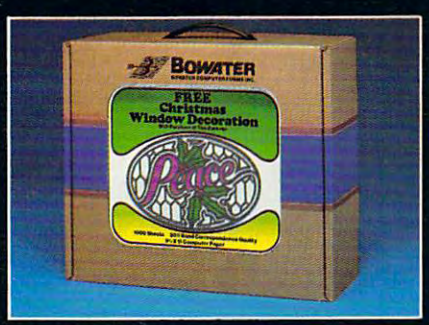

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An Overview Of Telecommunications Software

The following chart contains information on a variety of telecommunications programs for several different computer systems. There are hundreds more available, but we have limited this guide to software in the under-$100 price range.

Choose carefully when shopping for a terminal program. The most expensive, multifeatured modem is helpless without adequate software.

Data for this guide was supplied by .MENU—The International Software Database Corporation. For further information and ordering, contact .MENU, 1520 South College Avenue, Fort Collins, CO 80524. Call toll-free 1-800-THE-MENU or 303-482-5000 (in Colorado or outside the U.S.). Telex ISD 454590. When ordering, please use the International Standard Program Number (ISPN).

Product	Price	ISPN	Publisher/ Vendor	Systems	Description
Apple Sourcelink	$29.95	74737-0500	Source Telecomputing Corp.	Apple II, II+, IIc, IIe	Communications software designed to supplement use of The Source
ASCII Express II	$59.95	75100-2100	Roger Wagner Publishing	Apple II, II+, IIe	
Basic Terminal	Cassette $14.95	17512-0600	Practicorp International	VIC-20	Allows the user with either a plug-in modem or RS-232/modem combination to communicate with a remote time-sharing system
BITS (Basic Interactive Terminal Software)	$54.95	73612-1000	Software Sorcery	Apple II+, IIc, IIe	
Busiterm	$59.95		Skyles Electric Works	Commodore 64	
CHAT	$40	45537-1000	Lovells	Apple II, II+	
COMMTALK Ver. 2	$89.95	29393-1000	Enhanced Technology Assoc.	IBM PC	Has automated communication and information retrieval
Copylink PC	$99.95	84616-1000	U.S. Digital Corp.	IBM PC	
Copylink Ver. 2.41	$99.95	83208-2000	U.S. Digital Corp.	Apple II, IBM PC	
CW/Term Ver. 1.0	$60	13300-0500	The Code Works	IBM PC	
Data Capture IIe	$90	74850-1100	Southeastern Software	Apple IIc, IIe	
Data Capture Ver. 5.0	$90	74850-1050	Southeastern Software	Apple II, II+	
Data Express	$75	50500-0970	Microlab Inc.	Apple II, II+, IIc, IIe	Has an unattended answer mode
Datalink	$99.95	44850-2000	Link Systems	Apple II, II+, IBM PC	
Datalink (enhanced version)	$99.95 $175.00	44850-2500	Link Systems	Apple II, II+, IBM PC	
Direct.Connect	$95	25975-1000	Direct.Aid	IBM PC	
Dow Jones Spreadsheet Link	$99	26725-4000	Dow Jones & Company Inc.	Apple II, II+, IIe, Macintosh, IBM PC	Download information from Dow Jones News/Retrieval directly into a spreadsheet template set up for analysis
Dow Jones Straight Talk	$95	26725-4250	Dow Jones & Company Inc.	Mac	Designed to help the user obtain, store, and organize information from Dow Jones News/Retrieval
Flex-I-Term	$95.95	70675-2000	Source View Corp.	Apple II, II+, IIe	
Genterm Ver. 2.60	$79.95	37600-1000	Information Analysis Sys. Corp.	IBM PC	Asynchronous communications system with optional terminal evaluation
Habacom	$69.95	33987-0500	Haba Systems Inc.	Mac	
Hello Central	$99.95	67731-2700	Howard W. Sams and Company Inc.	Apple II	
Home Connection	$49.95		Penguin Software	Apple II	
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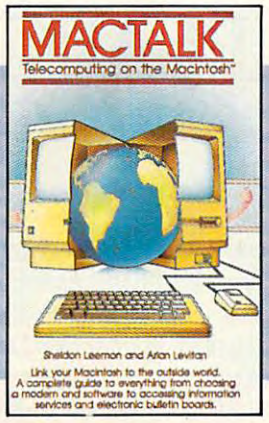

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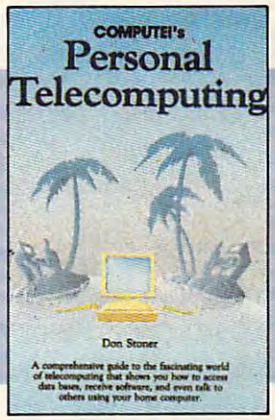

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Joan Nickerson
Anne Wayman

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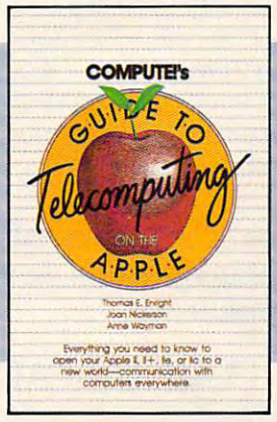

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What's New Online?

Kathy Yakal, Assistant Features Editor

The major telecommunications services have added several new features over the past year, and a few new services oriented toward personal computer users have come online. Here are the highlights.

American People/Link

Last December, American Home Network premiered American People/Link, a telecommunications network focusing on family entertainment and online conversations. Electronic mail, a CB simulation, and a wide variety of telegames are its main features.

In mid-August, American People/Link started adding online clubs to its other services. Similar to special interest groups (SIGs) on other telecommunications networks, they provide an electronic forum for people with similar interests to share information. Initial clubs cater to such interests as sports, aviation, humor, women's issues, and health.

Subscriber fees are as follows: For the first three hours of nonprime-time use each month, the hourly charge is $4.78 for 300 bps and $7.78 for 1200 bps. Additional time costs $2.95/hour for 300 bps and $5.95/hour for 1200 bps. Prime-time access is $9.95 for both 300 and 1200 bps ($14.95 in some cities).

For more information, contact: American Home Network, Inc., Arlington Ridge Office Center, 3215 N. Frontage Road, Suite 1505, Arlington Heights, IL 60004. 800-524-0100 (Illinois residents call 312-870-5200).

CompuServe Information Service

CompuServe, the nation's largest consumer information service, experienced tremendous growth in 1985. Its subscriber base grew by more than 70 percent to nearly a quarter-million, and several new services were added.

Travelshopper gives subscribers access to Trans World Airlines' reservation system. You can find the lowest rates and most convenient flights, then make a reservation while online. Tickets can be sent to your home or to the airline ticket counter, or issued by a local travel agency.

The *Executive Service Option* (formerly called *Executive Information Services*) is a database of sophisticated financial information

which is now available to all subscribers. It offers a variety of tools for investment and financial planning, as well as special merchandise offers and discounts. There is a one-time charge of $10 ($5 for new users) and a $10 minimum monthly usage fee.

CompuServe has also upgraded and simplified its electronic mail service. *Easyplex* features different modes for different levels of expertise; online instructions; easy editing; and an "address book" which stores names and user IDs of up to 50 people.

Gannett Co., Inc., is now distributing *USA TODAY Update* through CompuServe. *Hotlines*, updated hourly from 8 a.m. to 11 p.m., offers business, financial, local, and international news, plus weather reports. *Decisionlines*, updated daily, is targeted to specific industries and professions such as travel, technology, law, and energy.

Since August 1983, the NCR Universal Credit Union has allowed its members to conduct transactions electronically from anywhere in the world through CompuServe's *Companion at-Home*. In the last year, three additional major credit unions have announced an intention to do the same: Northwest Orient Airlines Employee Credit Union, Pacific IBM Employees Credit Union, and Oak Ridge National Laboratories Employees Credit Union.

For more information, contact: CompuServe, P.O. Box 20212, Columbus, OH 43220. 800-848-8199.

Delphi

Since June, Delphi has offered service at 2400 bps, for an additional $5 an hour.

Two new areas of the service have also been developed. Subscribers can now get current news, sports, and financial information on Delphi through AP News Services. And owners of Commodore, Apple II-series, Macintosh, and Atari computers can share information and get technical help through several new online SIGs.

For more information, contact: Delphi, 3 Blackstone Ct., Cambridge, MA 02139. 800-544-4005.

Dow Jones News/Retrieval

Dow Jones has added two new databases to its information service. *Peterson's College Selection Service* has profiles on more than 3,000 two- and four-year colleges and universities. And a new medical and drug reference database addresses the diagnosis of hundreds of diseases and offers information on many pharmaceutical drugs.

American Express Advance lets cardholders look up previous statements on their accounts. *American Express Shopping And Travel Service* offers online shopping and travel information.

In June, Dow Jones' per-minute fees for 300 bps changed to 90 cents (prime time) and 20 cents (nonprime time). The 1200 and 2400 bps rates are double the 300 bps rate. Certain business-related databases require an additional 30 cents (prime) and 60 cents (nonprime) per minute. In addition to the $75 standard membership fee, there's also a $12 annual service fee.

For more information, contact: Dow Jones News/Retrieval, P.O. Box 300, Princeton, NJ 08540. 800-257-5114.

The Source

Over the past year, The Source simplified use of its telecommunications network. The updated menu incorporates a self-teaching design to help users find what they're looking for more quickly.

Online assistance has always been available on The Source, but now it's expanded and it's free. The tutorial includes four lessons of graduated difficulty to familiarize new users with the system. Unlimited free access to this assistance allows both new and experienced subscribers to explore areas of the system that they may not have known about before.

In August, officials at The Source announced that individual SIGs would soon be online. Though details have not been fully developed at this writing, the SIGs are expected to address the special interests of personal computer owners. An additional per-minute fee will be charged for this service.

In August, 2400 bps service began in ten major cities. Additional cities will soon be added via Uninet and Telenet. The base rate for prime-time 2400 bps service is 46 cents per minute; nonprime time is 20 cents per minute.

A new database contains updated listings for 14,000 domestic and 8,000 international hotels. Each listing contains the hotel's address and telephone number, as well as information on restaurants, convention facilities, sports and leisure services, and rates.

For more information, contact: The Source, 1616 Anderson Road, McLean, VA 22102. 800-336-3366.

Viewtron

Viewtron is a new videotex service scheduled to begin this fall for Commodore, Apple, and IBM owners. Operated by Viewdata Corporation, a subsidiary of Knight-Ridder Newspapers, Inc., Viewtron was to start October 1 in most areas of the U.S. with access to a Telenet, Tymnet, or Uninet number, except Massachusetts, New Hampshire, Vermont, and Maine. Viewtron plans to offer news, weather, sports, and current stock prices; book, movie, and software reviews; communication with other subscribers through electronic mail and a CB simulator; and online shopping and banking.

Viewtron is to be the first major news and information service in the U.S. to display color graphics, though only for Commodore users. Because of this feature, Commodore owners need special terminal software designed for the system. IBM and Apple owners can use any terminal software with VT-100 emulation (or Viewtron's package).

To subscribe, you must buy a Viewtron Software Starter Kit ($9.95) which contains terminal software, one free hour of service, an ID and password, and a user manual. Rates after the first hour are nine cents a minute (after 6 p.m. weekdays, all day weekends) and 22 cents a minute (weekdays before 6). There is no monthly minimum and no extra charge for 1200 bps access.

Viewdata is offering free starter kits with the purchase of some Anchor Automation modems. A 300 bps Westridge 6420 modem with software is $49.95; a 1200 bps Volksmodem 12 is $189.95.

For more information, contact: Viewdata Corporation of America, Inc., 1111 Lincoln Road, 7th Floor, Miami Beach, FL 33139. 800-543-5500, Department 9401. ©

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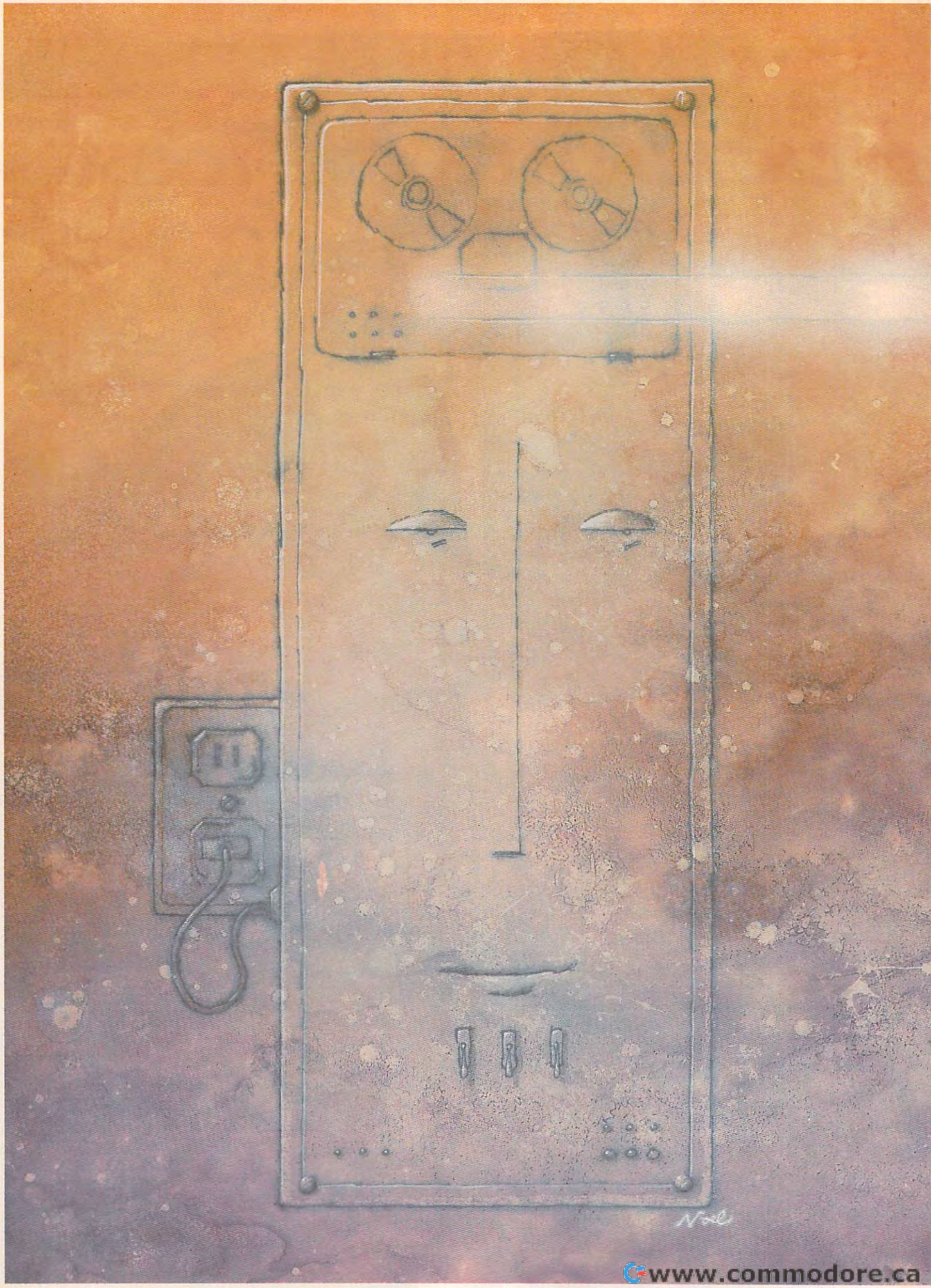

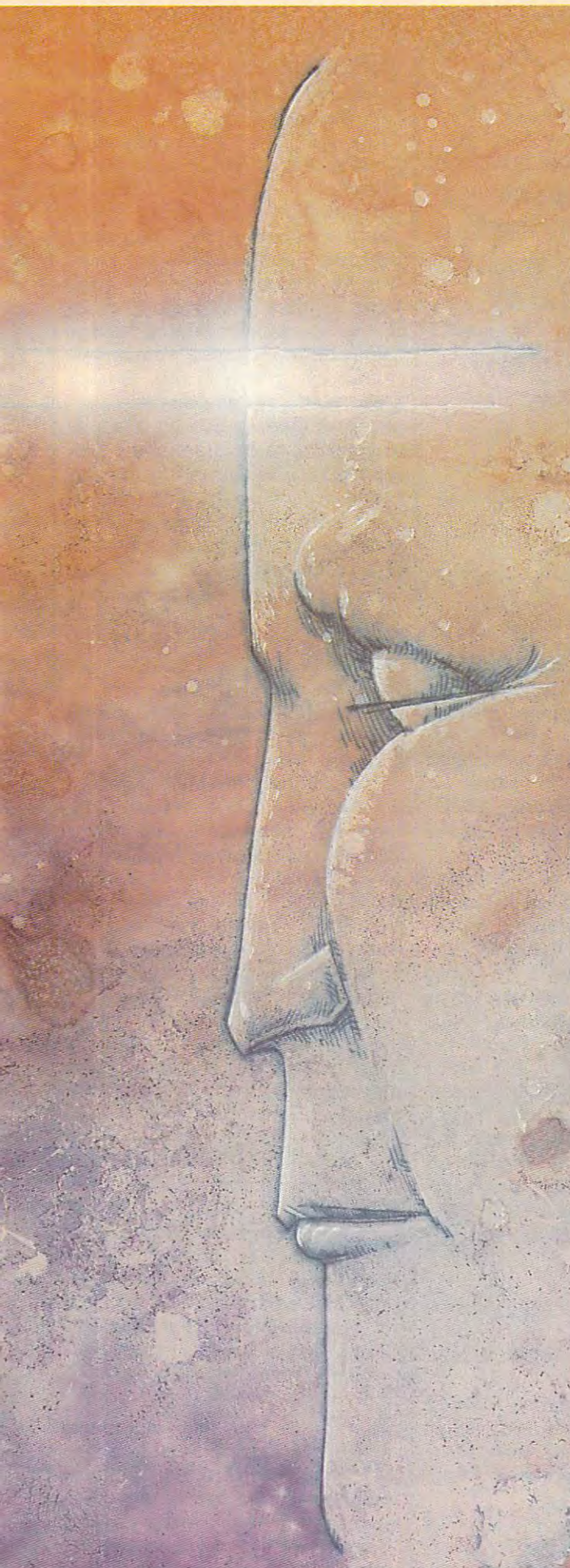

Programming Languages

Communicating With Your Computer

Todd Heimarck, Assistant Editor
Kathy Yakal, Assistant Features Editor

BASIC, Logo, Pascal, FORTRAN, COBOL, Forth—these and a hundred other odd-sounding names are the languages we use to communicate with computers. Since the beginning of the computer age, scientists and programmers have been striving to make this human-machine interaction easier, faster, and more powerful. Why are there so many languages? Which are best? And what will tomorrow's languages be like? The answers may help you decide which language is best for you.

Imagine that if every time you asked someone to do something, you had to tediously explain each step of the procedure. Outlining something as simple as taking out the garbage could take ten minutes:

Walk to the garbage can by placing one foot in front of the other and moving forward. Stop. Bend over at the waist, extending both arms out in front of you. Put your hands on either side of the garbage bag and grasp it by curling your fingers and applying pressure to get a good grip. Stand up straight again, holding the bag in front of you. Turn around and face the opposite direction, still holding the bag. Walk toward the back door. Stop. Bend over again and release your grip on the bag. Stand up, extend your right arm, and grasp the doorknob. Apply pressure, twist, and pull until the door opens.... **And so on.**

Human beings don't need that kind of step-by-step instruction for most tasks. But computers require it for *all* tasks. Technically, the only way to make a computer do something is to rearrange its internal pathways of electricity by flipping the equivalent of thousands of microscopic on/off switches. By programming at the computer's most fundamental level, —a binary code of ones and zeros which controls those switches—programmers can instruct computers to carry out very simple tasks, like adding two numbers or storing a number in memory. When hundreds or even thousands of these simple commands are combined to form a program, computers can seem to handle tasks of great complexity.

But programming a computer in binary codes can be a daunting job. To make it easier and faster, computer scientists and engineers have spent the last four decades developing scores of programming languages as alternatives to communicating with computers on the binary level. Many of these languages are composed of familiar English words, and they serve as translators or interpreters between the language of the programmer and the language of the machine. For example, many of today's personal computers come with a language called BASIC, which stands for *Beginner's All-purpose Symbolic Instruction Code.* A typical English-like BASIC command is PRINT. When PRINT is followed by some text inside quotation marks, such as PRINT "HELLO", the computer prints the text on the monitor screen. To do the same thing directly in machine language, a programmer might have to write a half-dozen or more commands.

For this reason, languages such as BASIC are known as *high-level languages*—they are relatively far removed from the binary level of the machine. Programming in a high-level language versus programming in machine language is somewhat like the difference between saying "Please take out the garbage" or outlining the whole process step-by-step as shown above.

There are other reasons why high-level languages are continually being developed, too. Different people have different programming styles, so more languages provide more choices. Also, special programming jobs require specialized tools; the language for writing an accounting program might not be the best for writing an adventure game.

Special programming jobs require specialized tools; the language for writing an accounting program might not be the best for writing an adventure game.

The evolution of these languages, however, has distanced programmers from the inner workings of computers. High-level languages make it easier to write programs, but fewer and fewer people understand what's really happening inside the box—how the electrons are zipping in and out of logic gates. It's like driving a car without thinking about how the gas and air are exploding inside the cylinders, pushing the pistons up and down. Whether or not it's important to know these details is a matter of debate within the computing community.

Today, you can run a program on just about any personal computer without knowing anything about programming. Usually it's as simple as inserting a floppy disk or program cartridge, switching on the system, and perhaps typing a single command to get things started.

This is quite a jump from 40 years ago, when the first electronic digital computer, ENIAC, was built. ENIAC (Electronic Numeric Integrator and Calculator) was a 30-ton, 100-foot-long machine which contained almost a hundred thousand vacuum tubes, resistors, and capacitors. ENIAC had to be programmed by *hard-wiring*—engineers rewired it for each new program they wanted to run. There was no memory inside the computer to store programs. And today's mass-storage devices, such as floppy disks and tapes, were not yet imagined. Hard-wiring ENIAC could take days as engineers prepared the monster to solve one type of complex calculation. Once programmed, ENIAC could solve the equations far faster than people. But if a different type of calculation was required, the hard-wiring had to start all over again.

The difficulty of programming a behemoth such as ENIAC meant that only a handful of scientists and engineers could really "talk" to the computer. And they had to communicate completely in the machine's own primitive language of wires and connections.

In addition to being enormously expensive to build and maintain, these early computers were expensive to use because hard-wiring took so much time—time that could be spent on calculations. So engineers borrowed an idea from computer pioneer John von Neumann—*stored programs.* Adding memory to a computer to temporarily store a program as it runs is much faster and easier than rewiring the hardware. You can change programs simply by replacing the program in memory with a new one.

By mid-1948, British computer scientists had completed the Mark I, commonly recognized as the first stored-program computer. By flipping switches on the front of the Mark I, engineers could enter short programs into the machine. This was a major improvement, but still clumsy. Reportedly, the codes had to be entered *backward.*

Next, a way had to be found to store programs between jobs; there isn't nearly enough memory in a computer to permanently keep all the possible programs that could be written. Also, many programs require data

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which changes from job to job and can't be stored as part of the program, such as the monthly electric bills of utility company customers.

This time, engineers borrowed a piece of nineteenth-century technology—cardboard punch cards. This idea was originally developed by nineteenth-century mathematician Charles Babbage, who took the concept from an earlier system used by the French to control weaving looms. Punch cards had proven their worth in data processing during the 1890 U.S. census, when they were used to speed up tabulation on mechanical adding machines.

By adapting punch cards to computers, it became possible to write and store programs without tying up the machine itself. Programmers typed their programs on keypunch machines, then waited their turn to feed the stack of cards into the computer. After the results were printed out, the computer was prepared to accept another batch of cards. This system was called *batch processing*.

For the first time, programmers were physically separated from computers. There were software experts, who wrote programs on batches of cards, and hardware experts, who fed the cards into computers.

The first real software breakthrough was an *assembler* program. An assembler translates mnemonics like LD (load a number from memory) and ST (store a number in memory) into the binary ones and zeros the computer understands. Each assembler operation code (or *opcode*) corresponds directly to a machine language instruction.

Soon, programmers began collecting useful pieces of programs written with assemblers. For example, if someone needed a routine to calculate square roots, they could borrow one from another programmer who had already figured out the math, rather than waste time reinventing the wheel. Such a fill-in-the-blanks routine is called a *macro-instruction*, or macro for short.

A library of macros isn't quite a language, because it's not organized or standardized. But macros were the first step toward high-level languages.

As computer education began seeping downward from colleges, for the first time there was a need for languages tailored especially for young people.

One of the first high-level languages was FORTRAN (FORmula TRANslator), developed in 1954. Before FORTRAN, engineers and scientists who were unfamiliar with computers had to describe a problem to a computer programmer, who would then write a program to solve it. FORTRAN made it easier for scientists and engineers to write their own programs.

Just as FORTRAN was written for engineers, COBOL (*COmmon Business Oriented Language*) was created for accountants. Developed in the 1950s by U.S. Navy Captain Grace Hopper, COBOL is still one of the most popular languages for large business computers, and is often used to write payroll programs and other applications in large data processing departments.

In 1964, when FORTRAN and COBOL were the most popular programming languages, two Dartmouth University professors formulated a couple of important ideas. First, they suggested that instead of processing programs in batches, a single computer could be hooked up to several terminals, sharing its time among many users. A fast typist works at perhaps 100 words per minute, while a computer can accept keystrokes much faster—in millionths of a second. A *time-sharing system* of terminals would allow more than one person to use the computer simultaneously. Because the computer works so fast, each person could have the illusion that he was the only one working with the machine.

Their second idea was a new language, BASIC, a general computing language which would be easier to learn than FORTRAN or COBOL and more flexible.

Dartmouth became the first university to make computer time generally available to undergraduates, thanks to time-sharing and BASIC. (The two professors, John Kemeny and Thomas Kurtz, recently released a new version of BASIC called *True BASIC*.)

With batch processing, programmers had to write a program by punching it onto cards, then submit it for processing, collect the results the next day, find out there was a bug, rewrite it, submit it again, and so on. Time-sharing allowed programmers to begin debugging a program immediately. It also made computers accessible to more people and paved the way for personal computing.

Soon after BASIC was developed, many more programming languages began appearing. Computers were being adapted to more applications, and more people began using computers, so demand grew for better and more specialized languages.

In the late 1960s, a debate heated up within the academic and computer communities over *structured programming*. This is a method intended to keep programmers more organized and programs more readable and easily modified. The first language specifically designed to encourage structured programming was Pascal—invented by Niklaus Wirth in Switzerland and named after the French mathematician and logician, Blaise Pascal. Today, Pascal is popular in high schools and colleges because instructors say it teaches good programming style. It's also easier to follow the flow of a program written in Pascal.

Meanwhile, computer education began seeping downward from colleges into high schools, junior highs, and even elementary schools. For the first time, there was a need for languages tailored especially for young people. In the late 1960s, Seymour Papert of the Massachusetts Institute of Technology

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developed Logo. Many of Logo's commands give directions to a *turtle* on the computer screen, a small object whose movements define and execute a graphics program. The on-screen turtle was adapted from Papert's original Logo, which attached the computer to an actual robotic turtle which children could program to draw designs on paper. Many elementary schools now teach Logo as the first programming language for young children.

New approaches to programming languages also were being explored. For example, Forth is an unusual language originally developed to control telescopes in observatories. It's roughly halfway between machine language and high-level languages like BASIC, and is *extensible*—you can define new functions and commands which then become part of the language. In a sense, it's a language that lets you create your own personal language. If you want, you can build up the language piece by piece, until you finally define a single word that runs the whole program.

Although there are hundreds of programming languages, most are not available for personal computers. Some languages were designed for large mainframe computers and cannot fit into small amounts of memory. Others are just too specialized for general use. If you'd like to explore the alternatives, here are some issues to consider:

• *What types of programs will you be writing?*

One language might offer lots of commands for handling files and variables, but very little in the way of graphics. Another might be strong in mathematical functions, but weak in handling strings and text. Look for a language that is suited for the kind of programs you want to write. There are always books and manuals which list the commands available in a language and describe what they do.

• *How much control do you want over the hardware and software? Is the language high-level, low-level, or somewhere in between?*

A low-level language like machine language puts you in direct control of the computer. Individual instructions do very simple things, like fetching and storing numbers in memory, comparing two numbers, and basic addition and subtraction. To multiply two numbers, you might need several instructions. (However, on the newer chips, multiplication requires only a single instruction.)

The commands in high-level languages look more like words in a human language, so they're easier to learn.

High-level languages take you several steps away from machine language and the hardware. The commands look more like words in a human language, so they're easier to learn. Also, individual commands are usually broader, performing tasks which might require dozens of commands in machine language. But you pay a price: Direct control over the finer points of the computer may be more difficult, and the finished programs run more slowly and often consume more memory. Remember, the only language the computer *really* understands is machine language—at some stage, it has to translate programs written in another language into its native tongue.

• *How fast is the language?*

Speed is important in some programs. A certain part of a program may take 1/20 second to execute in one language and 1/2 second in another, not a noticeable difference if it's used once or twice. But if it's executed several thousand times, the difference could become significant.

Machine language is the fastest, and most commercial software is written in machine language. (In fact, most high-level languages themselves are written in machine language.) Mid-level languages such as Forth and C, while not as fast as machine language, are generally quicker than higher-level languages.

Because the faster languages are usually low-level, they may be more difficult to learn and use. High-level languages are fine for many programs, and here's where you must strike a balance: Would you rather spend five hours working with a low-level language to write a program that runs in one minute, or spend one hour working with a high-level language to write the same program that runs in 15 minutes? If you're going to run the program every day, you might choose to spend the extra time writing it with the faster language. But for an infrequently used program, you might prefer the language that's easier and slower.

In some cases, the speed of a language doesn't matter. If a printer seems to take forever to print reports or mailing labels, rewriting the program with a faster language may not help. The printer is probably the limiting factor on speed, not the language.

• *What are the system requirements? And how much free memory for programs remains after the language is loaded into the computer?*

You may find languages that require a certain operating system. C, for example, was originally written for the Unix operating system, although that has changed—other versions of C are now available. On a Commodore 64, certain languages work only with the CP/M cartridge. And some languages won't work without two disk drives.

Check the memory requirements. You may have to install additional memory boards or controller cards. Even if you have the minimum memory specified for a certain language, you may be left with very little space for your programs.

• *What programming style are you most comfortable with? Scientific and structured? Or creative and artistic?*

Some people write programs methodically, step by step. They draw a flowchart on paper, diagramming the program in modules. They fully document each section, describing exactly what happens when. Not until they finish the preliminary planning and structuring do they enter the program into the computer. In business, the structured approach is preferable. If a programmer quits for

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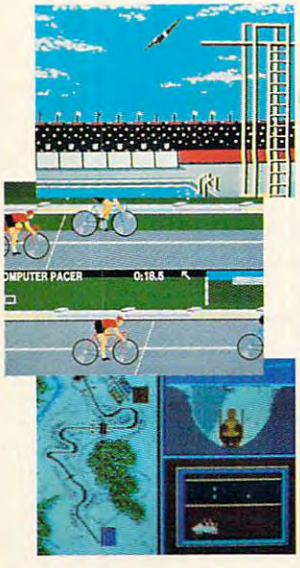

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some reason, the company needs to know how the programs are put together.

Others prefer a looser, more improvisational style. They type a few lines, run the program, make some changes, test it again, and so on. Then they write and test a new section. The programs are not necessarily unstructured or illogical; it's just that the program ideas are not written down. The program may change as it develops, evolving into something quite different from the original plan.

There are advantages and disadvantages to each style. Planning ahead takes a lot of time up front, before a single line is entered. And it locks you into a certain structure. But the programs are generally easy to follow and debug. When teams of programmers work together, they generally use the planned-out approach.

More casual programmers who work interactively with the computer can see immediate results, positive feedback that the program is progressing. There's also an element of creative experimentation: "I'll try this and if it doesn't work, I'll try something else." Less time is spent on planning, and more time on actual programming. The casual approach can be carried too far, however. If the program is written sloppily, even its author might not understand how it works if modifications are required a few months later.

• If you need to write fast programs, but don't want to use machine language, will a compiler do the job?

There are two general ways in which commands in higher-level languages are translated into the machine language that the computer can understand.

An *interpreter* language translates the commands as the program runs, on the fly. The BASICs built into personal computers are interpreters.

A *compiler*, on the other hand, translates all the high-level commands into machine language before running the program. This compilation step may take several minutes, but when it's done, the finished program usually runs much faster than an interpreted program (though not as fast as programs written directly in machine language).

Some languages (including BASIC) are available as both interpreters and compilers. There are tradeoffs either way. Compiled programs run faster than interpreted programs, but usually require much more memory—sometimes too much for small computers. Interpreters are more interactive, because you can type in a few statements, quickly try them out, and continue. A compiler might take ten minutes to compile a program. The choice between an interpreter and a compiler depends a great deal on your personal programming style, the amount of memory in your computer, and your need for speed in the finished product.

Ultimately, the language you choose for communicating with your computer depends on a great number of things. After reviewing all the options, you may find it desirable to learn more than one language, especially if you plan to write different kinds of programs.

During recent years, computer scientists, programmers, and linguists have been working in the field of artificial intelligence to develop methods for computers to more closely mimic human thought. An important part of this work has been research into so-called *natural languages*—those languages which humans use. We may see a day when the perfect natural language interface is developed, and we need only tell the computer, in our own tongue, what we want it to do. The latest generation of personal computers—such as the Apple Macintosh, Atari 520ST, and Commodore Amiga—represent another small step in that direction.

For now, however, control over a computer means meeting the machine at least halfway—learning a language which gives the computer something intelligible to work with. No longer must people learn to program to use a computer enjoyably and productively. But for thousands of computer owners, learning to communicate with their machines in a common language opens up the world of computing in ways which are better experienced than explained.

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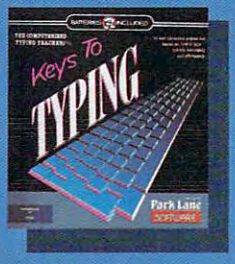

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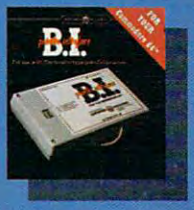

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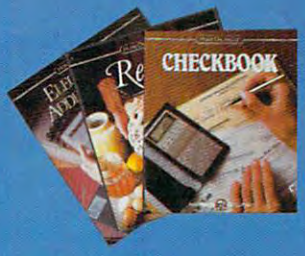

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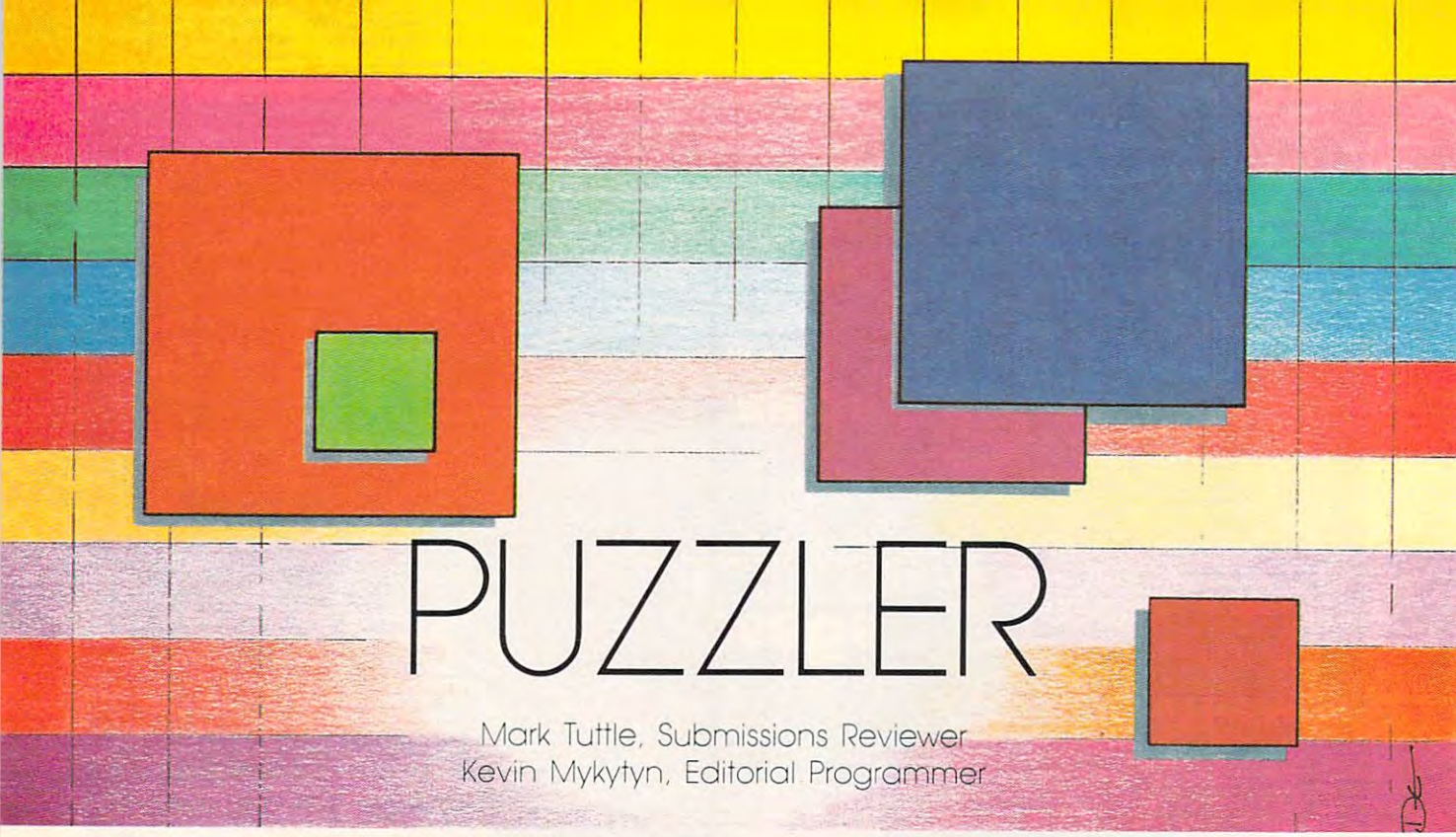

PUZZLER

Mark Tuttle, Submissions Reviewer
Kevin Mykytyn, Editorial Programmer

Here's a game that tests your skill in pattern-matching and visualization. It runs on the Commodore 64; unexpanded VIC-20; Plus/4 and 16; IBM PC with color/graphics adapter and BASICA; PCjr with Cartridge BASIC; Apple II-series computers; TI-99/4A with Extended BASIC; and Atari 400/800, XL, and XE computers with at least 16K RAM for tape or 24K for disk. The Commodore 64 and Atari versions also require a joystick.

How good are you at recognizing patterns? Many intelligence tests measure this important conceptual skill. "Puzzler" challenges your ability to find matching patterns in a background of similar shapes. It displays two puzzle grids composed of multicolored blocks (see photos). Both grids contain exactly the same blocks, but those in the left grid have been scrambled. Your job is to rearrange the blocks in the left puzzle grid until they match those on the right. You must solve the puzzle before time runs out.

Because all versions of Puzzler are similar, we've printed general game instructions followed by specific notes for each computer. Read the general instructions as well as the section for your machine, then type in the program listed for your computer. Don't forget to save a copy of the game before you run it.

Puzzle Building

Puzzler begins by letting you choose the size of the puzzle grid. Enter values for the number of rows and columns in the grid. The maximum puzzle size differs among the various versions. Of course, larger puzzles are more difficult to solve than small ones. Next, enter the number of colors the puzzle will use. Two-color puzzles are the easiest. The maximum number of colors depends on which version you're playing. The more colors you choose, the harder your job becomes.

Puzzler then spends a short time building the two grids. Since the blocks are arranged at random, each new puzzle is different from the last. While you try to solve the puzzle, the computer keeps track of the time and alerts you when the puzzle is solved or time runs out. The time limit depends on the size of the puzzle.

Puzzler allows three different operations. You can move within the puzzle grid from one block to another, pick up a block and move it to a new position, or rotate a block in its current position. Use the cursor keys (or joystick in some versions) to move around in the grid. Your position is indicated by a colored cursor (or index arrows in some versions). To pick up a block, press RETURN (or the joystick button) once. The cursor or arrow changes color to show that you're carrying the piece. Then move to the position where you want to place the block, and press RETURN (or the button) once. The block in the current position trades positions with the block you're carrying.

Each block consists of four colored squares. To rotate a block in its current position, press RETURN (or the joystick button) twice. The block rotates 90 degrees. You may rotate a block as many times as you want.

Continue moving and rotating blocks until both puzzle grids match. Every block must match in color and be turned in the right direction.

Commodore 64 Version

Plug a joystick into port 2. The puzzle may contain as many as seven rows and columns, and up to 16 different colors. The box-shaped cursor shows your position on the puzzle grid. Press the joystick button twice without moving the joystick to rotate the block under the cursor. Press the button once to pick up the piece under the cursor: The cursor changes color to show that you're carrying the block. Now you may move to any other place in the grid. When you find the spot

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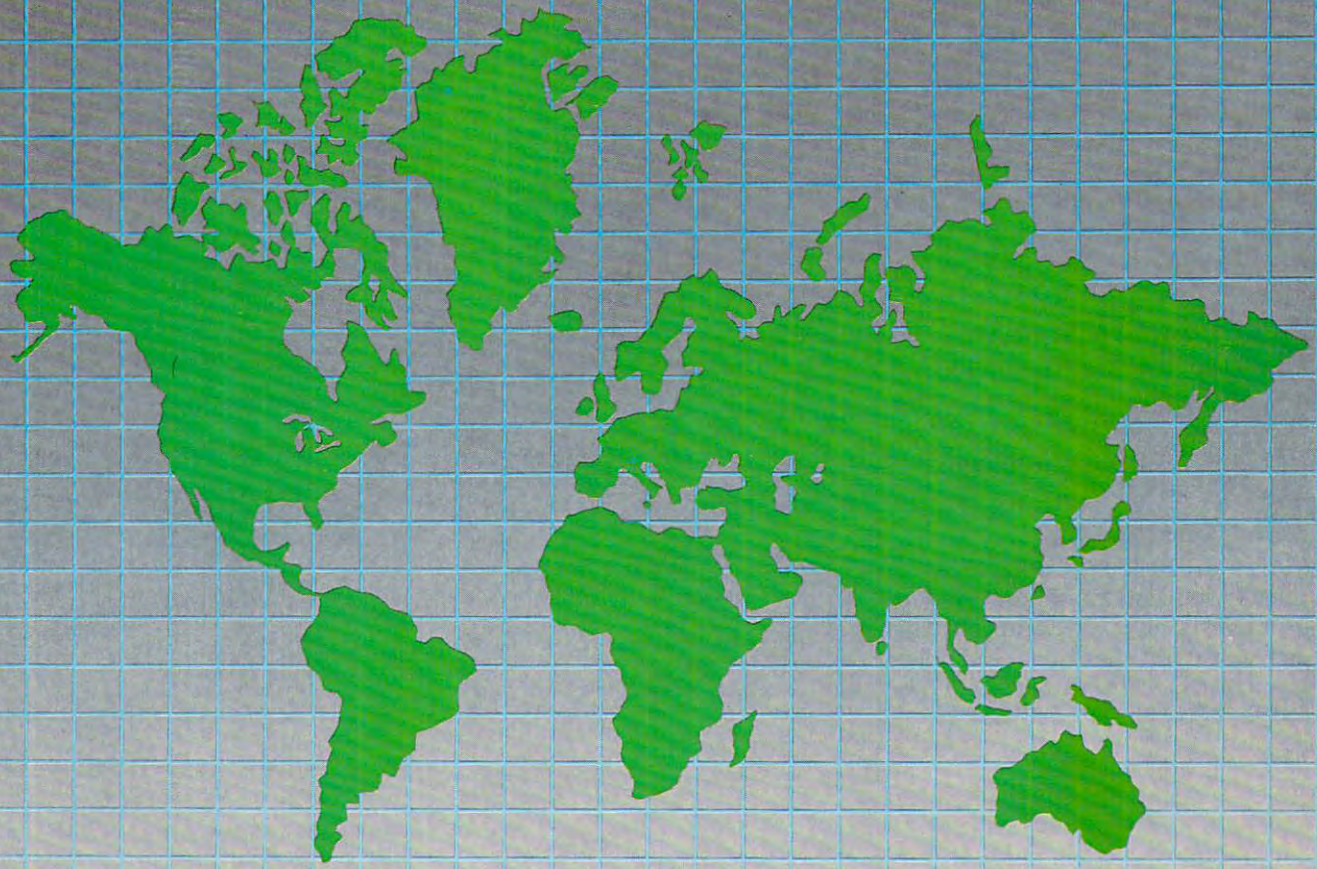

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you want, press the button again to set down the block. It changes places with the block in that position.

VIC-20 Version

VIC-20 Puzzler is played with the cursor keys. The maximum puzzle size is four columns by six rows, with up to six colors. Your position in the grid is shown by two index arrows, normally colored black. Press RETURN twice to rotate a block. Press RETURN once to pick up a block, then move it with the cursor keys and press RETURN to put it down. The arrows turn blue when RETURN is pressed once, and red when it is pressed a second time.

Plus/4 And 16 Version

Puzzler for the Commodore Plus/4 and 16 permits up to seven rows and columns and seven different colors. It is played exactly like the VIC-20 version.

Atari Version

Plug a joystick into port 1. Atari Puzzler lets you build puzzles with as many as eight rows and columns and up to four different colors. Manipulate the joystick as explained in the Commodore 64 instructions.

IBM Version

IBM Puzzler allows grids as large as seven rows and columns with up to seven different colors. Index arrows indicate your position in the grid, as explained in the VIC-20 instructions. Use the cursor keys to move within the grid. Press Enter to move or rotate a block.

TI-99/4A Version

You have the option of playing with either a joystick or keyboard controls. Puzzles can be as large as six rows and six columns with as many as six different colors. The box-shaped cursor shows your position in the puzzle grid and changes colors to indicate when you're carrying a block. When using the keyboard, make sure the Alpha Lock key is down. Move the cursor with the arrow keys and press Enter to rotate or move a block.

Apple Version

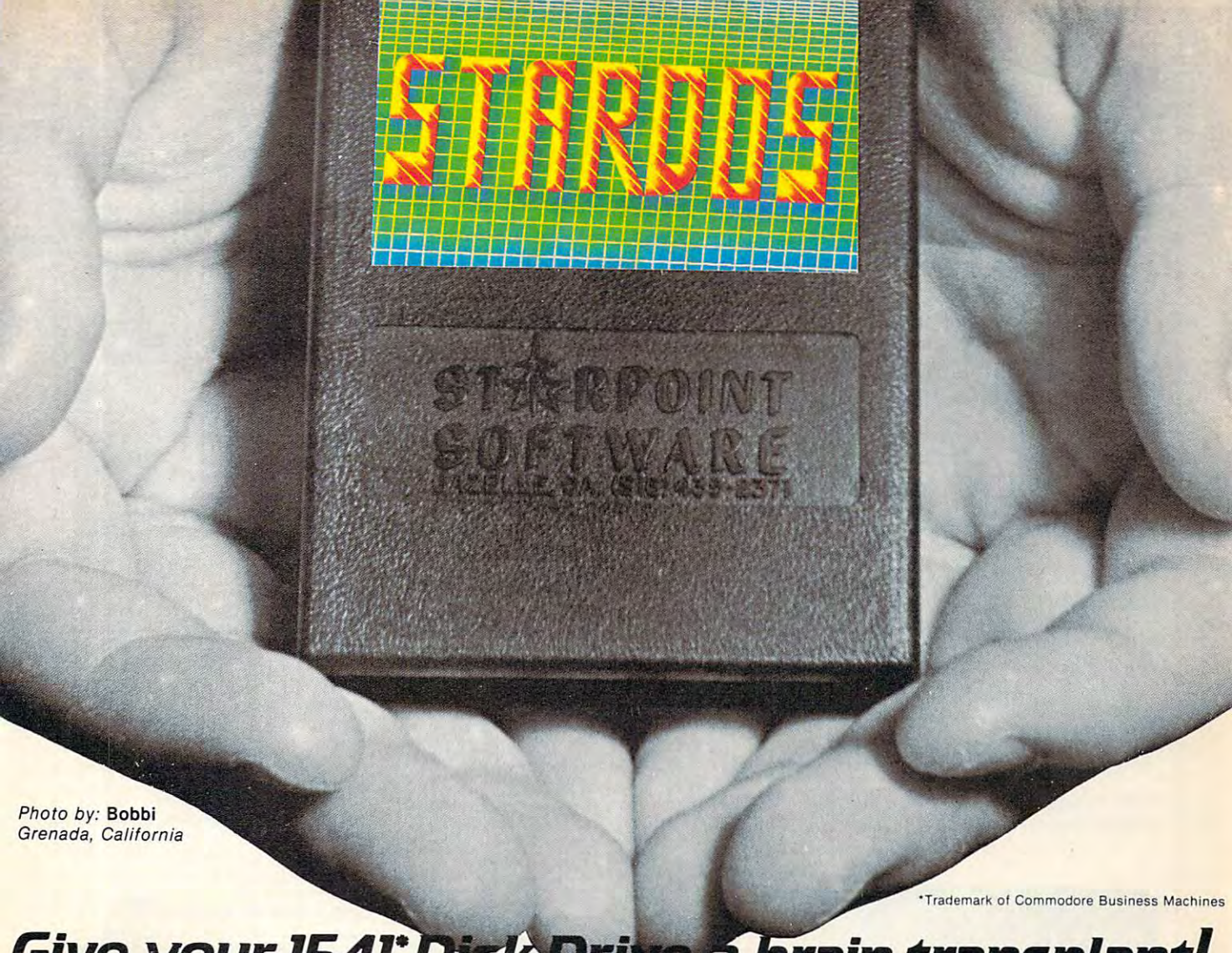
Puzzler runs on any Apple II-series computer with either DOS 3.3 or ProDOS. Press the space bar to move or rotate a block, and press I, J, K, and L to move up, left, down, and right, respectively. Your position in the grid is indicated by small white highlights in the corners of the block.

Program 1: Commodore 64 Puzzler

Version by John Krause, Assistant Technical Editor

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
100 GOSUB460                :rem 171
110 IFT<TI/60THENPOKE53269,0:G
    OTO790                  :rem 185
120 A=INT(T-TI/60+.5):B=INT(A/
    60)                     :rem 89
130 PRINT"{HOME}{3 DOWN}"SPC(1
    7)B"{LEFT}:";           :rem 226
140 Z$=STR$(A-60*B):Z$=RIGHT$(
    Z$,LEN(Z$)-1):IFLEN(Z$)=1T
    HENPRINT"0";            :rem 236
150 PRINTZ$                 :rem 161
160 A=NOTPEEK(56320)        :rem 124
170 R=R+SGN((AAND2)-(AAND1))
                            :rem 55
180 C=C+SGN((AAND8)-(AAND4))
                            :rem 35
190 IFR<0THENR=0            :rem 213
200 IFR>=R3THENR=R3-1       :rem 20
210 IFC<0THENC=0            :rem 176
220 IFC>=C3THENC=C3-1       :rem 218
230 POKE53248,CS+16*C:POKE5324
    9,RS+16*R               :rem 218
240 IF(AAND16)=0THEN110:rem 31
250 IFF=0THENF=1:POKE53287,14:
    RR=R:CC=C:WAIT56320,16:GOT
    O110                    :rem 115
260 F=0:IFRR=RANDCC=CTHENGOSUB
    300:GOTO280             :rem 111
270 GOSUB330                :rem 175
280 POKE53287,15:WAIT56320,16:
    IFA$<>B$THEN110         :rem 53
290 GOTO800                 :rem 108
300 B=C1+80*R+C+C+41:GOSUB420
                            :rem 81
310 POKEB,PEEK(A):POKEB+1,PEEK
    (A+1)                   :rem 46
320 POKEB+40,PEEK(A+NC):POKEB+
    41,PEEK(A+NC+1):RETURN
                            :rem 132
330 GOSUB360:B=C1+80*R+2*C+41:
    GOSUB310                :rem 147
340 B=C1+80*RR+2*CC+41:A=AA:GO
    TO310                   :rem 201
350 REM *** MOVE            :rem 49
360 AA=SS+2*NC*RR+2*CC:A=SS+2*
    NC*R+C+C                :rem 191
370 D=PEEK(A):POKEA,PEEK(AA):P
    OKEAA,D                 :rem 251
380 D=PEEK(A+1):POKEA+1,PEEK(A
    A+1):POKEAA+1,D         :rem 108
390 D=PEEK(A+NC):POKEA+NC,PEEK
    (AA+NC):POKEAA+NC,D
                            :rem 237
400 D=PEEK(A+NC+1):POKEA+NC+1,
    PEEK(AA+NC+1):POKEAA+NC+1,
    D:RETURN                :rem 111
410 REM *** ROTATE          :rem 198
420 A=SS+2*NC*R+C+C         :rem 42
430 D=PEEK(A):POKEA,PEEK(A+NC)
                            :rem 24
440 POKEA+NC,PEEK(A+NC+1)
                            :rem 191
450 POKEA+NC+1,PEEK(A+1):POKEA
    +1,D:RETURN             :rem 240
460 POKE53269,0:A$="":POKE5328
    0,6:POKE53281,6         :rem 233
470 PRINT"{CLR}"CHR$(14)SPC(16
    )"{2 DOWN}{WHT}PUZZLER":PR
    INTSPC(16)"{7 T}"       :rem 153
480 FORT=54272TO54295:POKET,0:
    NEXT:POKE54296,15       :rem 91
490 INPUT"{HOME}{7 DOWN}NUMBER
     OF ROWS (2-7)";R3:rem 203
500 IFR3<2ORR3>7THEN490
                            :rem 126
510 INPUT"{HOME}{10 DOWN}NUMBE
    R OF COLUMNS (2-7)";C3
                            :rem 190
520 IFC3<2ORC3>7THEN510:rem 91
530 INPUT"{HOME}{13 DOWN}NUMBE
    R OF COLORS (2-14)";CO
                            :rem 238
540 IFCO<2ORCO>14THEN530
                            :rem 197
550 PRINT"{2 DOWN}PLEASE WAIT
    {SPACE}..."             :rem 134
560 S1=1473-40*R3-C3:C1=S1+542
    72:S2=S1+20:C2=C1+20:NR=2*
    R3:NC=2*C3              :rem 120
570 FORA=1TONR*NC:A$=A$+CHR$(R
    ND(1)*CO):NEXT:B$=A$
                            :rem 203
580 A=256*PEEK(46)+PEEK(45)
                            :rem 204
590 SS=256*PEEK(A+4)+PEEK(A+3)
                            :rem 158
600 FORR=0TOR3-1:FORC=0TOC3-1:
    B=INT(RND(1)*4)         :rem 195
610 IFBTHENGOSUB420:B=B-1:GOTO
    610                     :rem 16
620 NEXT:NEXT               :rem 80
630 FORR=0TOR3-1:FORC=0TOC3-1
                            :rem 13
640 RR=INT(RND(1)*R3):CC=INT(R
    ND(1)*C3):GOSUB360:NEXT:NE
    XT                      :rem 80
650 PRINT"{CLR}"SPC(17)"{DOWN}
    PUZZLER                 :rem 141
660 FORA=1TONR:FORB=1TONC:POKE
    C1+40*A+B,PEEK(SS+E)
                            :rem 118
670 POKES1+40*A+B,160:E=E+1:NE
    XT:NEXT                 :rem 201
680 FORA=1TONR:FORB=1TONC:POKE
    C2+40*A+B,ASC(MID$(B$,G+1)
    )                       :rem 153
690 POKES2+40*A+B,160:G=G+1:NE
    XT:NEXT                 :rem 208
700 POKE2040,14:POKE53287,15:P
    OKE53277,1:POKE53271,1
                            :rem 183
710 FORA=896TO924:READB:POKEA,
    B:NEXT                  :rem 15
720 FORA=925TO958:POKEA,0:NEXT
                            :rem 102
730 RS=144-4*NR:CS=102-4*NC:R=
    0:C=0                   :rem 223
740 T=NR*NC*3:POKE53269,1:TI$=
    "000000":RETURN         :rem 105
750 DATA255,192,0,128,64,0,128
    ,64,0                   :rem 232
760 DATA128,64,0,128,64,0,128,
    64,0                    :rem 182
770 DATA128,64,0,128,64,0,128,
    64,0                    :rem 183
780 DATA255,192             :rem 29
790 Z1=50:Z2=10:Z3=-2:GOSUB830
    :PRINT"{HOME}{DOWN}"SPC(15
    )"{YEL}TIME'S UP":GOTO820
                            :rem 114
800 Z1=10:Z2=50:Z3=2:GOSUB830
                            :rem 180
810 PRINT"{HOME}{DOWN}"SPC(13)
    "{YEL}YOU SOLVED IT!"
                            :rem 19
```



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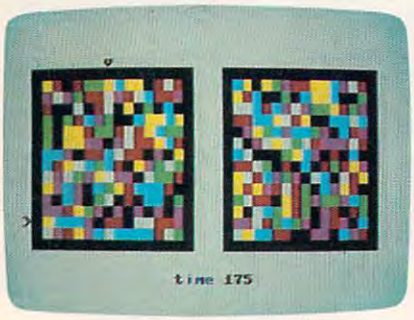
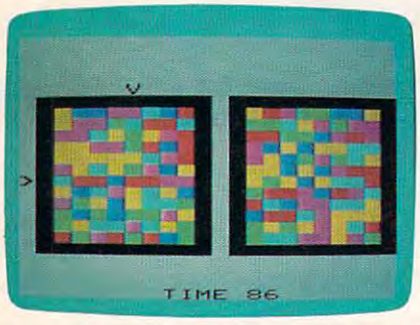
```
820 PRINTTAB(8)"{DOWN}FIRE BUT
    TON TO PLAY AGAIN{HOME}":W
    AIT56320,16,16:RUN:rem 238
830 A=15:D=107:POKE53248+21,0:
    POKE54277,A:POKE54284,A:PO
    KE54291,A:POKE54278,D
                        :rem 165
840 POKE54285,D:POKE54292,D:PO
    KE54286,50:POKE54287,40:PO
    KE54276,33          :rem 43
850 POKE54283,33:POKE54290,33:
    FORF1=Z1TOZ2STEPZ3:POKE542
    73,F1:POKE54287,F1:rem 226
860 FORF2=30TO1STEP-5:POKE5428
    0,F2:POKE53280,F2:NEXTF2,F
    1                   :rem 194
870 POKE54276,32:POKE54283,32:
    POKE54290,32:RETURN
                        :rem 127
880 POKE54277,26:POKE54276,23:
    POKE54273,30:RETURN
                        :rem 133
```



"Commodore 64 Puzzler" permits large puzzles with up to 16 different colors.



Index arrows indicate your position in "VIC-20 Puzzler."

Program 2: VIC-20 Puzzler

Version by Kevin Mykytyn, Editorial Programmer

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
10 X$="{RVS} {OFF}":CO(0)=0:CO
   (1)=6:CO(2)=2:DN$="{HOME}
   {22 DOWN}"           :rem 53
20 PRINT"{RED}{CLR}{4 DOWN}"SP
   C(8)"PUZZLER":PRINT"
   {4 DOWN}{BLK}{4 SPACES}ENTE
   R GRID SIZE":LN=2:HN=4
                        :rem 87
30 PRINT"{2 DOWN}{4 SPACES}COL
   UMNS? (2-4)":GOSUB370:COL=A
   :HN=6                :rem 199
40 PRINT"{2 DOWN}{4 SPACES}ROW
   S?{4 SPACES}(2-6)":GOSUB370
   :ROW=A               :rem 203
50 PRINT"{2 DOWN}HOW MANY COLO
   RS? (2-6)":GOSUB370:CR=A
                        :rem 19
70 PRINT"{CLR} {BLK} CONSTRUCT
   ING PUZZLE":PRINTDN$SPC(5)"
   {BLU}PLEASE WAIT{BLK}";
                        :rem 238
80 PRINTLEFT$(DN$,11-ROW):GOSU
   B390                 :rem 84
90 FORI=1TOROW*2:PRINTLEFT$(DN
   $,I+12-ROW);:PRINTSPC(5-COL
   )X$;:PRINTSPC(COL*2)X$;
                        :rem 98
95 PRINTSPC(9-2*COL)X$;:PRINTS
   PC(2*COL)X$;:NEXT:IFCOL<>4T
   HENPRINT             :rem 2
100 GOSUB390:A$="":FORA=1TOROW
   *COL*4:A$=A$+CHR$(INT(RND(
   1)*CR)+2):NEXTA:B$=A$
                        :rem 22
110 FORA=1TOROW*COL:Q=(A-1)*4+
   1:Q2=INT(RND(1)*ROW*COL)*4
   +1:GOSUB400:NEXT     :rem 132
120 FORA=1TOROW*COL:R=RND(1)*4
   :Q=(A-1)*4+1:GOSUB410:NEXT
   :IFA$=B$THEN110      :rem 37
130 FORA=1TOROW*COL:Q=(A-1)*4+
   1:T$=B$:XBAS=17-COL:YBAS=1
   3-ROW:GOSUB440:XBAS=6-COL
                        :rem 19
135 T$=A$:GOSUB440:NEXT
                        :rem 126
140 PRINT"{HOME}{OFF}
   {21 SPACES}":PRINTDN$"
   {BLK}{8 SPACES}TIME
   {4 SPACES}";         :rem 198
150 A=1:PB=1:OA=1:FL=0:TM=ROW*
   COL*2.5+30           :rem 85
160 IFFL=1THENQ2=(OA-1)*4+1:FL
   =2                   :rem 73
170 ZZ=A:A=OA:GOSUB460:A=ZZ:XP
   =XBAS-2:YP=YBAS+Y1*2:GOSUB
   600:PRINT" ";        :rem 116
175 YP=YBAS-2:XP=XBAS+X1*2:GOS
   UB600:PRINT" ";:GOSUB460
                        :rem 88
180 POKE646,CO(FL):YP=YBAS+Y1*
   2:XP=XBAS-2:GOSUB600:PRINT
   ">";:XP=XBAS+X1*2:YP=YBAS-
   2                    :rem 244
190 GOSUB600:POKE646,CO(FL):PR
   INT"V";:OA=A:MAX=ROW*COL:G
   ETK$                 :rem 36
200 IFK$="{UP}"THENA=A-COL:GOT
   O240                 :rem 164
210 IFK$="{LEFT}"THENA=A-1:GOT
   O240                  :rem 4
220 IFK$="{RIGHT}"THENA=A+1:GO
   TO240                :rem 131
230 IFK$="{DOWN}"THENA=A+COL:G
   OTO240               :rem 37
235 GOTO250             :rem 106
240 IFA>MAXORA<1THENA=OA
                        :rem 22
250 IFK$=OK$THEN290     :rem 90
260 OK$=K$:IFK$=CHR$(13)ANDFL=
   0THENFL=1:GOTO290    :rem 60
270 IFK$=CHR$(13)ANDFL=1THENQ=
   (A-1)*4+1:R=1:GOSUB410:T$=
   A$:GOSUB440:FL=0:GOTO290
                        :rem 250
280 IFK$=CHR$(13)ANDFL=2THENGO
   SUB470:FL=0          :rem 226
290 PRINTDN$SPC(12)INT(TM)"
   {LEFT} ";:TM=TM-.08
                        :rem 237
300 IFTM<0THENPRINTDN$"{BLU}
   {OFF}{7 SPACES}TIME'S UP
   {3 SPACES}";:Z1=255:Z2=150
   :GOTO330             :rem 95
310 IFA$=B$THENPRINTDN$"{BLU}
   {OFF}{3 SPACES}YOU SOLVED
   {SPACE}IT{3 SPACES}";:Z1=1
   50:Z2=255:GOTO330    :rem 116
320 IFA<>OATHEN160      :rem 53
322 IFK$=CHR$(13)THEN170
                        :rem 79
325 GOTO190             :rem 109
330 GOSUB360:PRINTDN$"
   {4 SPACES}PRESS ANY KEY";
                        :rem 9
340 POKE198,0:WAIT198,1:RUN
                        :rem 97
360 POKE36878,15:FORA=Z1TOZ2ST
   EP2*SGN(Z2-Z1):POKE36875,A
   :POKE36874,A-5       :rem 255
365 POKE36879,(PEEK(36879)AND2
   48)ORRND(1)*8:NEXTA:FORT=1
   5TO0STEP-1:POKE36878,T:NEX
   T                    :rem 109
367 POKE36879,27:RETURN
                        :rem 143
370 Z=RND(1):GETK$:A=VAL(K$):I
   FA<LNORA>HNTHEN370:rem 218
380 RETURN              :rem 123
390 PRINTSPC(5-COL);:FORI=1TO(
   COL+1)*2:PRINTX$;:NEXT:PRI
   NTSPC(9-2*COL);      :rem 13
395 FORI=1TO(COL+1)*2:PRINTX$;
   :NEXT:RETURN         :rem 218
400 T$=A$:GOSUB500:FORZ=0TO3:T
   =PEEK(Q+Z+BP):POKEQ+Z+BP,P
   EEK(Q2+Z+BP)         :rem 242
405 POKEQ2+Z+BP,T:NEXT:A$=T$:R
   ETURN                :rem 244
410 IFR=0THENRETURN     :rem 242
420 T$=A$:GOSUB500:FORX=1TOR:T
   =PEEK(BP+Q):POKEBP+Q,PEEK(
   BP+Q+2):POKEBP+Q+2,PEEK(BP
   +Q+3)                :rem 144
430 POKEBP+Q+3,PEEK(BP+Q+1):PO
   KEBP+Q+1,T:NEXT:A$=T$:RETU
   RN                   :rem 120
440 GOSUB460:XP=XBAS+X1*2:YP=Y
   BAS+Y1*2:GOSUB600:FORT=0TO
   3:IFT=2THENYP=YP+1:GOSUB60
   0                    :rem 109
450 POKE646,ASC(MID$(T$,Q+T,1)
   ):PRINTX$;:NEXT:RETURN
                        :rem 237
460 Z=A-1:Y1=INT(Z/COL):X1=Z-Y
   1*COL:RETURN         :rem 167
470 Q=(A-1)*4+1:GOSUB400:T$=A$
   :GOSUB440:ZZ=A:AA=Q:Q=Q2:A
   =(Q2-1)/4+1:T$=A$:GOSUB440
   :A=ZZ                :rem 131
480 Q=AA:RETURN         :rem 198
500 T$=T$:BP=PEEK(51)+256*PEEK
   (52)-1:RETURN        :rem 238
600 PRINTLEFT$(DN$,YP)SPC(XP);
   :RETURN              :rem 130
```

Program 3: Puzzler For Commodore Plus/4 And 16

Version by Patrick Parrish, Programming Supervisor

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
10 X$="{RVS} {OFF}":CO(0)=1:CO
   (1)=7:CO(2)=3:DN$="{HOME}
   {22 DOWN}":COLOR0,2:COLOR4,
   2
20 PRINT"{73}{CLR}{6 DOWN}"SPC(
   16)"PUZZLER":PRINT"{3 DOWN}
```

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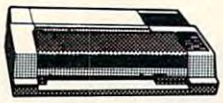

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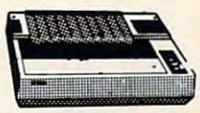

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```
    {BLK}"SPC(12)"ENTER GRID SI
    ZE:":LN=2:HN=7
 30 PRINT"{DOWN}"SPC(12)"COLUMN
    S? (2-7)":GOSUB430:COL=A
 40 PRINT"{DOWN}"SPC(12)"ROWS?
    {4 SPACES}(2-7)":GOSUB430:R
    OW=A
 50 PRINT"{DOWN}"SPC(10)"HOW MA
    NY COLORS? (2-7)":GOSUB430:
    CR=A
 60 PRINT"{CLR}"SPC(10)"CONSTRU
    CTING PUZZLE":PRINTDN$SPC(1
    4)"{ß7}PLEASE WAIT{BLK}";
 70 PRINTLEFT$(DN$,11-ROW):GOSU
    B450
 80 FORI=1TOROW*2:PRINTLEFT$(DN
    $,I+12-ROW);:PRINTSPC(9-COL
    )X$;:PRINTSPC(COL*2)X$;
 90 PRINTSPC(17-2*COL)X$;:PRINT
    SPC(2*COL)X$;:NEXT:PRINT
100 GOSUB450:A$="":FORA=1TOROW
    *COL*4:A$=A$+CHR$(INT(RND(
    0)*CR)+2):NEXTA:B$=A$
110 FORA=1TOROW*COL:Q=(A-1)*4+
    1:Q2=INT(RND(1)*ROW*COL)*4
    +1:GOSUB470:NEXT
120 FORA=1TOROW*COL:R=RND(1)*4
    :Q=(A-1)*4+1:GOSUB490:NEXT
    :IFA$=B$THEN110
130 FORA=1TOROW*COL:Q=(A-1)*4+
    1:T$=B$:XBAS=29-COL:YBAS=1
    3-ROW:GOSUB520:XBAS=10-COL
140 T$=A$:GOSUB520:NEXT
150 PRINT"{HOME}{OFF}"SPC(10)"
    {19 SPACES}":PRINTDN$SPC(1
    4)"{2 SPACES}{ß7}TIME
    {6 SPACES}";
160 A=1:PB=1:OA=1:FL=0:TM=ROW*
    COL*3+30
170 IFFL=1THENQ2=(OA-1)*4+1:FL
    =2
180 ZZ=A:A=OA:GOSUB540:A=ZZ:XP
    =XBAS-2:YP=YBAS+Y1*2:GOSUB
    580:PRINT" ";
190 YP=YBAS-2:XP=XBAS+X1*2:GOS
    UB580:PRINT" ";:GOSUB540
200 COLOR1,CO(FL),4:YP=YBAS+Y1
    *2:XP=XBAS-2:GOSUB580:PRIN
    T">";:XP=XBAS+X1*2:YP=YBAS
    -2
210 GOSUB580:COLOR1,CO(FL),4:P
    RINT"V";:OA=A:MAX=ROW*COL:
    GETK$
220 IFK$="{UP}"THENA=A-COL:GOT
    O270
230 IFK$="{LEFT}"THENA=A-1:GOT
    O270
240 IFK$="{RIGHT}"THENA=A+1:GO
    TO270
250 IFK$="{DOWN}"THENA=A+COL:G
    OTO270
260 GOTO280
270 IFA>MAXORA<1THENA=OA
280 IFK$=OK$THEN320
290 OK$=K$:IFK$=CHR$(13)ANDFL=
    0THENFL=1:GOTO320
300 IFK$=CHR$(13)ANDFL=1THENQ=
    (A-1)*4+1:R=1:GOSUB490:T$=
    A$:GOSUB520:FL=0:GOTO320
310 IFK$=CHR$(13)ANDFL=2THENGO
    SUB550:FL=0
320 PRINTDN$"{BLK}"SPC(20)INT(
    TM)"{LEFT} ";:TM=TM-.08
330 IFTM<0THENPRINTDN$SPC(10)"
    {ß7}{OFF}{5 SPACES}TIME'S U
    P{3 SPACES}";:Z1=1023:Z2=0
    :GOTO380
340 IFA$=B$THENPRINTDN$SPC(10)
    "{ß7}{OFF}{3 SPACES}YOU SOL
    VED IT!{2 SPACES}";:Z1=0:Z
    2=1023:GOTO380
350 IFA<>OATHEN170
```

"Puzzler" for the Commodore Plus/4 and 16 uses keyboard controls.

```
360 IFK$=CHR$(13)THEN180
370 GOTO210
380 GOSUB400:PRINTDN$SPC(10)"
    {3 SPACES}PRESS ANY KEY";
390 POKE239,0:WAIT239,1:RUN
400 VOL 8:FORA=Z1TOZ2STEP10*SG
    N(Z2-Z1):SOUND 1,A,2
410 COLOR0,RND(1)*15+1:NEXTA:F
    ORT=8TO0STEP-1:VOL T:NEXT
420 COLOR0,2:COLOR4,2:RETURN
430 Z=RND(1):GETK$:A=VAL(K$):I
    FA<LNORA>HNTHEN430
440 RETURN
450 PRINTSPC(9-COL);:FORI=1TO(
    COL+1)*2:PRINTX$;:NEXT:PRI
    NTSPC(17-2*COL);
460 FORI=1TO(COL+1)*2:PRINTX$;
    :NEXT:RETURN
470 T$=A$:GOSUB570:FORZ=0TO3:T
    =PEEK(Q+Z+BP):POKEQ+Z+BP,P
    EEK(Q2+Z+BP)
480 POKEQ2+Z+BP,T:NEXT:A$=T$:R
    ETURN
490 IFR=0THENRETURN
500 T$=A$:GOSUB570:FORX=1TOR:T
    =PEEK(BP+Q):POKEBP+Q,PEEK(
    BP+Q+2):POKEBP+Q+2,PEEK(BP
    +Q+3)
510 POKEBP+Q+3,PEEK(BP+Q+1):PO
    KEBP+Q+1,T:NEXT:A$=T$:RETU
    RN
520 GOSUB540:XP=XBAS+X1*2:YP=Y
    BAS+Y1*2:GOSUB580:FORT=0TO
    3:IFT=2THENYP=YP+1:GOSUB58
    0
530 P=ASC(MID$(T$,Q+T,1)):COLO
    R1,P+(P=4)*2,P-1-(P=4)*4:P
    RINTX$;:NEXT:RETURN
540 Z=A-1:Y1=INT(Z/COL):X1=Z-Y
    1*COL:RETURN
550 Q=(A-1)*4+1:GOSUB470:T$=A$
    :GOSUB520:ZZ=A:AA=Q:Q=Q2:A
    =(Q2-1)/4+1:T$=A$:GOSUB520
    :A=ZZ
560 Q=AA:RETURN
570 T$=T$:BP=PEEK(51)+256*PEEK
    (52)-1:RETURN
580 PRINTLEFT$(DN$,YP)SPC(XP);
    :RETURN
```

Program 4: Atari Puzzler

Version by Kevin Mykytyn, Editorial Programmer

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
AG 10 OPEN #1,4,12,"K:":POKE
      106,PEEK(106)-8:GRAPH
      ICS 0:CHBAS=PEEK(106)*
      256:POKE 82,0:SOUND 0,
      0,0,0
CI 20 POKE 752,1:POSITION 14
      ,11:PRINT "PLEASE WAIT
      "
IJ 30 FOR A=0 TO 1023:POKE C
      HBAS+A,PEEK(57344+A):N
      EXT A:FOR A=CHBAS+8 TO
       CHBAS+39:READ B:POKE
      A,B:NEXT A:GRAPHICS 0
GJ 40 SPRBAS=PEEK(106)+4:POK
      E 53277,3:POKE 623,1:P
      OKE 704,0
HM 50 SPR=SPRBAS*256+512:OY=
      SPR:FOR A=SPR TO SPR+1
      27:POKE A,0:NEXT A:POK
      E 53256,1
HD 60 DIM T$(256),A$(256),B$
      (256),T2$(1),R(4),SP(8
      ):FOR A=1 TO 8:READ Z:
      SP(A)=Z:NEXT A
BF 70 GRAPHICS 17:POSITION 7
      ,6:PRINT #6;"puzzler":
      FOR A=1 TO 3:R(A)=32+A
      :NEXT A:R(4)=161
EE 80 POSITION 3,10:PRINT #6
      ;"enter grid size":LN=
      3:HN=8
HG 90 POSITION 3,14:PRINT #6
      ;"COLUMNS ? (3-8)":GOS
      UB 480:COL=A
LK 100 POSITION 3,14:PRINT #
       6;"ROWS{3 SPACES}":GO
       SUB 480:ROW=A
BO 110 POSITION 3,10:PRINT #
       6;"HOW MANY COLORS ?"
       :LN=2:HN=4
IN 120 POSITION 3,14:PRINT #
       6;"{5 SPACES}(2-4)
       {6 SPACES}":GOSUB 480
       :COLR=A
FD 130 GRAPHICS 0:DL=PEEK(56
       0)+256*PEEK(561):POKE
        DL+3,66:FOR I=DL+6 T
       O DL+27:POKE I,4:NEXT
        I
EN 140 POKE I,6:I=I+1:POKE I
       ,65:POKE I+1,0:POKE I
       +2,DL/256:POKE 82,0
GP 150 POSITION 11,0:PRINT "
       CONSTRUCTING PUZZLE":
       POSITION 5,23:PRINT "
       PLEASE WAIT";:POKE 75
       6,CHBAS/256
EO 160 POKE 559,46:POKE 5427
       9,SPRBAS:POSITION 0,1
       2-ROW:GOSUB 520
IF 170 FOR I=1 TO ROW*2:PRIN
       T :POKE 85,10-COL:PRI
       NT "$";:POKE 85,11+CO
       L:PRINT "$";:POKE 85,
       29-COL:PRINT "$";
BB 180 POKE 85,30+COL:PRINT
       "$";:NEXT I:PRINT :GO
       SUB 520
FD 190 FOR A=1 TO ROW*COL*4:
       A$(A,A)=CHR$(R(INT(RN
       D(1)*COLR+1))):B$(A,A
       )=A$(A,A):NEXT A
MJ 200 FOR A=1 TO ROW*COL:Q=
       (A-1)*4+1:Q2=INT(RND(
       1)*ROW*COL)*4+1:GOSUB
        530:NEXT A
GK 210 FOR A=1 TO ROW*COL:R=
       RND(1)*4:Q=(A-1)*4+1:
       GOSUB 540:NEXT A:IF A
       $=B$ THEN 200
KC 220 FOR A=1 TO ROW*COL:Q=
       (A-1)*4+1:T$=B$:XBAS=
       30-COL:YBAS=13-ROW:GO
       SUB 570:XBAS=11-COL:T
       $=A$:GOSUB 570:NEXT A
KM 230 POSITION 11,0:PRINT "
```

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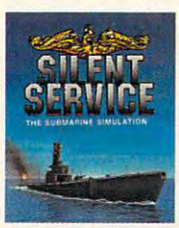

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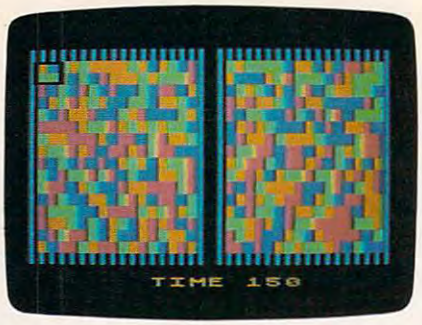


Play "Atari Puzzler" with a joystick.

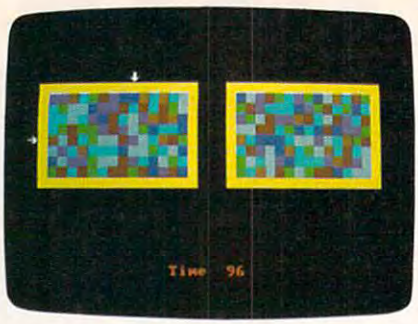
```
      {22 SPACES}":POKE DL+3
      ,68:POSITION 3,23:PRI
      NT "{4 SPACES}TIME
      {7 SPACES}";
EO 240 A=1:PB=1:OA=1:TIME=10
      000
FN 250 IF PEEK(704)=15 THEN
      Q2=(OA-1)*4+1:POKE 70
      4,47
HK 260 GOSUB 590:POKE 53248,
      0:FOR X=OY TO OY+7:PO
      KE X,0:NEXT X
KD 270 OY=Y1*8+16+YBAS*4+SPR
      :FOR X=1 TO 8:POKE OY
      +X-1,SP(X):NEXT X:POK
      E 53248,46+XBAS*4+X1*
      8
HD 280 OA=A:MAX=ROW*COL:J=ST
      ICK(0)-6:ON J GOTO 29
      0,340,340,340,300,340
      ,310,320:GOTO 340
LP 290 A=A+1:GOTO 330
LJ 300 A=A-1:GOTO 330
GF 310 A=A+COL:GOTO 330
FP 320 A=A-COL
BG 330 IF A>MAX OR A<1 THEN
      A=OA
MJ 340 IF STRIG(0)=PB THEN 3
      80
JL 350 PB=STRIG(0):IF STRIG(
      0)=0 AND PEEK(704)=0
      THEN POKE 704,15:GOTO
       380
PC 360 IF STRIG(0)=0 AND PEE
      K(704)=15 THEN Q=(A-1
      )*4+1:R=1:GOSUB 540:T
      $=A$:GOSUB 570:POKE 7
      04,0:GOTO 380
NB 370 IF STRIG(0)=0 AND PEE
      K(704)=47 THEN GOSUB
      600:POKE 704,0
IB 380 POSITION 12,23:PRINT
      INT(TIME);" ";:TIME=T
      IME-0.1
JK 390 IF TIME<0 THEN POSITI
      ON 3,23:PRINT "
      {3 SPACES}TIME'S UP
      ";:Z1=20:Z2=70:GOTO 4
      30
DB 400 IF A$(1,ROW*COL*4)=B$
      (1,ROW*COL*4) THEN PO
      SITION 4,23:PRINT "YO
      U SOLVED IT";:Z1=70:Z
      2=20:GOTO 430
GO 410 IF A<>OA THEN GOTO 25
      0
GJ 420 GOTO 280
PI 430 GOSUB 460:POSITION 2,
      23:PRINT "PRESS FIREB
      UTTON";
PI 440 IF STRIG(0) THEN 440
AE 450 POKE 53248,0:GOTO 70
FC 460 FOR A=Z1 TO Z2 STEP S
      GN(Z2-Z1):SOUND 0,A,1
      0,15:FOR T=A-1 TO A+1
      :SOUND 1,T,10,15:NEXT
       T:POKE 712,A
AL 470 NEXT A:POKE 712,0:FOR
       A=15 TO 0 STEP -1:SO
      UND 0,Z2,10,A:SOUND 1
      ,Z2,10,A:NEXT A:RETUR
      N
MM 480 GET #1,A:IF A<LN+48 O
      R A>HN+48 THEN 480
AP 490 A=A-48:RETURN
KL 500 DATA 255,255,255,255,
      255,255,255,255,170,1
      70,170,170,170,170,17
      0,170,85,85,85,85,85,
      85,85,85
JK 510 DATA 220,220,220,220,
      220,220,220,220,252,1
      32,132,132,132,132,13
      2,252
BE 520 FOR I=1 TO (COL+1)*2:
      POKE 85,9-COL+I:PRINT
       "$";:POKE 85,28-COL+
      I:PRINT "$";:NEXT I:R
      ETURN
BN 530 T$=A$(Q,Q+3):A$(Q,Q+3
      )=A$(Q2,Q2+3):A$(Q2,Q
      2+3)=T$:RETURN
PG 540 IF R=0 THEN RETURN
IE 550 T$=A$(Q,Q+3):FOR X=1
      TO R:T2$=T$(1,1):T$(1
      ,1)=T$(3,3):T$(3,3)=T
      $(4,4):T$(4,4)=T$(2,2
      ):T$(2,2)=T2$
BN 560 NEXT X:A$(Q,Q+3)=T$:R
      ETURN
IC 570 GOSUB 590:POSITION XB
      AS+X1*2,YBAS+Y1*2:PRI
      NT T$(Q,Q+1):POSITION
       XBAS+X1*2,YBAS+Y1*2+
      1
JG 580 PRINT T$(Q+2,Q+3):RET
      URN
KL 590 Z=A-1:Y1=INT(Z/COL):X
      1=Z-Y1*COL:RETURN
OO 600 Q=(A-1)*4+1:GOSUB 530
      :T$=A$:GOSUB 570:ZZ=A
      :AA=Q:Q=Q2:A=(Q2-1)/4
      +1:T$=A$:GOSUB 570:A=
      ZZ:Q=AA:RETURN
```

Program 5: Puzzler For IBM PC/PCjr

Version by Kevin Mykytyn, Editorial Programmer

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
HP 10 DEF SEG=0:POKE 1047,64:WID
      TH 40:KEY OFF:SCREEN 0,0:C
      LS:X$=CHR$(219):CO(0)=15:C
      O(1)=14:CO(2)=12
KF 20 COLOR 12:LOCATE 5,18,0:PRI
      NT "Puzzler":COLOR 9:LOCAT
      E 10,14:PRINT "Enter grid
      size":LN=3:HN=7
OM 30 LOCATE 14,14:PRINT "Column
      s? (3-7)":GOSUB 370:COL=A
CF 40 COLOR 10:LOCATE 14,14:PRIN
      T "Rows?    ":GOSUB 370:ROW
      =A
EO 50 COLOR 14:LOCATE 10,14:PRIN
      T "How many colors?":LN=2:
      HN=7
PM 60 LOCATE 14,14:PRINT "     (
      2-7)      ":GOSUB 370:COLR=
      A
DF 70 CLS:LOCATE 1,12:PRINT "Con
      structing puzzle":LOCATE 2
      5,16:COLOR 11:PRINT "Pleas
      e wait";:COLOR 14
OL 80 LOCATE 12-ROW,1:GOSUB 390
CD 90 FOR I=1 TO ROW*2:PRINT:PRI
      NT TAB(10-COL)X$;:PRINT TA
      B(11+COL)X$;:PRINT TAB(29-
      COL)X$;:PRINT TAB(30+COL)X
      $;:NEXT:PRINT:GOSUB 390
MH 100 A$="":FOR A=1 TO ROW*COL*
      4:A$=A$+CHR$(INT(RND(1)*C
      OLR)+1):NEXT A:B$=A$
KN 110 FOR A=1 TO ROW*COL:Q=(A-1
      )*4+1:Q2=INT(RND(1)*ROW*C
      OL)*4+1:GOSUB 400:NEXT A
DH 120 FOR A=1 TO ROW*COL:R=RND(
      1)*4:Q=(A-1)*4+1:GOSUB 41
      0:NEXT:IF A$=B$ THEN 110
QN 130 FOR A=1 TO ROW*COL:Q=(A-1
      )*4+1:T$=B$:XBAS=30-COL:Y
      BAS=13-ROW:GOSUB 440:XBAS
      =11-COL:T$=A$:GOSUB 440:N
      EXT
EP 140 LOCATE 1,12:PRINT STRING$
      (20,32):LOCATE 25,13:COLO
      R 12:PRINT "   Time
      ";
PB 150 A=1:PB=1:OA=1:FL=0:TIME=R
      OW*COL*2.5+30
DD 160 IF FL=1 THEN Q2=(OA-1)*4+
      1:FL=2
KA 170 COLOR CO(FL):ZZ=A:A=OA:GO
      SUB 460:A=ZZ:LOCATE YBAS+
      Y1*2,XBAS-2:PRINT " ";:LO
      CATE YBAS-2,XBAS+X1*2:PRI
      NT " ";
CJ 180 GOSUB 460:LOCATE YBAS+Y1*
      2,XBAS-2:PRINT CHR$(26);:
      LOCATE YBAS-2,XBAS+X1*2:P
      RINT CHR$(25);
BA 190 OA=A:MAX=ROW*COL:K$=INKEY
      $:K$=RIGHT$(K$,1):J=ASC(K
      $+CHR$(0))-71:ON ABS(J) G
      OTO 200,250,250,210,250,2
      20,250,250,230:GOTO 250
QK 200 A=A-COL:GOTO 240
LO 210 A=A-1:GOTO 240
KA 220 A=A+1:GOTO 240
DP 230 A=A+COL
PL 240 IF A>MAX OR A<1 THEN A=OA
EG 250 IF J=PB THEN 290
OD 260 PB=J:IF J=-58 AND FL=0 TH
      EN FL=1:GOTO 290
DM 270 IF J=-58 AND FL=1 THEN Q=
      (A-1)*4+1:R=1:GOSUB 410:T
      $=A$:GOSUB 440:FL=0:GOTO
      290
EP 280 IF J=-58 AND FL=2 THEN GO
      SUB 470:FL=0
KB 290 LOCATE 25,21:COLOR 12:PRI
      NT INT(TIME)" ";:TIME=TIM
      E-.025
KA 300 IF TIME<0 THEN LOCATE 25,
      13:PRINT "    Time's up
      ";:Z1=500:Z2=100:GOTO 3
      30
```



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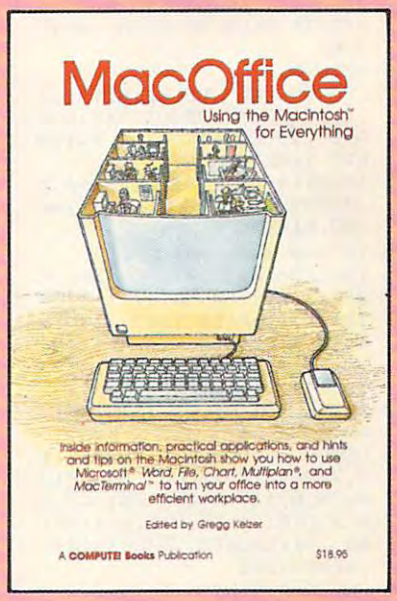

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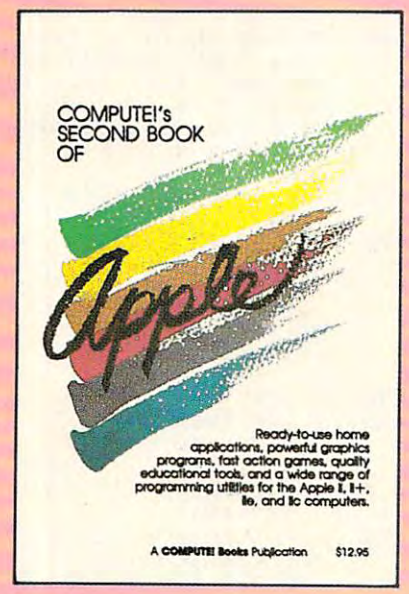

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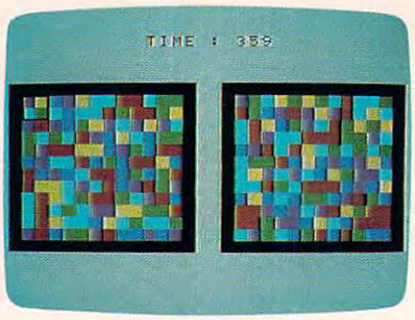
```
OC 310 IF A$=B$ THEN LOCATE 25,1
      5:PRINT "You solved it";:
      Z1=100:Z2=500:GOTO 330
NF 320 IF A<>0A THEN 160 ELSE IF
       J=-58 THEN 170 ELSE 190
PB 330 GOSUB 360:LOCATE 25,13:PR
      INT " Press any key  ";
EM 340 A$=INKEY$:IF A$="" THEN 3
      40
GH 350 RUN
PD 360 FOR A=Z1 TO Z2 STEP 20*SG
      N(Z2-Z1):SOUND A,2:COLOR
      0,0,RND(1)*6+1:FOR TD=1 T
      O 99:NEXT:NEXT:COLOR 15,0
      ,0:RETURN
LE 370 Z=RND(1):K$=INKEY$:A=VAL(
      K$):IF A<LN OR A>HN THEN
      370
NN 380 RETURN
QI 390 FOR I=1 TO (COL+1)*2:LOCA
      TE ,9-COL+I:PRINT X$;:LOC
      ATE ,28-COL+I:PRINT X$;:N
      EXT I:RETURN
GK 400 T$=MID$(A$,Q,4):MID$(A$,Q
      ,4)=MID$(A$,Q2,4):MID$(A$
      ,Q2,4)=T$:RETURN
BG 410 IF R=0 THEN RETURN
PK 420 T$=MID$(A$,Q,4):FOR X=1 T
      O R:T2$=MID$(T$,1,1):MID$
      (T$,1,1)=MID$(T$,3,1):MID
      $(T$,3,1)=MID$(T$,4,1):MI
      D$(T$,4,1)=MID$(T$,2,1):M
      ID$(T$,2,1)=T2$
OF 430 NEXT:MID$(A$,Q,4)=T$:RETU
      RN
GC 440 GOSUB 460:LOCATE YBAS+Y1*
      2,XBAS+X1*2:COLOR ASC(MID
      $(T$,Q,1)):PRINT X$;:COLO
      R ASC(MID$(T$,Q+1,1)):PRI
      NT X$;:LOCATE YBAS+Y1*2+1
      ,XBAS+X1*2
DH 450 COLOR ASC(MID$(T$,Q+2,1))
      :PRINT X$;:COLOR ASC(MID$
      (T$,Q+3,1)):PRINT X$;:RET
      URN
EB 460 Z=A-1:Y1=INT(Z/COL):X1=Z-
      Y1*COL:RETURN
CP 470 Q=(A-1)*4+1:GOSUB 400:T$=
      A$:GOSUB 440:ZZ=A:AA=Q:Q=
      Q2:A=(Q2-1)/4+1:T$=A$:GOS
      UB 440:A=ZZ:Q=AA:RETURN
```

Program 6: TI-99/4A Puzzler

Version by Patrick Parrish, Programming Supervisor

```
100 RANDOMIZE :: CALL CLE
    AR :: GOSUB 380 :: CA
    LL MAGNIFY(3)
110 GOSUB 370 :: CALL SCR
    EEN(2):: DISPLAY AT(7
    ,11):"PUZZLER !" :: D
    ISPLAY AT(12,4):"INPU
    T GRID SIZE (3-6)
120 DISPLAY AT(14,11):"RO
    WS ?" :: ACCEPT AT(14
    ,18):R :: IF R<3 OR R
    >6 THEN 120
130 DISPLAY AT(16,10):"CO
    LUMNS ?" :: ACCEPT AT
    (16,20):C :: IF C<3 O
    R C>6 THEN 130
140 DISPLAY AT(18,3):"HOW
     MANY COLORS (2-6)?"
    :: ACCEPT AT(18,26):C
    OLS :: IF COLS<2 OR C
    OLS>6 THEN 140
150 CALL CLEAR :: FOR I=1
     TO 8 :: CALL COLOR(I
```



"Puzzler" for the TI-99/4A can be played with a joystick or the keyboard.

```
    ,2,1):: NEXT I :: CAL
    L SCREEN(15):: U=C*2+
    3 :: U=INT((19-U)/2):
    : D=R*C*10
160 TE=12-R :: DISPLAY AT
    (2,5):"CONSTRUCTING P
    UZZLE" :: DISPLAY AT(
    23,9):"PLEASE WAIT"
170 MT=C*2+2 :: CALL HCHA
    R(TE,U,35,MT):: CALL
    HCHAR(TE,U+16,35,MT):
    : A=R*2
180 CALL VCHAR(TE+1,U,35,
    A):: CALL VCHAR(TE+1,
    U+C*2+1,35,A):: CALL
    VCHAR(TE+1,U+16,35,A)
    :: CALL VCHAR(TE+1,U+
    C*2+17,35,A)
190 CALL HCHAR(A+TE+1,U,3
    5,MT):: CALL HCHAR(A+
    TE+1,U+16,35,MT):: Y=
    TE+1 :: X=U
200 A$="" :: FOR I=1 TO R
    *C*4 :: RANDOMIZE ::
    A$=A$&CHR$(INT(RND*CO
    LS)*8+96):: NEXT I ::
     B$=A$ :: FOR I=1 TO
    R*C
210 R1=INT(R*C*RND)*4+1 :
    : R2=INT(R*C*RND)*4+1
    :: IF R1=R2 THEN 210
220 TEM$=SEG$(A$,R1,4)::
    TEM2$=SEG$(A$,R2,4)::
     GOSUB 490 :: NEXT I
    :: FOR T=1 TO R*C*4-3
     STEP 4
230 TEM$=SEG$(A$,T,4):: R
    1=INT(RND*4):: FOR J=
    1 TO R1 :: GOSUB 520
    :: NEXT J :: GOSUB 53
    0 :: NEXT T :: IF A$=
    B$ THEN 200
240 FOR I=0 TO R-1 :: FOR
     J=0 TO C-1 :: GOSUB
    420
250 DISPLAY AT(Y+2*I,X+2*
    J+15):SEG$(B$,J*4+1+I
    NT((2*I+1)/2)*C*4,2);
    :: DISPLAY AT(Y+2*I+1
    ,X+2*J+15):SEG$(B$,J*
    4+3+INT((2*I+1)/2)*C*
    4,2);
260 NEXT J :: NEXT I :: C
    ALL HCHAR(2,7,32,19):
    : CALL HCHAR(23,11,32
    ,11):: SC=2 :: LY=TE*
    8+1 :: LX=U*8+1 :: SY
    =LY :: SX=LX :: Q=1 :
    : F,I,J=0
270 DISPLAY AT(2,10):"TIM
    E :";D
280 CALL SPRITE(#1,100,CS
    (F),SY,SX):: D=D-.25
    :: DISPLAY AT(2,16):I
    NT(D):: IF INT(D)=0 T
    HEN GOTO 340
290 CALL KEY(0,K,ST):: CA
    LL KEY(1,KK,ST):: IF
    ST=0 THEN CALL JOYST(
    1,H,V):: H=SGN(H):: V
    =SGN(-V)ELSE H=(K=83)
    -(K=68):: V=(K=69)-(K
    =88)
300 J=J+H :: I=I+V :: J=J
    +(J>C-1)*C-(J<0)*C ::
     I=I+(I>R-1)*R-(I<0)*
    R :: SX=LX+J*16 :: SY
    =LY+I*16 :: IF KK=18
    OR K=32 THEN GOSUB440
310 IF (OX<>SX OR OY<>SY)
    AND F=1 THEN F=2 :: G
    OSUB 470
320 IF A$<>B$ THEN 280
330 FOR I=1 TO 30 STEP 3
    :: CALL SOUND(75,220+
    20*I,4):: CALL SCREEN
    (INT(I/2)+1):: NEXT I
     :: REM WIN GAME
340 FOR I=30 TO 1 STEP -3
     :: CALL SOUND(75,220
    +20*I,4):: CALL SCREE
    N(INT(I/2)+1):: NEXT
    I :: CALL SCREEN(15)
350 DISPLAY AT(23,6):"PLA
    Y AGAIN (Y/N)?" :: AC
    CEPT AT(23,24)BEEP VA
    LIDATE("YNyn"):A$ ::
    IF A$="N" OR A$="n" T
    HEN STOP
360 CALL DELSPRITE(#1)::
    GOTO 110
370 CALL CLEAR :: FOR I=1
     TO 8 :: CALL COLOR(I
    ,16,1):: NEXT I :: RE
    TURN
380 CALL CHAR(100,"FF8080
    8080808080808080808
    080FFFF0101010101010101
    0101010101101FF")
390 FOR I=96 TO 136 STEP
    8 :: CALL CHAR(I,"FFF
    FFFFFFFFFFFFF"):: NEX
    T I
400 FOR I=9 TO 14 :: READ
     A :: CALL COLOR(I,A,
    1):: NEXT I :: CALL C
    HAR(35,RPT$("F",16)):
    : FOR F=0 TO 2 :: REA
    D CS(F):: NEXT F :: R
    ETURN
410 DATA 3,5,7,8,11,14,2,
    16,10
420 DISPLAY AT(Y+2*I,X+2*
    J-1):SEG$(A$,J*4+1+IN
    T((I*2+1)/2)*C*4,2);:
    : DISPLAY AT(Y+2*I+1,
    X+2*J-1):SEG$(A$,J*4+
    3+INT((2*I+1)/2)*C*4,
    2);
430 RETURN
440 IF F=0 THEN OX=SX ::
    OY=SY :: GOSUB 510 ::
     R1=T :: F=1 :: GOSUB
     470 :: OJ=J :: OI=I
    :: RETURN
450 IF F=1 THEN GOSUB 510
    :: TEM$=SEG$(A$,T,4)
    :: GOSUB 520 :: GOSUB
     530 :: GOSUB 420 ::
    F=0 :: GOSUB 470 :: R
    ETURN
460 GOSUB 510 :: R2=T ::
    GOSUB 480 :: GOSUB 42
    0 :: TJ=J :: TI=I ::
    I=OI :: J=OJ :: GOSUB
```

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```
      420 :: F=0 :: GOSUB
     470 :: J=TJ :: I=TI :
     : RETURN
470  CALL COLOR(#1,CS(F)):
     : RETURN
480  IF R1=R2 THEN RETURN
     :: REM TRANSPOSE
490  IF R2>R1 THEN A=R1 ::
      B=R2 ELSE A=R2 :: B=
     R1
500  A$=SEG$(A$,1,A-1)&SEG
     $(A$,B,4)&SEG$(A$,A+4
     ,B-A-4)&SEG$(A$,A,4)&
     SEG$(A$,B+4,LEN(A$)-B
     +5):: RETURN
510  T=J*4+1+INT((I*2+1)/2
     )*C*4 :: RETURN :: RE
     M CALC STRING POINTER
520  TEM$=SEG$(TEM$,3,1)&S
     EG$(TEM$,1,1)&SEG$(TE
     M$,4,1)&SEG$(TEM$,2,1
     ):: RETURN :: REM ROT
     ATE
530  A$=SEG$(A$,1,T-1)&TEM
     $&SEG$(A$,T+4,LEN(A$)
     -T-3):: RETURN :: REM
      SUBSTITUTE ROTATED S
     UBSTRING
```

"Puzzler" runs on any Apple II-series computer.

Program 7: Apple Puzzler

Version by Kevin Martin, Editorial Programmer

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
29 100 A$ = "": IF PEEK (24576)
       = 162 THEN 140
55 110 FOR I = 24576 TO 24872
B2 120 READ A: POKE I,A
FE 130 NEXT
C5 140 HIMEM: 24576
50 150 GOSUB 550
50 160 IF T = 0 THEN VTAB 21: PR
       INT TAB( 14)"OUT OF TIME"
       : GOTO 380
DB 170 HTAB 17: VTAB 23: PRINT T
       ;" "
47 180 T = T - 1
2A 190 IF PEEK ( - 16384) < 128
       THEN 160
90 200 GET C$: IF (C$ < "I" OR C
       $ > "L") AND C$ < > " " T
       HEN 160
81 210 R = R - (C$ = "I") + (C$
       = "K")
59 220 C = C - (C$ = "J") + (C$
       = "L")
7E 230 IF R < 0 THEN R = 0
9E 240 IF R > = R3 THEN R = R3 -
        1
AF 250 IF C < 0 THEN C = 0
DE 260 IF C > = C3 THEN C = C3 -
        1
61 270 POKE 773,X1 + C * 2 - 1:
       POKE 772,Y1 + R * 2 - 1:
       CALL 24671
C0 280 IF C$ < > " " THEN 160
46 290 IF F = 0 THEN 440
0A 300 F = 0: IF RR = R AND CC =
        C THEN GOSUB 510: GOTO 3
       20
4B 310 GOSUB 460
D2 320 CALL 24691
C4 330 POKE 768,X1: POKE 769,Y1:
        CALL 24576
B0 340 POKE 773,X1 + C * 2 - 1:
       POKE 772,Y1 + R * 2 - 1:
       POKE 774,255: CALL 24753
C3 350 IF A$ < > B$ THEN 160
DA 360 CALL 24691
74 370 HOME : PRINT TAB( 16);"CO
       RRECT!"
59 380 HTAB 13: VTAB 22: PRINT "
       PRESS ANY KEY."
1C 390 HTAB 17: VTAB 23: PRINT T
0F 400 POKE - 16368,0
0F 410 IF PEEK ( - 16384) < 128
       THEN 410
D4 420 GET A$
AC 430 RUN
3D 440 F = 1:RR = R:CC = C: POKE
        773,X1 + C * 2 - 1: POKE
       772,Y1 + R * 2 - 1: POKE
       774,119: CALL 24671
9D 450 GOTO 160
B8 460 AA = SS + 2 * NC * RR + 2
       * CC:A = SS + 2 * NC * R
       + C * 2
04 470 D = PEEK (A): POKE A, PEE
       K (AA): POKE AA,D
C0 480 D = PEEK (A + 1): POKE A
       + 1, PEEK (AA + 1): POKE
       AA + 1,D
9B 490 D = PEEK (A + NC): POKE A
       + NC, PEEK (AA + NC): PO
       KE AA + NC,D
A4 500 D = PEEK (A + NC + 1): PO
       KE A + NC + 1, PEEK (AA +
        NC + 1): POKE AA + NC +
       1,D: RETURN
4E 510 A = SS + 2 * NC * R + C *
       2
4B 520 D = PEEK (A): POKE A, PEE
       K (A + NC)
4E 530 POKE A + NC, PEEK (A + NC
       + 1)
6F 540 POKE A + NC + 1, PEEK (A
       + 1): POKE A + 1,D: RETUR
       N
62 550 TEXT : HOME
0B 560 PRINT TAB( 16);"PUZZLER"
F2 570 INPUT "NUMBER OF ROWS (2-
       7):";R3
B8 580 IF R3 < 2 OR R3 > 7 THEN
       570
77 590 INPUT "NUMBER OF COLUMNS
       (2-7):";C3
6F 600 IF C3 < 2 OR C3 > 7 THEN
       590
8C 610 INPUT "NUMBER OF COLORS (
       2-15):";CO
FD 620 IF CO < 2 OR CO > 15 THEN
        610
0D 630 PRINT "PLEASE WAIT..."
FC 640 NR = 2 * R3:NC = 2 * C3
7E 650 FOR A = 1 TO NR * NC:B =
       INT ( RND (1) * CO + 1):A
       $ = A$ + CHR$ (B + B * 16
       ): NEXT :B$ = A$
A2 660 A = PEEK (105) + PEEK (10
       6) * 256
CF 670 SS = PEEK (A + 3) + PEEK
       (A + 4) * 256
54 680 X1 = 10 - C3:Y1 = 9 - R3:
       X2 = X1 + 20
50 690 POKE 24600, PEEK (A + 3):
       POKE 24601, PEEK (A + 4)
96 700 POKE 768,X2: POKE 769,Y1:
       POKE 770,NC: POKE 771,NR
       + Y1
49 710 GR
F4 720 CALL 24576
ED 730 FOR R = 0 TO R3 - 1: FOR
       C = 0 TO C3 - 1:B = INT (
       RND (1) * 4)
4B 740 IF B THEN GOSUB 510:B = B
       - 1: GOTO 740
CA 750 NEXT : NEXT
42 760 FOR R = 0 TO R3 - 1: FOR
       C = 0 TO C3 - 1
B4 770 RR = INT ( RND (1) * R3):
       CC = INT ( RND (1) * C3):
       GOSUB 460: NEXT : NEXT
D2 780 POKE 768,X1: POKE 769,Y1:
        CALL 24576
5E 790 HOME : PRINT TAB( 16);"PU
       ZZLER"
20 800 POKE 772,Y1 - 1: POKE 773
       ,X1 - 1: POKE 774,255: CA
       LL 24753
B3 810 R = 0:C = 0:T = NR * NC *
        75: RETURN
0E 820 DATA 162,0,172,1,3,185
C9 830 DATA 47,96,24,109,0,3
93 840 DATA 133,251,185,71,96,10
       5
72 850 DATA 0,133,252,160,0,189
BB 860 DATA 140,89,145,251,232,2
       00
AF 870 DATA 204,2,3,208,244,238
7B 880 DATA 1,3,173,1,3,205
DD 890 DATA 3,3,208,212,96,0
7E 900 DATA 128,0,128,0,128,0
39 910 DATA 128,40,168,40,168,40
F5 920 DATA 168,40,168,80,208,80
05 930 DATA 208,80,208,80,208,4
4A 940 DATA 4,5,5,6,6,7
21 950 DATA 7,4,4,5,5,6
1E 960 DATA 6,7,7,4,4,5
3E 970 DATA 5,6,6,7,7,32
CA 980 DATA 115,96,76,177,96,24
E3 990 DATA 121,47,96,133,251,18
       5
4C 1000 DATA 71,96,105,0,133,252
08 1010 DATA 96,172,7,3,173,8
FA 1020 DATA 3,32,101,96,160,0
67 1030 DATA 162,0,189,9,3,145
D1 1040 DATA 251,232,200,200,200
       ,189
A5 1050 DATA 9,3,145,251,232,173
8C 1060 DATA 7,3,24,105,3,141
31 1070 DATA 7,3,168,173,8,3
72 1080 DATA 32,101,96,160,0,189
9C 1090 DATA 9,3,145,251,232,200
CD 1100 DATA 200,200,189,9,3,145
BD 1110 DATA 251,232,96,172,4,3
CA 1120 DATA 140,7,3,173,5,3
09 1130 DATA 141,8,3,32,101,96
27 1140 DATA 160,0,162,0,177,251
67 1150 DATA 157,9,3,232,41,15
BD 1160 DATA 145,251,173,6,3,41
51 1170 DATA 240,17,251,145,251,
       200
1F 1180 DATA 200,200,177,251,157
       ,9
FE 1190 DATA 3,232,41,15,145,251
11 1200 DATA 173,6,3,41,240,17
3A 1210 DATA 251,145,251,173,4,3
FB 1220 DATA 24,105,3,141,4,3
AF 1230 DATA 168,173,5,3,32,101
2F 1240 DATA 96,160,0,177,251,15
       7
DF 1250 DATA 9,3,232,41,240,145
31 1260 DATA 251,173,6,3,41,15
0F 1270 DATA 17,251,145,251,200,
       200
EE 1280 DATA 200,177,251,157,9,3
96 1290 DATA 232,41,240,145,251,
       173
C0 1300 DATA 6,3,41,15,17,251
23 1310 DATA 145,251,96
```

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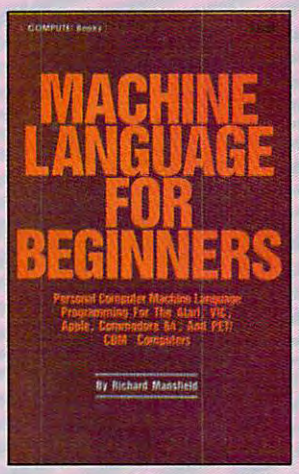

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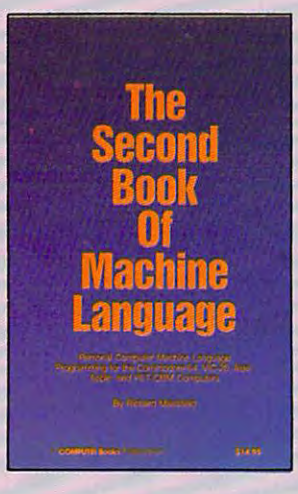

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Skyscape

Robert M. Simons

This unique program, written by a planetarium director, presents the sky as it can be viewed at any date and time from the year 1977 onward—including zodiac constellations and all the visible planets. It also calculates planet tables, positions of the sun, and phases of the moon for any date and time from 1977 into the future. As an extra (and timely) bonus, it can even display Halley's Comet, due to become visible in late 1985 and early 1986. "Skyscape" is both educational and entertaining. The original version is for the Commodore 64, and we've written additional versions for Apple II-series computers with DOS 3.3 or ProDOS; the TI-99/4A with Extended BASIC; the IBM PC with color/graphics adapter; the PCjr with Cartridge BASIC; and Atari 400/800, XL, and XE computers with at least 24K RAM for tape or 32K for disk.

For thousands of years the sun, moon, and planets in our solar system have excited human imagination. In ancient times they were regarded as gods whose distant motions influenced the course of earthly events. Though we now understand more about the true nature of celestial objects, many facts remain unknown, and a brilliant nighttime sky still presents an inspiring spectacle.

Whether you're seriously interested in the sky or just casually curious, "Skyscape" is a convenient tool for extending your knowledge. It opens a movable window on the heavens, displaying the position of our sun, moon, and neighboring planets from almost any location on Earth, at any point in time from 1977 into the distant future. Since it performs all the necessary calculations, you can enjoy and learn from this program even if you're not an expert in astronomy. In addition to providing data about the position of celestial objects, it draws a sky map on the screen, showing each object as it would appear to you at the chosen location and time.

To get started, type in the appropriate version of Skyscape for your computer and save a copy before running it.

Past, Present, Or Future

Skyscape begins by asking you to answer several questions. Enter the year, choosing any year from 1977 forward. In some ways this is the most important input of all, since objects in our solar system move significantly from one year to the next. After you choose the year, Skyscape allows you to enter the month and day.

Next you must enter the latitude (north/south position on Earth) from which you wish to view the sky. Latitude 0 places you, the observer, at the equator. Latitudes 1–90 place you in the northern hemisphere (north of the equator). To choose a southern latitude (south of the equator), enter a negative number from −1 to −90. Skyscape generally represents southerly locations with negative values.

Whenever Skyscape asks for information, it checks your entry to make sure it's in the acceptable range. If you enter an illegal value, the program displays an error message and gives you another chance.

The Sun And Moon

Though very different in size and composition, the sun and moon are alike in being the largest celestial objects visible from Earth. After you enter the date and latitude, Skyscape displays a table of data for the sun and moon. In addition to the date, day of the year, and latitude north or south, you'll see the following information:

- Sun's geocentric angle. This figure represents the sun's position as a number of degrees relative to the vernal equinox. The vernal equinox is where the sun is located when spring begins in the northern hemisphere (the same time that autumn begins in the southern hemisphere).

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• Sun's declination. The number of degrees north or south of the equator. Negative values indicate a southerly location.

• Sun's altitude at noon. The location of the sun in degrees from the northern or southern horizon at noon.

• Sun's right ascension. Just as longitude and latitude indicate locations on the Earth, *right ascension* and *declination* are used to pinpoint locations in the sky. For this purpose the sky is visualized as a gigantic sphere surrounding the Earth. Declination locates a point vertically in the celestial sphere and right ascension locates it horizontally. Right ascension values are given in *hours* and *minutes* in the range 0:00–23:59. Right ascension 0:00 is exactly at the vernal equinox. Larger right ascension values lie to the east of smaller ones.

• Right ascension at 9 p.m. The right ascension which would be on the meridian at 9 p.m. This coordinate system would be found on star charts. By comparing this number with those charts, you can tell what stars and constellations would be visible at that time.

• Moon's age. The number of days since the last new moon.

• Moon's elongation. The location of the moon in degrees east or west of the sun.

• Moon's phase. The phase of the moon on this particular day.

The Planet Table

After viewing the sun and moon display, press P to continue to the next display screen, which contains the planet table. (Press D if you wish to enter a new date.) The planet table shows vital information about the visible planets (through Uranus, which is at the limit of our visibility). The table shows the position of each planet in right ascension and degrees east or west of the sun. It also shows the distance of each planet from Earth in millions of miles.

If you'd rather see the distance in kilometers, modify the program to change the value of ES=93 to ES=149.6 (the program line which defines the value of ES varies with the version of Skyscape: Commodore 64—line 220; Atari—line 190; IBM—line 130; Apple—line 80; TI—line 150).

Some planets have an asterisk to the left of the right ascension figure. This signifies that they are visible at 9 o'clock this evening. For reference, the planet table also includes the sun's present right ascension and its right ascension at 9 p.m. Press D to input a new date or S to view a graphics display of the sky at any time in the current day.

The Visible Skyscape

After selecting the sky display, you must enter the hour when you wish to view the sky. The hour value should be a whole number from 0–23 (enter 22 for 10 p.m., etc.). You'll also need to enter the minutes (0–59). Skyscape then displays the time and offers you a chance to enter different values. Press RETURN or Enter when you're satisfied with the time.

Skyscape now displays the sky as it would appear at the chosen latitude, date, and time. Since the sky looks very different from different places on Earth, the latitude affects the display considerably. If your latitude is in the range 24–90 degrees north or south, the sky shows a dashed line representing the position of the celestial equator, along with symbols representing the sun, moon, and planets visible at that time. If your latitude is in the tropical region—from 23½ degrees north to 23½ degrees south—the dashed line indicates a position directly overhead.

If you're viewing in the northern hemisphere, north is above the dashed line and south is below it. In the southern hemisphere these directions are reversed. Below the sky display is a key that interprets the symbols used to represent celestial objects. If more than one object is positioned at the same spot, the symbols are displayed above each other.

At the bottom of the sky you may see two-letter abbreviations. These represent zodiac constellations that would be visible from your chosen vantage point. Skyscape uses the abbreviations AR (Aries), PI (Pisces), AQ (Aquarius), CP (Capricorn), SA (Sagittarius), SC (Scorpio), LI (Libra), VI (Virgo), LE (Leo), CA (Cancer), GE (Gemini) and TA (Taurus). Each constellation is located above the spot where its abbreviation appears. In northern latitudes, the border of each constellation's zone begins at its abbreviation and extends left. In southern latitudes, the constellation extends right from the position of its abbreviation.

Daytime skies are shown in blue and nighttime skies in black. Skyscape does not calculate the actual rising or setting time of the sun. Average rising and setting times of 6 a.m. and 6 p.m. are used in every case. You may obtain exact rising and setting times from local newspapers. However, keep in mind that there is usually about an hour of twilight before sunrise and after sunset.

Halley's Comet

In addition to permanent objects, Skyscape's graphics display includes Halley's Comet, which should be visible during late 1985 and early 1986. If you choose a date from November 1, 1985 to May 29, 1986, Skyscape calculates the position of Halley's Comet and includes it in the graphics display (if it would be visible at the place and time you select). The comet's position is based on the best predictions available at the time of this writing (summer 1985). These positions may differ slightly from the comet's actual position when it finally makes its appearance.

While Skyscape is generally accurate, it bases most position calculations on circular orbits. This introduces a certain element of error, since no object in our solar system has a perfectly circular orbit. The position error is most pronounced for Mercury and Mars (whose orbits are quite elliptical), but does not significantly affect other objects. I've found Skyscape accurate enough for my own purposes, which include planning astronomy classes and planetarium displays.

For instructions on entering these listings, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

Program 1: Commodore 64 Skyscape

```
100 POKE56,56:POKE55,0:CLR:FOR
    I=828TO909:READA:X=X+A:POK
    EI,A:NEXTI:PRINTCHR$(8)
                        :rem 246
110 IFX<>9923THENPRINT"ERROR I
    N DATA STATEMENTS.":STOP
                        :rem 187
```

Halley's Comet blazes across the sky in the graphics display of "Skyscape" for the Commodore 64.

```
120 DATA 173,14,220,41,254,141
    ,14,220,173,24      :rem 93
130 DATA 208,41,14,10,10,133,1
    67,169,208,133      :rem 102
140 DATA 252,173,0,221,41,3,73
    ,3,10,10,10,10      :rem 69
150 DATA 10,10,5,167,133,254,1
    65,1,41,251         :rem 205
160 DATA 133,1,169,0,133,251,1
    33,253,168,162      :rem 109
170 DATA 8,177,251,145,253,200
    ,208,249,230        :rem 21
180 DATA 252,230,254,202,208,2
    42,165,1,9          :rem 168
190 DATA 4,133,1,173,14,220,9,
    1,141,14,220,96     :rem 144
200 POKE53281,1:POKE646,0:GOSU
    B2210               :rem 5
210 D$="000031059090120151181212
    2243273304334":K1=1440:DI
    MHC(22):MM$="041081040"
                        :rem 225
220 M$="286317345011041072102133164194225255":D$(1)="S":
    D$(2)="N":ES=93     :rem 28
230 A$="JANFEBMARAPRMAYJUNJULA
    UGSEPOCTNOVDEC":OO$="
    {DOWN}OUT OF RANGE!!{DOWN}
    "                   :rem 232
240 MD$="312831303130313130313
    031":D9=↑/180:READEE:READM
    9:DIMP(6,6)         :rem 66
250 DEFFNR(X)=INT(X*100+.5)/10
    0                   :rem 207
260 DEFFNS(X)=INT(X*10+.5)/10
                        :rem 113
270 FORY=1TO2:FORX=1TO6:READP(
    X,Y):NEXT:NEXT:Y=0:rem 162
280 FORX=1TO6:READP$(X),P(X,3)
    :NEXT:FORX=1TO8:READA:POKE
    14335+X,A:NEXT      :rem 187
290 FORX=15024TO15079:READA:PO
    KEX,A:NEXT:FORX=1TO7:PP(X)
    =X+85:NEXT          :rem 228
300 J$="SATSUNMONTUEWEDTHUFRI"
    :FORX=1TO12:READF$:rem 151
310 CC$=CC$+"{5 SPACES}"+F$:NE
    XT:CC$=CC$+CC$:F$=RIGHT$(C
    C$,9):CC$=F$+CC$    :rem 133
320 FORX=1TO8:READPH$(X):NEXT
                        :rem 81
330 FORX=1TO22:READHC(X):NEXT:
    POKE53281,7:GOTO920:rem 42
340 CC=MT-720:IFCC<0THENCC=CC+
    K1                  :rem 155
350 CC=CC/120:CD=CC-INT(CC):CC
    =INT(CC):CD=INT(CD*7+.2):C
    C=81-(CC*7+CD)      :rem 255
360 GOSUB2000:PRINTCHR$(18);CD
    $;CHR$(146);:IFLL<0THENGOS
    UB2590              :rem 242
370 FORX=55976TO56015:POKEX,2:
    GOTO2620            :rem 38
380 PRINT"{CLR}{DOWN}"TAB(10)"
    ** DAYS SKY **":GOSUB1770:
    PRINT               :rem 253
390 PRINT:PRINT"INPUT THE TIME
    :":PRINT"{15 Y}":T1=0:T2=0
                        :rem 43
400 PRINT:INPUT"{5 SPACES}HOUR
     (0-23) ";T1:IFT1<0ORT1>23
    THENPRINTOO$:GOTO400
                        :rem 72
410 PRINT:INPUT"{3 SPACES}MINU
    TE (0-59) ";T2:IFT2<0ORT2>
    59THENPRINTOO$:GOTO410
                        :rem 243
420 R$=STR$(T1):T$=STR$(T2):T$
    =RIGHT$(T$,LEN(T$)-1):IFLE
    N(T$)=1THENT$="0"+T$
                        :rem 133
430 PRINT"{2 DOWN}TIME-- "R$":
    "T$                 :rem 127
440 PRINT:GOSUB2230:IFZ$="N"TH
    EN380               :rem 134
450 PRINT"{CLR}":T3=T1*60+T2+A
    A-720:IFT3<0THENT3=T3+K1
                        :rem 17
460 IFT3>K1THENT3=T3-K1
                        :rem 141
470 MT=T3-360:IFMT<0THENMT=MT+
    K1                  :rem 241
480 PT=T3+360:IFPT>K1THENPT=PT
    -K1                 :rem 76
490 GOSUB1770:PRINTTAB(27)R$":
    "T$                 :rem 176
500 C9$="{BLU}":TM=VAL(R$+"."+
    T$):IFTM<6ORTM>18THENC9$="
    {BLK}"              :rem 124
510 XX=7+LC:FORX=1TO14:IFX=XXT
    HEN530              :rem 56
520 PRINTC9$+"{RVS}{40 SPACES}
    ";"{BLK}";:GOTO540:rem 155
530 PRINTC9$+"{RVS} - - - - -
    {SPACE}- - - - - - - - - -
     - - - -{2 SPACES}";"{BLK}
    ";                  :rem 231
540 NEXTX:GOSUB340:IFLL<0THEN5
    70                  :rem 25
550 IFLL>24THENPRINT"{BLU}E"SP
    C(18)"S"SPC(19)"W{BLK}":GO
    TO590               :rem 221
560 PRINT"{BLU}UP-{BLK}NORTH
    {5 SPACES}{BLU}----{BLK}OV
    ERHEAD{5 SPACES}{BLU}DOWN-
    {BLK}SOUTH":GOTO590
                        :rem 225
570 IFABS(LL)>24THENPRINT"
    {BLU}W"SPC(18)"N"SPC(19)"E
    {BLK}":GOTO590      :rem 1
580 PRINT"{BLU}UP-{BLK}SOUTH
    {5 SPACES}{BLU}----{BLK}OV
    ERHEAD{5 SPACES}{BLU}DOWN-
    {BLK}NORTH"         :rem 210
590 T4=AA:GOSUB800:Y8=888:IFY9
    =999THEN630         :rem 242
600 Y8=Y9:GOSUB2450:IFA1<0THEN
    630                 :rem 234
610 IFPK>1703ORPK<1144THEN630
                        :rem 212
620 POKEPK,170          :rem 38
630 T4=AA+M2*K1:IFT4>K1THENT4=
    T4-K1               :rem 96
640 GOSUB800:IFY9=999THEN680
                        :rem 194
650 MM=INT(M1/9.83333)+1:GOSUB
    900:IFY9=999THEN680
                        :rem 133
660 GOSUB2450:IFPK>1703ORPK<11
    44THEN680           :rem 99
670 POKEPK,MM+128:PRINTCHR$(14
    6):IFABS(Y8-Y9)<=.5THENPOK
    EPK,81              :rem 81
680 FOR X=1TO7:IFX=7THEN2350
                        :rem 179
690 T4=P(X,6):GOSUB800:IFY9=99
    9THEN750            :rem 31
700 U9=SIN(P(X,6)*D9/4):U9=-3*
    U9+.5:U9=INT(U9):U(X)=U9*4
    0                   :rem 13
710 PK=1423-Y9+U(X)+LB:GOSUB24
    60                  :rem 97
720 IFPK>1703ORPK<1144THEN750
                        :rem 217
730 Z=PEEK(PK):IFZ<>160ANDZ<>1
    73THENPK=PK+SGN(LL)*40+(LL
    =0)*40:GOTO730      :rem 0
740 POKEPK,PP(X)        :rem 218
750 NEXTX:PRINT"{HOME}
    {19 DOWN}"          :rem 148
760 PRINT"{UP}VMERCURY
    {2 SPACES}WVENUS{4 SPACES}
    XMARS{5 SPACES}YJUPITER"
                        :rem 107
770 PRINT"ZSATURN{4 SPACES}+UR
    ANUS{3 SPACES}{RVS}*{OFF}S
    UN{6 SPACES}{RVS})Q({OFF}M
    OON"                :rem 162
780 PRINT"{2 SPACES}QNEW MOON
    {SPACE}+ SUN{2 SPACES}"B$
                        :rem 235
790 PRINT:PRINT"T- NEW TIME,P-
     P.TABLE,D- DATE,L- LAT":G
    OTO1920             :rem 225
800 Y9=999:IFMT<PTTHEN850
                        :rem 40
810 IFT4>=MT OR T4<=PTTHEN830
                        :rem 220
820 RETURN              :rem 122
830 IFT4>=MT AND T4<=K1THEN870
                        :rem 236
840 T4=T4+K1:GOTO870    :rem 162
850 IFT4>=MT AND T4<=PT THEN87
    0                   :rem 22
860 RETURN              :rem 126
870 Y9=INT((T4-MT)/18+.5):IFY9
    =40THENY9=39        :rem 221
880 RETURN              :rem 128
890 U9=SIN(T4/4*D9):U9=-3*U9+.
    5:U9=INT(U9):U9=U9*40:RETU
    RN                  :rem 238
900 MM=VAL(MID$(MM$,3*MM-2,3))
    :IFLL<0ANDMM<>81THENMM=ABS
    (MM-81)             :rem 12
910 RETURN              :rem 122
920 PRINT"{CLR}{DOWN}
    {6 SPACES}********** SKYSC
    APE **********":PRINT"
    {DOWN}DATE INPUT":S1=0
                        :rem 176
930 PRINT"{10 Y}":IFY<>0THENGO
    SUB1770:PRINT:PRINT
                        :rem 107
940 INPUT"YEAR{2 SPACES}";Y:IF
    Y<1977THENPRINT"MUST BE GR
    EATER THAN 1977":GOTO940
                        :rem 89
950 GOSUB1820:PRINT:INPUT"MONT
    H (1-12) ";M:IFM<1ORM>12TH
    ENPRINTOO$:GOTO950:rem 127
960 DI=VAL(MID$(MD$,2*M-1,2)):
    DI=DI-(M=2)*LY:DI$=STR$(DI
    ):DI$=RIGHT$(DI$,2):rem 25
970 PRINT"{DOWN}DAY (1-"DI$")
    {SPACE}";:INPUTD:IFD<1ORD>
    DITHENPRINTOO$:GOTO970
                        :rem 8
980 H$=MID$(A$,M*3-2,3):PRINT:
    PRINT"LATITUDE (-90 TO 90)
    ";:INPUTLL          :rem 80
990 GOSUB2480           :rem 240
1000 IFABS(LL)>90THENPRINTOO$:
     GOTO980            :rem 72
1010 PRINT:PRINT"{2 DOWN}
     {4 RIGHT}"H$;D"{LEFT},"Y:
     PRINT:GOSUB2230:IF Z$="N"
     THEN920            :rem 105
```


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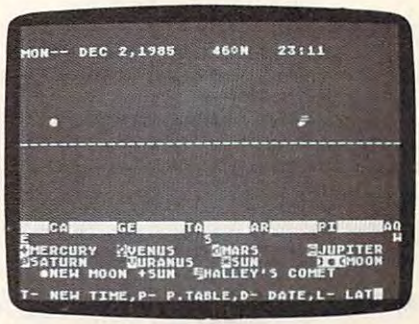
```
1020 D2=VAL(MID$(M$,M*3-2,3))+
     D:GOSUB1860:IFM>2THEND1=D
     1+LY:Y1=Y1+LY     :rem 253
1030 D3=D2-185:IFM=3ANDD<20THE
     ND2=D2+LY:D3=D3+LY:rem 81
1040 S=0:IFD3<=0THENA=180*D2/1
     85:GOTO1060       :rem 91
1050 A=180*D3/(180+ZY)+180
                       :rem 57
1060 IFA<>180THENS=23.43333333
     *SIN(D9*D2*180/185)
                       :rem 167
1070 IFA>180THENS=-23.43333333
     *SIN(D9*D3)       :rem 10
1080 IFA>=360THENA=A-360
                       :rem 97
1090 A=FNR(A)          :rem 192
1100 S=FNR(S):A1=(SGN(LL)-(LL=
     0))*S+90-ABS(LL):A1=FNR(A
     1):GOSUB1470:GOSUB1420
                       :rem 0
1110 W=1-(SGN(LL)<0):IFA1>90TH
     ENA1=180-A1:W=ABS(W-3)
                       :rem 231
1120 PRINT"{CLR}{DOWN}":GOSUB1
     770:PRINT:PRINT"{32 Y}":I
     $="{LEFT}@"       :rem 121
1130 PRINT:PRINT"DAY OF THE YE
     AR-----------",D1:rem 114
1140 PRINT"SUN'S GEOCENTRIC AN
     GLE----",A;I$     :rem 26
1150 PRINT"SUN'S DECLINATION--
     -------",S;I$     :rem 238
1160 PRINT"SUN'S ALTITUDE AT N
     OON----",A1;I$;D$(W)
                       :rem 121
1170 PRINT"SUN'S RIGHT ASCENSI
     ON-----",A3$      :rem 208
1180 PRINT"R.A. AT 9:00PM-----
     -------",A5$      :rem 113
1190 PRINT"MOON'S AGE---------
     -------",M1;"DY" :rem 178
1200 PRINT"MOON'S ELONGATION--
     -------",M8;"{LEFT}@";L$:
     I$=""             :rem 172
1210 PRINT"MOON'S PHASE - "PH$
     (M3)              :rem 115
1220 PRINT"{2 DOWN}-P- PLANET
     {SPACE}TABLE , -D- NEW DA
     TE":GOTO1920      :rem 159
1230 PRINT"{CLR}{DOWN}":PRINTT
     AB(7)"** PLANET TABLE **"
     :GOSUB1770:PRINT:PRINT:S1
     =1                :rem 188
1240 PRINT"PLANET{3 SPACES}DIS
     T.{2 SPACES}ANG. W/ SUN
     {4 SPACES}R.A"    :rem 255
1250 PRINT"{38 Y}":PRINT
                       :rem 138
1260 FORX=1TO6:A2=Y1/P(X,2)-IN
     T(Y1/P(X,2)):Q3=1:rem 238
1270 A2=A2*360+P(X,1):IFA2>360
     THENA2=A2-360     :rem 92
1280 E=180+A:IFE>360THENE=E-36
     0                 :rem 243
1290 E1=ABS(E-A2):IFE1>180THEN
      E1=360-E1        :rem 191
1300 GOSUB1530:E1=E1*D9:P5=P(X
     ,3):IFX=3THENGOSUB1980
                       :rem 125
1310 P(X,4)=SQR(1+P5↑2-2*P5*CO
     S(E1)):XX=(P5↑2-1-P(X,4)↑
     2)/(-2*P(X,4))    :rem 90
1320 P(X,5)=-ATN(XX/SQR(-XX*XX
     +1))+↑/2:P(X,4)=INT(P(X,4
     )*ES+.5)          :rem 55
1330 P(X,5)=P(X,5)/D9:P(X,5)=F
     NS(P(X,5)):Q1$=STR$(P(X,4
     )):Q2$=STR$(P(X,5))
                       :rem 145
1340 Q1=LEN(Q1$):Q2=LEN(Q2$):G
     OSUB1630          :rem 178
1350 PRINTP$(X);TAB(14-Q1);Q1$
     ;TAB(22-Q2);Q2$;:IFQ3=-1T
     HENPRINT"@W";     :rem 25
1360 IFQ3=1THENPRINT"@E";
                       :rem 11
1370 GOSUB1680:Q4$=STR$(Q4):Q5
     $=STR$(Q5):IFQ5<10THENQ5$
     ="0"+RIGHT$(Q5$,1)
                       :rem 221
1380 Q5$=RIGHT$(Q5$,2):Q4$=Q4$
     +":"+Q5$:Z=LEN(Q4$)
                       :rem 159
1390 PRINTTAB(26)QQ$TAB(34-Z)Q
     4$:NEXT:PRINT"{2 DOWN}* -
      VISIBLE AT 9 P.M."
                       :rem 65
1400 PRINT"{2 DOWN}SUN'S R.A.
     {SPACE}-------"SPC(Q8)A3$
     :PRINT"R.A. AT 9:00PM ---
     "SPC(Q9)A5$       :rem 139
1410 PRINT"{DOWN}-S- FOR DAYS
     {SPACE}SKY -D- FOR NEW DA
     TE":GOTO1920      :rem 48
1420 A2=K1*A/360:IFA2>K1THENA2
     =A2-K1            :rem 23
1430 A3=INT(A2/60):A4=A2-A3*60
     :A5=A3+9:IFA5>23THENA5=A5
     -24               :rem 223
1440 A4=INT(A2-A3*60+.5):IFA4=
     60THENA4=0:A3=A3+1
                       :rem 150
1450 IFA3=24THENA3=0   :rem 128
1460 AA=A3*60+A4:GOTO1780
                       :rem 113
1470 M1=(Y1/M9-INT(Y1/M9))*M9+
     10:IFM1>M9THENM1=M1-M9
                       :rem 33
1480 GOSUB2260:M8=360*M2:IFM8>
     180THENL$="W"     :rem 241
1490 IFM8<=180THENL$="E"
                       :rem 89
1500 IFM8>180THENM8=360-M8
                       :rem 237
1510 M1=FNR(M1):M8=FNR(M8):YY=
     INT(7*(Y1/7-INT(Y1/7))+.2
     ):IFYY=0THENYY=7  :rem 23
1520 K$=MID$(J$,YY*3-2,3):RETU
     RN                :rem 68
1530 Q3=0:Q1=E+180:IFQ1>360THE
     N1570             :rem 218
1540 IFA2>EANDA2<Q1THEN1560
                       :rem 78
1550 Q3=1:RETURN       :rem 215
1560 Q3=-1:RETURN      :rem 5
1570 Q1=Q1-360:IFA2<=360ANDA2>
     ETHEN1560         :rem 230
1580 IFQ3<>0THENRETURN:rem 154
1590 IFA2>0ANDA2<=Q1THEN1560
                       :rem 123
1600 IFQ3<>0THENRETURN:rem 147
1610 IFA2>Q1THEN1550   :rem 132
1620 RETURN            :rem 169
1630 Q5=Q3*P(X,5)*4+AA:IFQ5<0T
     HENQ5=Q5+K1       :rem 122
1640 IFQ5>K1THENQ5=Q5-K1
                       :rem 187
1650 P(X,6)=Q5:Q4=INT(Q5/60):Q
     5=INT(Q5-Q4*60+.5):IFQ5=6
     0THENQ5=0:Q4=Q4+1:rem 189
1660 IFQ4=24THENQ4=0   :rem 165
1670 RETURN            :rem 174
1680 SU=A5*60+A4:PS=SU+360:MS=
     SU-360:IFPS>K1THENPS=PS-K
     1                 :rem 230
1690 IFMS<0THENMS=MS+K1
                       :rem 190
1700 IF MS>PSTHEN1730  :rem 210
1710 IFP(X,6)<PSANDP(X,6)>MSTH
     EN1760            :rem 155
1720 QQ$=" ":RETURN    :rem 43
1730 IF P(X,6)<K1ANDP(X,6)>MST
     HEN1760           :rem 118
1740 IFP(X,6)<PSTHEN1760
                       :rem 146
1750 GOTO1720          :rem 208
1760 QQ$="*":RETURN    :rem 89
1770 PRINT:PRINT K$"-- "H$;D"
     {LEFT},"Y;TAB(20)ABS(LL)L
     L$;:RETURN        :rem 22
1780 A3$=STR$(A3):A3$=RIGHT$(A
     3$,2):A4$=STR$(A4):A4$=RI
     GHT$(A4$,2)       :rem 108
1790 IFA4<10THENA4$="0"+RIGHT$
     (A4$,1)           :rem 255
1800 A3$=A3$+":"+RIGHT$(A4$,2)
     :A5$=STR$(A5):A5$=RIGHT$(
     A5$,2)+":"+A4$    :rem 82
1810 Q8=7-LEN(A3$):Q9=7-LEN(A5
     $):RETURN         :rem 5
1820 LY=0:IFY/4=INT(Y/4)THENLY
     =1                :rem 217
1830 IFY/100=INT(Y/100)ANDY/40
     0<>INT(Y/400)THENLY=0
                       :rem 8
1840 IFY/1000=INT(Y/1000)ANDY/
     4000=INT(Y/4000)THENLY=0
                       :rem 140
1850 RETURN            :rem 174
1860 Y9=Y+1:IFY9/4=INT(Y9/4)TH
     ENZY=1            :rem 207
1870 IFY9/100=INT(Y9/100)ANDY9
     /400<>INT(Y9/400)THENZY=0
                       :rem 254
1880 IFY9/1000=INT(Y9/1000)AND
     Y9/4000=INT(Y9/4000)THENZ
     Y=0               :rem 130
1890 Y1=Y-1977:Y1=Y1*365+INT(Y
     1/4)+D1:IFY<2000THEN1910
                       :rem 88
1900 Y1=Y1-INT((Y-2001)/100)+I
     NT((Y-2001)/400)-INT((Y-1
     )/4000)           :rem 6
1910 RETURN            :rem 171
1920 GETI$:IFI$=""THEN1920
                       :rem 203
1930 IFI$="D"THEN920   :rem 88
1940 IF(I$="S"ORI$="T")ANDS1=1
     THEN380           :rem 97
1950 IFI$="P"THEN1230 :rem 145
1960 IFI$="L"ANDS1=1THEN2530
                       :rem 87
1970 GOTO1920          :rem 214
1980 P5=1.376344086:K5=A2*4
                       :rem 148
1990 K5=ABS(K5-1233.73)*90/K1:
     K5=K5*D9:K5=SIN(K5)*.3225
     81224:P5=P5+K5:RETURN
                       :rem 62
2000 IFCC<=1THENCC=CC+84
                       :rem 144
2010 CD$=MID$(CC$,CC-1,42)
                       :rem 70
2020 IFMID$(CD$,2,1)<>" "ANDMI
     D$(CD$,3,1)=" "THENCD$=MI
     D$(CD$,1,40):GOTO2050
                       :rem 8
2030 IFMID$(CD$,41,1)<>" "ANDM
     ID$(CD$,40,1)=" "THENCD$=
     MID$(CD$,3,42):GOTO2050
                       :rem 113
2040 CD$=MID$(CD$,2,40)
                       :rem 150
2050 CD$="{YEL}"+CD$+"{BLK}":R
     ETURN             :rem 128
2060 DATA365.26,29.530059,59.81
     8184,42.719626,262.364294
     ,52.916763        :rem 23
2070 DATA134.69697,218.79464,8
     7.97,224.7,686.98:rem 146
2080 DATA4332.79813,10759.7195
     ,30686.5884       :rem 90
2090 DATA"MERCURY",.3871,"VENU
     S",.7233,"MARS",1.5237,"J
     UPITER",5.2028    :rem 148
```

```
2100 DATA"SATURN",9.5308,"URAN
     US",19.182          :rem 14
2110 DATA56,68,68,68,56,0,0,0,
     255,239,199,131,131,199,2
     39,255              :rem 6
2120 DATA195,129,153,153,195,2
     31,129,231,252,249,195,15
     3,153,153,199,255   :rem 40
2130 DATA255,195,189,129,129,1
     89,195,255,252,193,145,13
     7,153,131,63,127    :rem 2
2140 DATA255,153,153,153,219,2
     31,255,255          :rem 230
2150 DATA245,234,213,202,213,1
     39,7,31             :rem 66
2160 DATA"SA","SC","LI","VI","
     LE","CA","GE","TA","AR","
     PI","AQ","CP"       :rem 220
2170 DATA"NEW","WAXING CRESCEN
     T","1ST QUARTER","WAXING
     {SPACE}GIBBOUS","FULL"
                         :rem 255
2180 DATA"WANING GIBBOUS","3RD
      QUARTER","WANING CRESCEN
     T"                  :rem 224
2190 DATA1770,1719,1620,1500,1
     418,1365,1335,1310,1290,1
     275,1260            :rem 96
2200 DATA1238,1220,1200,1178,1
     115,915,720,660,640,625,6
     10                  :rem 39
2210 PRINT"{CLR}{11 DOWN}"SPC(
     11)"**** SKYSCAPE ****"
                         :rem 116
2220 POKE53272,(PEEK(53272)AND
     240)OR14:SYS828:POKE53280
     ,7:RETURN           :rem 32
2230 PRINT"-N- TO RE-INPUT OR
     {SPACE}RETURN TO CONTINUE
     "                   :rem 192
2240 GETZ$:IFZ$=""THEN2240
                         :rem 229
2250 RETURN              :rem 169
2260 M2=M1/M9:IFM1<1ORM1>28.5T
     HENM3=1             :rem 180
2270 IFM1>=1ANDM1<6.9THENM3=2
                         :rem 204
2280 IFM1<=8.0ANDM1>=6.9THENM3
     =3                  :rem 112
2290 IFM1>8.0ANDM1<14.2THENM3=
     4                   :rem 32
2300 IFM1>=14.2ANDM1<=15.2THEN
     M3=5                :rem 195
2310 IFM1>15.2ANDM1<21.6THENM3
     =6                  :rem 77
2320 IFM1>=21.6ANDM1<=22.6THEN
     M3=7                :rem 203
2330 IFM1>22.6ANDM1<=28.5THENM
     3=8                 :rem 150
2340 RETURN              :rem 169
2350 B$="":IFY<>1985ANDY<>1986
     THEN750             :rem 109
2360 IF(Y=1985ANDD1<305)OR(Y=1
     986ANDD1>149)THEN750
                         :rem 131
2370 HD=D1+365:IFHD>516THENHD=
     HD-365              :rem 81
2380 H1=(HD-295)/10:HD=INT(H1)
     :H1=H1-HD           :rem 151
2390 T4=HC(HD)-HC(HD+1):T4=HC(
     HD)-H1*T4:IFT4>K1THENT4=T
     4-K1                :rem 219
2400 GOSUB800:IFY9=999THEN750
                         :rem 236
2410 GOSUB890:IFT4>1115ANDT4<1
     200THENU9=U9+40     :rem 176
2420 IFT4>1290THENU9=U9-40
                         :rem 2
2430 IFT4>615ANDT4<=1115THENU9
     =U9+80              :rem 113
2440 U(7)=U9:B$="{5 SPACES}HALLEY'S C
     OMET":GOTO710       :rem 43
2450 GOSUB890:PK=1423-Y9+U9+LB
                         :rem 249
2460 IFLL<0THENPK=2247+80*XX-P
     K                   :rem 106
2470 RETURN              :rem 173
2480 LL$="{LEFT}@N":IFLL<0THEN
     LL$="{LEFT}@S"      :rem 159
2490 L1=ABS(LL):IFABS(LL)<24TH
     ENL1=40             :rem 191
2500 LC=INT((L1-40)/7+.5):LB=L
     C*40:D1=VAL(MID$(D$,M*3-2
     ,3))+D              :rem 30
2510 IFABS(LL)<24THENLB=40*INT
     (ABS(LL)/7+.5)      :rem 47
2520 RETURN              :rem 169
2530 PRINT"{CLR}{DOWN}
     {6 SPACES}********** SKYS
     CAPE **********":PRINT"
     {DOWN}LATITUDE CHANGE"
                         :rem 8
2540 PRINT"{15 Y}":GOSUB 1770
                         :rem 222
2550 PRINT"{3 DOWN}":INPUT"INP
     UT NEW LATITUDE";LL:PRINT
     :PRINT              :rem 21
2560 IF ABS(LL)>90 THEN PRINT
     {SPACE}OO$:GOTO 2550
                         :rem 127
2570 GOSUB2230:IFZ$="N"THEN248
     0                   :rem 40
2580 GOSUB2480:I$="S":GOTO1940
                         :rem 217
2590 FORX=1704TO1723:U1=PEEK(X
     ):U2=PEEK(3447-X):POKEX,U
     2:POKE(3447-X),U1:NEXT
                         :rem 206
2600 FORX=1704TO1742:IFPEEK(X)
     =160THEN2620        :rem 229
2610 U1=PEEK(X):U2=PEEK(X+1):P
     OKEX,U2:POKEX+1,U1:X=X+1
                         :rem 72
2620 NEXT:RETURN         :rem 35
```



A view of the night sky in the Atari version of "Skyscape."

Program 2: Atari Skyscape

Version by Kevin Mykytyn, Editorial Programmer

```
CG 100 POKE 106,PEEK(106)-5:
       GRAPHICS 0:OPEN #1,4,
       8,"K:"
HO 110 DIM D$(36),MM$(9),M$(
       36),A$(36),OO$(16),MD
       $(24),ZZ$(20),P$(43),
       J$(21),F$(200),CC$(20
       0),SPC$(30),Q$(1)
BD 120 DIM PH$(120),HC(22),R
       $(10),T$(10),Q1$(10),
       Q2$(10),Q3$(10),Q4$(1
       0),Q5$(10),L$(10),QQ$
       (10),A1$(10),A2$(10),
       A4$(10)
CH 130 DIM A3$(10),I$(2),CD$
       (50),PP(8),DI$(3),H$(
       5),LL$(3),DIR$(2),Z$(
       1),K$(21),A5$(10),U(1
       0),P(6,6),B$(15)
KI 140 FOR A=1 TO 6:FOR B=1
       TO 6:P(A,B)=0:U(A)=0:
       NEXT B:NEXT A
GN 150 POKE 82,0:PI=3.1415:S
       CREEN=PEEK(88)+256*PE
       EK(89):FOR X=1 TO 30:
       SPC$(X,X)=" ":NEXT X
EB 160 P$=" ":P$(43)=P$:P$(2
       )=P$:PH$=" ":PH$(120)
       =PH$:PH$(2)=PH$
NO 170 GOSUB 2220
JO 180 D$="0000310590901201511812122432733043334":
       K1=1440:MM$="00908400
       8"
BD 190 M$="28631734501104107
       2102133164194225255":
       DIR$(1,1)="S":DIR$(2,
       2)="N":ES=93
PN 200 A$="JANFEBMARAPRMAYJU
       NJULAUGSEPOCTNOVDEC":
       OO$="{DOWN}OUT OF RAN
       GE!!{DOWN}"
PO 210 MD$="3128313031303131
       30313031":D9=3.141592
       65/180:READ EE:READ M
       9:GOTO 240
MI 220 ZZ=INT(ZZ*100+0.5)/10
       0:RETURN
GJ 230 ZZ=INT(ZZ*10+0.5)/10:
       RETURN
CP 240 FOR Y=1 TO 2:FOR X=1
       TO 6:READ ZZ:P(X,Y)=Z
       Z:NEXT X:NEXT Y:Y=0
LP 250 FOR X=1 TO 6:READ ZZ$
       :P$((X-1)*7+1,X*7)=ZZ
       $:READ ZZ:P(X,3)=ZZ:N
       EXT X:FOR X=1 TO 8:RE
       AD A
LB 260 POKE CHBAS+256+X,A:NE
       XT X
MN 270 FOR X=CHBAS+608 TO CH
       BAS+663:READ A:POKE X
       ,255-A:POKE X+1024,A:
       NEXT X:FOR X=1 TO 7:P
       P(X)=X+75:NEXT X
JO 280 J$="SATSUNMONTUEWEDTH
       UFRI":FOR X=1 TO 12:R
       EAD F$
PO 290 CC$((X-1)*7+1,(X-1)*7
       +5)="{5 SPACES}":CC$(
       (X-1)*7+6,X*7)=F$:NEX
       T X:CC$(LEN(CC$)+1,2*
       LEN(CC$))=CC$
KC 300 F$=CC$(LEN(CC$)-8,LEN
       (CC$)):F$(LEN(F$)+1,L
       EN(F$)+LEN(CC$))=CC$:
       CC$=F$
HO 310 FOR X=1 TO 8:READ ZZ$
       :PH$((X-1)*15+1,X*15)
       =ZZ$:NEXT X
NN 320 FOR X=1 TO 22:READ ZZ
       :HC(X)=ZZ:NEXT X:FOR
       X=CHBAS+680 TO CHBAS+
       687:READ B:POKE X,B:N
       EXT X:GOTO 920
JK 330 CC=MT-720:IF CC<0 THE
       N CC=CC+K1
CO 340 CC=CC/120:CD=CC-INT(C
       C):CC=INT(CC):CD=INT(
       CD*7+0.2):CC=81-(CC*7
       +CD)
MO 350 GOSUB 2010:PRINT CD$;
       :IF LL<0 THEN GOSUB 2
       620
HJ 360 RETURN
IA 370 PRINT "{CLEAR}":POSIT
       ION 10,1:PRINT "** DA
       YS SKY **":GOSUB 1770
       :PRINT
```

```
GJ 380  R$="":T$="":ZZ$="":PR
        INT :PRINT "INPUT THE
         TIME ":PRINT "{15 U}
        ":T1=0:T2=0
BP 390  PRINT :PRINT "
        {5 SPACES}HOUR (0-23)
         ";:INPUT T1:IF T1<0
        OR T1>23 THEN PRINT O
        O$:GOTO 390

LI 400  PRINT :PRINT "
        {3 SPACES}MINUTE (0-5
        9) ";:INPUT T2:IF T2<
        0 OR T2>59 THEN PRINT
         OO$:GOTO 400
PG 410  R$=STR$(T1):T$=STR$(T
        2):IF LEN(T$)=1 THEN
        ZZ$="0":ZZ$(2,LEN(T$)
        +1)=T$:T$=ZZ$
EH 420  PRINT "{2 DOWN}TIME--
        ";R$;":";T$
IH 430  PRINT :GOSUB 2260:IF
        Z$="N" THEN 370
PK 440  PRINT "{CLEAR}":T3=T1
        *60+T2+AA-720:IF T3<0
         THEN T3=T3+K1
IM 450  IF T3>K1 THEN T3=T3-K
        1
PA 460  MT=T3-360:IF MT<0 THE
        N MT=MT+K1
EL 470  PT=T3+360:IF PT>K1 TH
        EN PT=PT-K1
LK 480  GOSUB 1770:PRINT SPC$
        (1,3);R$;":";T$
HP 490  RF=128:ZZ$=R$:ZZ$(LEN
        (ZZ$)+1,LEN(ZZ$)+1)="
        .":ZZ$(LEN(ZZ$)+1,LEN
        (ZZ$)+LEN(T$))=T$:TM=
        VAL(ZZ$)
FE 500  IF TM<6 OR TM>18 THEN
         RF=0
DI 510  XX=7+LC:FOR X=1 TO 14
        :IF X=XX THEN 530
HG 520  FOR A=1 TO 40:PRINT C
        HR$(RF+32);:NEXT A:GO
        TO 540
FF 530  FOR ZZ=1 TO 40:PRINT
        CHR$(45+RF);:NEXT ZZ
BI 540  NEXT X:GOSUB 330:IF L
        L<0 THEN 570
GF 550  IF LL>24 THEN PRINT "
        E{18 SPACES}S
        {19 SPACES}W":GOTO 590
NE 560  PRINT "UP-NORTH
        {5 SPACES}----OVERHEA
        D{5 SPACES}DOWN-SOUTH
        ":GOTO 590
IJ 570  IF ABS(LL)>24 THEN PR
        INT "W{18 SPACES}N
        {19 SPACES}E":GOTO 590
MF 580  PRINT "UP-SOUTH
        {5 SPACES}----OVERHEA
        D{5 SPACES}DOWN-NORTH
        "
PC 590  T4=AA:GOSUB 800:Y8=88
        8:IF Y9=999 THEN 630
ON 600  Y8=Y9:GOSUB 2480:IF A
        1<0 THEN 630
EO 610  IF PK>SCREEN+679 OR P
        K<SCREEN+120 THEN 630
LC 620  POKE PK,10+RF
GA 630  T4=AA+M2*K1:IF T4>K1
        THEN T4=T4-K1
MC 640  GOSUB 800:IF Y9=999 T
        HEN 680
IF 650  MM=INT(M1/9.83333)+1:
        GOSUB 900:IF Y9=999 T
        HEN 680
OA 660  GOSUB 2480:IF PK>SCRE
        EN+679 OR PK<SCREEN+1
        20 THEN 680
MN 670  POKE PK,MM+RF:IF ABS(
        Y8-Y9)<=0.5 THEN POKE
         PK,84
LG 680  FOR X=1 TO 7:IF X=7 T
        HEN 2380
BP 690  T4=P(X,6):GOSUB 800:I
        F Y9=999 THEN 750
DN 700  U9=SIN(P(X,6)/4*D9):U
        9=-3*U9+0.5:U9=INT(U9
        ):U(X)=U9*40
CK 710  PK=SCREEN+399-Y9+U(X)
        +LB:GOSUB 2490
FD 720  IF PK>SCREEN+679 OR P
        K<SCREEN+120 THEN 750
NL 730  Z=PEEK(PK):IF Z<>RF A
        ND Z<>13+RF THEN PK=P
        K+SGN(LL)*40-(LL=0)*4
        0:PRINT "A":GOTO 730
JN 740  POKE PK,PP(X)+RF
KI 750  NEXT X:POSITION 0,19
LC 760  PRINT "{■}MERCURY
        {M}VENUS{4 SPACES}
        {M}MARS{5 SPACES}{J}J
        UPITER"
AJ 770  PRINT "{P}SATURN
        {4 SPACES}{U}URANUS
        {3 SPACES}■SUN
        {6 SPACES}▯{T}▯MOON"
GJ 780  PRINT "  {T}NEW MOON
        +SUN   ";B$
BN 790  PRINT :PRINT "T- NEW
        TIME,P- P.TABLE,D- DA
        TE,L- LAT";:GOTO 1930
CI 800  Y9=999:IF MT<PT THEN
        850
NM 810  IF T4>=MT OR T4<=PT T
        HEN 830
HK 820  RETURN
OM 830  IF T4>=MT AND T4<=K1
        THEN 870
KC 840  T4=T4+K1:GOTO 870
BG 850  IF T4>=MT AND T4<=PT
        THEN 870
HO 860  RETURN
AN 870  Y9=INT((T4-MT)/18+0.5
        ):IF Y9=40 THEN Y9=39
IA 880  RETURN
NE 890  U9=SIN(T4/4/(1/D9)):U
        9=-3*U9+0.5:U9=INT(U9
        ):U9=U9*40:RETURN
KF 900  MM=VAL(MM$(3*MM-2,3*M
        M)):IF LL<0 AND MM<>8
        1 THEN MM=ABS(MM-17)
HK 910  RETURN
NM 920  PRINT "{CLEAR}{DOWN}
        {5 SPACES}**********
        SKYSCAPE **********"
        :PRINT "{DOWN}DATE IN
        PUT":S1=0
BH 930  PRINT "{10 U}":IF Y<>
        0 THEN GOSUB 1770:PRI
        NT :PRINT
CA 940  PRINT "YEAR  ";:INPUT
         Y:IF Y<1977 THEN PRI
        NT "MUST BE GREATER T
        HAN 1977":GOTO 940
EH 950  GOSUB 1830:PRINT :PRI
        NT "MONTH (1-12) ";:I
        NPUT M:IF M<1 OR M>12
         THEN PRINT OO$:GOTO
        950
DK 960  DI=VAL(MD$(2*M-1,2*M)
        ):DI=DI+(M=2)*LY:DI$=
        STR$(DI)
IK 970  PRINT "{DOWN}DAY (1-"
        ;DI$;") ";:INPUT D:IF
         D<1 OR D>DI THEN PRI
        NT OO$:GOTO 970
JN 980  H$=A$(M*3-2,M*3):PRIN
        T :PRINT "LATITUDE (-
        90 TO 90)";:INPUT LL
DK 990  GOSUB 2510
EG 1000 IF ABS(LL)>90 THEN P
        RINT OO$:GOTO 780
BP 1010 PRINT :PRINT "
        {2 DOWN}{4 RIGHT}";H
        $;" ";D;",";Y:PRINT
        :GOSUB 2260:IF Z$="N
        " THEN 920
JM 1020 D2=VAL(M$((M*3)-2,M*
        3))+D:GOSUB 1870:IF
        M>2 THEN D1=D1+LY:Y1
        =Y1+LY
FB 1030 D3=D2-185:IF M=3 AND
         D<20 THEN D2=D2+LY:
        D3=D3+LY
FL 1040 S=0:IF D3<=0 THEN A=
        180*D2/185:GOTO 1060
IK 1050 A=(180*D3/(180+ZY))+
        180
EB 1060 IF A<>180 THEN S=23.
        433333*SIN(D9*D2*180
        /185)
NH 1070 IF A>180 THEN S=-23.
        4333333*SIN(D9*D3)
GB 1080 IF A>=360 THEN A=A-3
        60
LG 1090 ZZ=A:GOSUB 220:A=ZZ
OK 1100 ZZ=S:GOSUB 220:S=ZZ:
        A1=(SGN(LL)+(LL=0))*
        S+90-ABS(LL):ZZ=A1:G
        OSUB 220:A1=ZZ:GOSUB
         1470:GOSUB 1420
OG 1110 W=1+(SGN(LL)<0):IF A
        1>90 THEN A1=180-A2:
        W=ABS(W-3)
JC 1120 PRINT "{CLEAR}{DOWN}
        ":GOSUB 1770:PRINT :
        PRINT "{32 U}":I$="@
        "
HC 1130 PRINT :PRINT "DAY OF
         THE YEAR----------
        ",D1
BK 1140 PRINT "SUN'S GEOCENT
        RIC ANGLE----",A;I$
OO 1150 PRINT "SUN'S DECLINA
        TION---------",S;I$
JH 1160 PRINT "SUN'S ALTITUD
        E AT NOON----",A1;I$
        ;DIR$(W,W)
NA 1170 PRINT "SUN'S RIGHT A
        SCENSION-----",A3$
HB 1180 PRINT "R.A. AT 9:00P
        M----------",A5$
LC 1190 PRINT "MOON'S AGE---
        ----------",M1;"
        DY"
PI 1200 PRINT "MOON'S ELONGA
        TION---------",M8;I$
        ;L$:I$=""
IF 1210 PRINT "MOON'S PHASE
        - ";PH$((M3-1)*15+1,
        M3*15)
LI 1220 PRINT "{2 DOWN}-P- P
        LANET TABLE , -D- NE
        W DATE":GOTO 1930
FD 1230 PRINT "{CLEAR}{DOWN}
        ":PRINT "{7 SPACES}*
        * PLANET TABLE **":G
        OSUB 1770:PRINT :PRI
        NT :S1=1
PP 1240 PRINT "PLANET
        {3 SPACES}DIST.  ANG
        . W/ SUN{4 SPACES}R.
        A"
HO 1250 PRINT "{38 U}":PRINT

OO 1260 FOR X=1 TO 6:A2=Y1/P
        (X,2)-INT(Y1/P(X,2))
        :Q3=1
FM 1270 A2=A2*360+P(X,1):IF
        A2>360 THEN A2=A2-36
        0
PD 1280 E=180+A:IF E>360 THE
        N E=E-360
LP 1290 E1=ABS(E-A2):IF E1>1
        80 THEN E1=360-E1
HO 1300 GOSUB 1530:E1=E1*D9:
        P5=P(X,3):IF X=3 THE
        N GOSUB 1990
FK 1310 P(X,4)=SQR(1+P5^2-2*
        P5*COS(E1)):XX=(P5^2
        -1-P(X,4)^2)/(-2*P(X
        ,4))
```

```
NI 1320 P(X,5)=-ATN(XX/SQR(-
        XX*XX+1))+PI/2:P(X,4
        )=INT(P(X,4)*ES+0.5)
        :P(X,5)=P(X,5)/D9
LA 1330 ZZ=P(X,5):GOSUB 230:
        P(X,5)=ZZ:Q1$=STR$(P
        (X,4)):Q2$=STR$(P(X,
        5))
LC 1340 Q1=LEN(Q1$):Q2=LEN(Q
        2$):GOSUB 1630
DG 1350 PRINT P$((X-1)*7+1,X
        *7);:POKE 85,14-Q1:P
        RINT Q1$;:POKE 85,22
        -Q2:PRINT Q2$;:IF Q3
        =-1 THEN PRINT "ØW";
AL 1360 IF Q3=1 THEN PRINT "
        ØE";
LN 1370 GOSUB 1680:Q4$=STR$(
        Q4):Q5$=STR$(Q5):IF
        Q5<10 THEN ZZ$="Ø":Z
        Z$(2,LEN(Q5$)+1)=Q5$
        :Q5$=ZZ$
BL 1380 Q4$(LEN(Q4$)+1,LEN(Q
        4$)+1)=":":Q4$(LEN(Q
        4$)+1,LEN(Q4$)+LEN(Q
        5$))=Q5$:Z=LEN(Q4$)
AD 1390 PRINT ;:POKE 85,26:P
        RINT QQ$;:POKE 85,34
        -Z:PRINT Q4$:NEXT X:
        PRINT "{2 DOWN}* - V
        ISIBLE AT 9:ØØ P.M."
JB 1400 PRINT "{2 DOWN}SUN'S
         R.A. -------";SPC$(
        1,Q8);A3$:PRINT "R.A
        . AT 9:ØØPM ---";SPC
        $(1,Q9);A5$
DN 1410 PRINT "{DOWN}-S- FOR
         DAYS SKY -D- FOR NE
        W DATE":GOTO 1930
BH 1420 A2=K1*A/360:IF A2>K1
         THEN A2=A2-K1
NP 1430 A3=INT(A2/60):A4=A2-
        A3*60:A5=A3+9:IF A5>
        23 THEN A5=A5-24
MG 1440 A4=INT(A2-A3*60+0.5)
        :IF A4=60 THEN A4=Ø:
        A3=A3+1
IA 1450 IF A3=24 THEN A3=Ø
HB 1460 AA=A3*60+A4:GOTO 178
        Ø
CB 1470 M1=(Y1/M9-INT(Y1/M9)
        )*M9+10:IF M1>M9 THE
        N M1=M1-M9
PE 1480 GOSUB 2290:M8=360*M2
        :IF M8>180 THEN L$="
        W"
FJ 1490 IF M8<=180 THEN L$="
        E"
ON 1500 IF M8>180 THEN M8=36
        Ø-M8
DD 1510 ZZ=M1:GOSUB 220:M1=Z
        Z:ZZ=M8:GOSUB 220:M8
        =ZZ:YY=INT(7*(Y1/7-I
        NT(Y1/7))+0.2):IF YY
        =Ø THEN YY=7
PG 1520 K$=J$(YY*3-2,YY*3):R
        ETURN
NK 1530 Q3=Ø:Q1=E+180:IF Q1>
        360 THEN 1570
EO 1540 IF A2>E AND A2<Q1 TH
        EN 1560
NH 1550 Q3=1:RETURN
AF 1560 Q3=-1:RETURN
OG 1570 Q1=Q1-360:IF A2<=360
         AND A2>E THEN 1560
JK 1580 IF Q3<>Ø THEN RETURN
HL 1590 IF A2>Ø AND A2<=Q1 T
        HEN 1560
JD 1600 IF Q3<>Ø THEN RETURN
IE 1610 IF A2>Q1 THEN 1550
KJ 1620 RETURN
HK 1630 Q5=Q3*P(X,5)*4+AA:IF
         Q5<Ø THEN Q5=Q5+K1
LL 1640 IF Q5>K1 THEN Q5=Q5-
        K1
ON 1650 P(X,6)=Q5:Q4=INT(Q5/
        60):Q5=INT(Q5-Q4*60+
        0.5):IF Q5=60 THEN Q
        5=Ø:Q4=Q4+1
KF 1660 IF Q4=24 THEN Q4=Ø
KO 1670 RETURN
OG 1680 SU=A5*60+A4:PS=SU+36
        Ø:MS=SU-360:IF PS>K1
         THEN PS=PS-K1
LO 1690 IF MS<Ø THEN MS=MS+K
        1
NC 1700 IF MS>PS THEN 1730
JL 1710 IF P(X,6)<PS AND P(X
        ,6)>MS THEN 1760
CL 1720 QQ$=" ":RETURN
GK 1730 IF P(X,6)<K1 AND P(X
        ,6)>MS THEN 2000
JC 1740 IF P(X,6)<PS THEN 17
        60
NA 1750 GOTO 1720
FJ 1760 QQ$="*":RETURN
MA 1770 PRINT :PRINT K$;"--
        ";H$;" ";D;",";Y;:PO
        KE 85,20:PRINT ABS(L
        L);LL$;:RETURN
HK 1780 A3$=STR$(A3):A4$=STR
        $(A4)
NL 1790 IF A4<10 THEN ZZ$="Ø
        ":ZZ$(2,2)=A4$:A4$=Z
        Z$
NL 1800 A3$(LEN(A3$)+1,LEN(A
        3$)+1)=":":A3$(LEN(A
        3$)+1,LEN(A3$)+LEN(A
        4$))=A4$:A5$=STR$(A5
        )
PD 1810 A5$(LEN(A5$)+1,LEN(A
        5$)+1)=":":A5$(LEN(A
        5$)+1,LEN(A5$)+LEN(A
        4$))=A4$
AG 1820 Q8=7-LEN(A3$):Q9=7-L
        EN(A5$):RETURN
NK 1830 LY=Ø:IF Y/4=INT(Y/4)
         THEN LY=1
AJ 1840 IF Y/100=INT(Y/100)
        AND Y/400<>INT(Y/400
        ) THEN LY=Ø
IN 1850 IF Y/1000=INT(Y/1000
        ) AND Y/4000=INT(Y/4
        000) THEN LY=Ø
KP 1860 RETURN
NA 1870 Y9=Y+1:IF Y9/4=INT(Y
        9/4) THEN ZY=1
PP 1880 IF Y9/100=INT(Y9/100
        ) AND Y9/400<>INT(Y9
        /400) THEN ZY=Ø
ID 1890 IF Y9/1000=INT(Y9/10
        00) AND Y9/4000=INT(
        Y9/4000) THEN ZY=Ø
FB 1900 Y1=Y-1977:Y1=Y1*365+
        INT(Y1/4)+D1:IF Y<20
        00 THEN 1920
AH 1910 Y1=Y1-INT((Y-2001)/1
        00)+INT((Y-2001)/400
        )-INT((Y-1)/4000)
KM 1920 RETURN
PG 1930 XX=VAL(STR$(Ø)):GET
        #1,I:Q$=CHR$(I)
GB 1940 IF Q$="D" THEN 920
HB 1950 IF (Q$="S" OR Q$="T"
        ) AND S1=1 THEN 370
JK 1960 IF Q$="P" THEN 1230
GD 1970 IF Q$="L" AND S1=1 T
        HEN 2560
NI 1980 GOTO 1930
FP 1990 P5=1.37634408:K5=A2*
        4
FN 2000 K5=ABS(K5-1233.73)*9
        Ø/K1:K5=K5*D9:K5=SIN
        (K5)*Ø.322581224:P5=
        P5+K5:RETURN
JB 2010 IF CC<=1 THEN CC=CC+
        84
MN 2020 CD$=CC$(CC-1,CC+41)
MP 2030 IF CD$(2,2)<>"■" AND
         CD$(3,3)="■" THEN C
        D$=CD$(1,40):GOTO 20
        60
JM 2040 IF CD$(41,41)<>"■" A
        ND CD$(40,40)="■" TH
        EN CD$=CD$(3,42):GOT
        O 2060
GO 2050 CD$=CD$(2,41)
KI 2060 RETURN
BI 2070 DATA 365.26,29.53059
        ,59.818184,42.719626
        ,262.364294,52.91676
        3
JD 2080 DATA 134.69697,218.7
        9464,87.97,224.7,686
        .98
FL 2090 DATA 4332.79813,1075
        9.7195,30686.5884
HM 2100 DATA MERCURY,.3871,V
        ENUS,.7233,MARS,1.52
        37,JUPITER,5.2028
IH 2110 DATA SATURN ,9.5308,
        URANUS,19.182
AH 2120 DATA 56,68,68,68,56,
        Ø,Ø,Ø,255,239,199,13
        1,131,199,239,255
CJ 2130 DATA 195,129,153,153
        ,195,231,129,231,252
        ,249,195,153,153,153
        ,199,255
AD 2140 DATA 255,195,189,129
        ,129,189,195,255,252
        ,193,145,137,153,131
        ,63,127
OH 2150 DATA 255,153,153,153
        ,219,231,255,255
ED 2160 DATA 245,234,213,202
        ,213,139,7,31
KN 2170 DATA SA,SC,LI,VI,LE,
        CA,GE,TA,AR,PI,AQ,CP
KM 2180 DATA NEW,WAXING CRES
        CENT,1ST QUARTER,WAX
        ING GIBBOUS,FULL
BF 2190 DATA WANING GIBBOUS,
        3RD QUARTER,WANING C
        RESCENT
FI 2200 DATA 1770,1719,1620,
        1500,1418,1365,1335,
        1310,1290,1275,1260
OA 2210 DATA 1238,1220,1200,
        1178,1115,915,720,66
        0,640,625,610,255,25
        5,Ø,Ø,Ø,Ø,Ø,Ø
BF 2220 POKE 756,PEEK(106)+1
        :PRINT "{CLEAR}
        {6 DOWN}{11 SPACES}**
        ** SKYSCAPE ****"
IN 2230 PRINT "{2 DOWN}
        {10 SPACES}REDEFINING
         CHARACTERS"
EE 2240 CHBAS=(PEEK(106)+1)*
        256:FOR I=Ø TO 1023:
        POKE CHBAS+I,PEEK(57
        344+I):NEXT I
KJ 2250 RETURN
MD 2260 PRINT "-N- TO RE-INP
        UT OR RETURN TO CONT
        INUE"
NK 2270 GET #1,ZZ:Z$=CHR$(ZZ)
KM 2280 RETURN
LH 2290 M2=M1/M9:IF M1<1 OR
        M1>28.5 THEN M3=1
MG 2300 IF M1>=1 AND M1<6.9
        THEN M3=2
MP 2310 IF M1<=8 AND M1>6.9
        THEN M3=3
LM 2320 IF M1>8 AND M1<14.2
        THEN M3=4
MG 2330 IF M1>=14.2 AND M1<=
        15.2 THEN M3=5
FA 2340 IF M1>15.2 AND M1<21
        .6 THEN M3=6
MO 2350 IF M1>=21.6 AND M1<=
        22.6 THEN M3=7
```

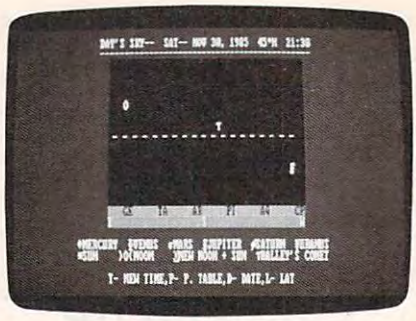
```
JJ 2360 IF M1>22.6 AND M1<=2
        8.5 THEN M3=8
KM 2370 RETURN
HA 2380 B$="":IF Y<>1985 AND
         Y<>1986 THEN 750
IG 2390 IF (Y=1985 AND D1<30
        5) OR (Y=1986 AND D1
        >149) THEN 750
EL 2400 HD=D1+365:IF HD>516
        THEN HD=HD-365
JB 2410 H1=(HD-295)/10:HD=IN
        T(H1):H1=H1-HD
NF 2420 T4=HC(HD)-HC(HD+1):T
        4=HC(HD)-H1*T4:IF T4
        >K1 THEN T4=T4-K1
OP 2430 GOSUB 800:IF Y9=999
        THEN 750
LD 2440 GOSUB 890:IF T4>1115
         AND T4<1200 THEN U9
        =U9+40
AF 2450 IF T4>1290 THEN U9=U
        9-40
HE 2460 IF T4>615 AND T4<=11
        15 THEN U9=U9+80
OE 2470 U(7)=U9:B$="{R}HALLE
        Y'S COMET":GOTO 710
MC 2480 GOSUB 890:PK=SCREEN+
        399-Y9+U9+LB
II 2490 IF LL<0 THEN PK=2*SC
        REEN+199+80*XX-PK
KH 2500 RETURN
FP 2510 LL$="@N":IF LL<0 THE
        N LL$="@S"
LJ 2520 L1=ABS(LL):IF ABS(LL
        )<24 THEN L1=40
OP 2530 LC=INT((L1-40)/7+0.5
        ):LB=LC*40:D1=VAL(D$
        ((M*3)-2,M*3))+D
GC 2540 IF ABS(LL)<24 THEN L
        B=40*INT(ABS(LL)/7+0
        .5)
KM 2550 RETURN
GB 2560 PRINT "{CLEAR}{DOWN}
        {6 SPACES}**********
        * SKYSCAPE *********
        **":PRINT "{DOWN}LAT
        ITUDE CHANGE"
GD 2570 PRINT "{15 U}":GOSUB
         1770
AD 2580 PRINT "{3 DOWN}":PRI
        NT "INPUT NEW LATITU
        DE";:INPUT LL:PRINT
        :PRINT
IF 2590 IF ABS(LL)>90 THEN P
        RINT OO$:GOTO 4560
BP 2600 GOSUB 2260:IF Z$="N"
         THEN 2510
MO 2610 GOSUB 2510:I$="S":GO
        TO 1950
OI 2620 FOR X=SCREEN+680 TO
        SCREEN+699:U1=PEEK(X
        ):U2=PEEK(2*SCREEN+1
        399-X):POKE X,U2:POK
        E 2*SCREEN+1399-X,U1
        :NEXT X
GJ 2630 FOR X=SCREEN+680 TO
        SCREEN+718:IF PEEK(X
        )=128 THEN 2650
EL 2640 U1=PEEK(X):U2=PEEK(X
        +1):POKE X,U2:POKE X
        +1,U1:X=X+1
HO 2650 NEXT X:RETURN
```

Program 3: IBM PC/PCjr Skyscape

Version by Tim Victor, Editorial Programmer

```
MP 100 KEY OFF:WIDTH 80:COLOR 0,
       0,0:CLS
QK 110 GOSUB 2210
FL 120 D$="0000310590901201511812
       12243273304334":K1=1440:
       DIM HC(22):MM$="041079040
       "
LI 130 M$="28631734501104107210213
       3164194225255":D$(1)="S
       ":D$(2)="N":ES=93
DJ 140 A$="JANFEBMARAPRMAYJUNJUL
       AUGSEPOCTNOVDEC":OO$="OUT
        OF RANGE!":DG$=CHR$(248)
HH 150 MD$="3128313031303131303
       3031":D9=ATN(1)/45:READ E
       E:READ M9:DIM P(6,6)
MM 160 DEF FNR(X)=INT(X*10+.5)/1
       0
JA 170 DEF FNS(X)=INT(X*100+.5)/
       100
AA 180 FOR Y=1 TO 2:FOR X=1 TO 6
       :READ P(X,Y):NEXT:NEXT:Y=
       0
HM 190 FOR X=1 TO 6:READ P$(X),P
       (X,3):NEXT
IP 200 FOR X=1 TO 7:READ PP(X):N
       EXT
IK 210 J$="SATSUNMONTUEWEDTHUFRI
       ":FOR X=1 TO 12:READ F$
FP 220 CC$=CC$+"      "+F$:NEXT:C
       C$=CC$+CC$:F$=RIGHT$(CC$,
       9):CC$=F$+CC$
IL 230 FOR X=1 TO 8:READ PH$(X):
       NEXT
JH 240 FOR X=1 TO 22:READ HC(X):
       NEXT:GOTO 880
JE 250 CC=MT-720:IF CC<0 THEN CC
       =CC+K1
MI 260 CC=CC/120:CD=CC-INT(CC):C
       C=INT(CC):CD=INT(CD*7+.2)
       :CC=81-(CC*7+CD)
JP 270 GOSUB 2060:IF LL<0 THEN G
       OSUB 2610
MM 280 PRINT CD$:RETURN
LC 290 LOCATE 24,20:PRINT SPC(40
       );
EH 300 LOCATE 4,SL:PRINT "** DAY
       S SKY **":LOCATE 5,SL:PRI
       NT "--------------"
LH 310 LOCATE 7,SL:PRINT "INPUT
       THE TIME:":LOCATE 8,SL:PR
       INT "----------------"
NH 320 LOCATE 9,SL:PRINT "HOUR (
       0-23)";:GOSUB 2450:IF I$<
       >"" THEN T1=VAL(I$)
HM 330 IF T1<0 OR T1>23 THEN LOC
       ATE 10,SL+3:PRINT OO$:GOT
       O 320
PC 340 LOCATE 11,SL:PRINT "MINUT
       E (0-59)";:GOSUB 2450:IF
       I$<>"" THEN T2=VAL(I$)
NK 350 IF T2<0 OR T2>59 THEN LOC
       ATE 12,SL:PRINT OO$:GOTO
       340
IA 360 R$=RIGHT$(STR$(T1),2):T$=
       RIGHT$(STR$(T2),2):IF T2<
       10 THEN T$="0"+RIGHT$(T$,
       1)
KP 370 LOCATE 14,SL:PRINT "TIME-
       R$":"T$
CN 380 LOCATE 24,20:GOSUB 2230:I
       F I$="N" THEN 290
KN 390 COLOR 3,4:CLS:T3=T1*60+T2
       +AA-720:IF T3<0 THEN T3=T
       3+K1
LK 400 IF T3>K1 THEN T3=T3-K1
JL 410 MT=T3-360:IF MT<0 THEN MT
       =MT+K1
OD 420 PT=T3+360:IF PT>K1 THEN P
       T=PT-K1
HN 430 LOCATE 2,18:PRINT "DAY'S
       SKY--  ";:GOSUB 1800:PRIN
       T "  R$":"T$
JG 440 LOCATE 3,18:PRINT"-------
       ----------------------
       ----------"
IH 450 COLOR 7,1:TM=VAL(R$+"."+T
       $):IF TM<6 OR TM>18 THEN
       COLOR 7,0
DB 460 XX=7+LC:FOR X=1 TO 14:LOC
       ATE 3+X,20:IF X=XX THEN 4
       80
EI 470 PRINT SPC(40);:GOTO 490
NB 480 PRINT " - - - - - - - - -
        - - - - - - - - - - - ";
IG 490 NEXT:LOCATE 18,20:COLOR 0
       ,6:GOSUB 250:LOCATE 19,20
       :COLOR 7,1:IF LL<0 THEN 5
       20
EJ 500 IF LL>24 THEN PRINT "E"SP
       C(18)"S"SPC(19)"W":GOTO 5
       40
GF 510 PRINT "UP-NORTH      ----O
       VERHEAD      DOWN-SOUTH":G
       OTO 540
BJ 520 IF LL<-24 THEN PRINT "E"S
       PC(18)"N"SPC(19)"W":GOTO
       540
GG 530 PRINT "UP-SOUTH      ----O
       VERHEAD      DOWN-NORTH"
PE 540 T4=AA:GOSUB 780:Y8=888
GN 550 IF Y9=999 THEN 590
PC 560 GOSUB 2460:Y8=Y9:IF A1<0
       THEN 590

EM 570 IF U9>17 OR U9<4 THEN 590
CL 580 COLOR 7,1:LOCATE U9,59-Y9
       :PRINT CHR$(42)
OB 590 T4=AA+M2*K1:IF T4>K1 THEN
        T4=T4-K1
EM 600 COLOR 7,1:IF TM<6 OR TM>1
       8 THEN COLOR 7,0
HJ 610 GOSUB 780:IF Y9=999 THEN
       650
KF 620 MM=INT(M1/9.83333)+1:GOSU
       B 860
MK 630 GOSUB 2460:IF U9>17 OR U9
       <4 THEN 650
OK 640 LOCATE U9,59-Y9:PRINT CHR
       $(MM):IF ABS(Y8-Y9)<=.5 T
       HEN COLOR 1,7:LOCATE U9,5
       9-Y9:PRINT CHR$(79):COLOR
        7,1
AC 650 FOR X=1 TO 7:IF X=7 THEN
       2350
JN 660 T4=P(X,6):GOSUB 780:IF Y9
       =999 THEN 730
IK 670 U9=SIN((P(X,6)/4)/(1/D9))
       :U9=-3*U9+.5
HD 680 GOSUB 2470
KA 690 IF U9<4 OR U9>17 THEN 730
DB 700 Z=SCREEN(U9,59-Y9)
BL 710 IF Z<>32 AND Z<>45 THEN U
       9=U9+SGN(LL)+(LL=0):GOTO
       700
DP 720 LOCATE U9,59-Y9:PRINT CHR
       $(PP(X));
OJ 730 NEXT
DE 740 LOCATE 21,14:COLOR 3,4:FO
       R X=1 TO 6:PRINT CHR$(PP(
       X));P$(X);"  ";:NEXT
JA 750 LOCATE 22,14:PRINT "*SUN
          )O(MOON      NEW MOON +
        SUN  ";B$
PC 760 LOCATE 22,33:COLOR 4,3:PR
       INT "O":COLOR 3,4
HM 770 LOCATE 24,20:PRINT "T- NE
```



"Skyscape" on the IBM PC/PCjr.

```
      W TIME,P- P. TABLE,D- DAT
      E,L- LAT";:SL=62:GOTO 198
      Ø
MI 78Ø Y9=999:IF MT<PT THEN 82Ø
NH 79Ø IF T4<MT AND T4>PT THEN R
      ETURN
FK 8ØØ IF T4<MT OR T4>K1 THEN T4
      =T4+K1
HM 81Ø GOTO 83Ø
LB 82Ø IF T4<MT OR T4>PT THEN RE
      TURN
FA 83Ø Y9=INT((T4-MT)/18+.5):IF
      Y9=4Ø THEN Y9=39
NK 84Ø RETURN
FC 85Ø U9=SIN((T4/4)/(1/D9)):U9=
      INT(-3*U9+.5):RETURN
FL 86Ø MM=VAL(MID$(MM$,3*MM-2,3)
      ):IF L<Ø AND MM<>81 THEN
      MM=ABS(MM-81)
NA 87Ø RETURN
OM 88Ø COLOR Ø,3:CLS:LOCATE 2,2Ø
      :PRINT "*************** SK
      YSCAPE ***************":LO
      CATE 4,1Ø:PRINT "DATE INP
      UT":S1=Ø
CA 89Ø LOCATE 5,1Ø:PRINT "------
      ----":IF Y<>Ø THEN LOCATE
       4,4Ø:GOSUB 18ØØ
LI 9ØØ LOCATE 7,4:PRINT "YEAR";:
      GOSUB 245Ø:IF I$<>"" THEN
       Y=VAL(I$)
MC 91Ø IF Y<1977 THEN PRINT "MUS
      T BE AFTER 1977":GOTO 9ØØ
OJ 92Ø GOSUB 188Ø:LOCATE 9,4:PRI
      NT "MONTH (1-12)";:GOSUB
      245Ø:IF I$<>"" THEN M=VAL
      (I$)
MB 93Ø IF M<1 OR M>12 THEN PRINT
       OO$:GOTO 92Ø
OJ 94Ø DI=VAL(MID$(MD$,2*M-1,2))
      :DI=DI-(M=2)*LY:DI$=STR$(
      DI)
IO 95Ø LOCATE 11,4:PRINT"DAY (1-
      "DI$")";:GOSUB 245Ø:IF I$
      <>"" THEN D=VAL(I$)
FE 96Ø IF D<1 OR D>DI THEN PRINT
       OO$:GOTO 95Ø
LB 97Ø H$=MID$(A$,(M*3)-2,3):LOC
      ATE 13,4:PRINT "LATTITUDE
       (Ø-9Ø)";:GOSUB 245Ø:IF I
      $<>"" THEN LL=VAL(I$)
CH 98Ø GOSUB 25ØØ
FB 99Ø IF ABS(LL)>9Ø THEN PRINT
      OO$:GOTO 97Ø
QP 1ØØØ D1=VAL(MID$(D$,(M*3)-2,3
       ))+D:GOSUB 192Ø:IF M>2
       THEN D1=D1+LY:Y1=Y1+LY
NA 1Ø1Ø S=Ø:GOSUB 154Ø:LOCATE 4,
      4Ø:GOSUB 18ØØ:LOCATE 5,4
      Ø:PRINT "---------------
      ---------".
HN 1Ø2Ø LOCATE 24,2Ø:GOSUB 223Ø:
      IF I$="N" THEN 88Ø
BB 1Ø3Ø LOCATE 24,2Ø:PRINT SPC(4
      Ø);
FN 1Ø4Ø D2=VAL(MID$(M$,(M*3)-2,3
       ))+D:GOSUB 192Ø::IF M>
       2 THEN D1=D1+LY:Y1=Y1+
       LY
AD 1Ø5Ø D3=D2-185:IF M=3 AND D<2
       Ø THEN D2=D2+LY:D3=D3
       +LY
QM 1Ø6Ø IF D3<=Ø THEN A=18Ø*D2/1
      85:GOTO 1Ø8Ø
II 1Ø7Ø A=(18Ø*D3/(18Ø+ZY))+18Ø
LC 1Ø8Ø IF A<18Ø THEN S=23.43333
      *SIN(D9*D2*18Ø/185)
LD 1Ø9Ø IF A>18Ø THEN S=-23.4333
      3*(SIN(D9*D3))
HQ 11ØØ IF A>=36Ø THEN A=A-36Ø
LC 1110 A=FNR(A)
KA 1120 S=FNR(S):A1=(SGN(LL)-(LL
      =Ø))*S+9Ø-ABS(LL):A1=FNR
      (A1):GOSUB 149Ø:GOSUB 14
      4Ø
AF 1130 W=1-(LL<Ø):IF A1>9Ø THEN
       A1=18Ø-A1:W=3-W
PE 1140 LOCATE 7,36:PRINT "DAY O
      F THE YEAR-----------
      ";D1
JO 1150 LOCATE 8,36:PRINT "SUN'S
       GEOCENTRIC ANGLE----
      ";STR$(A);DG$
JM 1160 LOCATE 9,36:PRINT "SUN'S
       DECLINATION---------
      ";STR$(S);DG$
OA 1170 LOCATE 10,36:PRINT "SUN'
      S ALTITUDE AT NOON----
      ";STR$(A1);DG$;D$(W)
NM 1180 LOCATE 11,36:PRINT "SUN'
      S RIGHT ASCENSION-----
      ";A3$
HF 1190 LOCATE 12,36:PRINT "R.A.
       AT 9:ØØPM-----------
      ";A5$
BC 12ØØ LOCATE 13,36:PRINT "MOON
      'S AGE----------------
      ";STR$(M1);"DY"
HN 1210 LOCATE 14,36:PRINT "MOON
      'S ELONGATION--------
      ";STR$(M8);DG$;L$
GM 1220 LOCATE 15,36:PRINT "MOON
      'S PHASE - "PH$(M3)
LD 1230 LOCATE 24,20:PRINT "-P-
      PLANET TABLE, -D- NEW DA
      TE";:GOTO 198Ø
JK 1240 COLOR 7,5:CLS:LOCATE 2,2
      Ø:PRINT "SKYSCAPE-   ";:
      GOSUB 18ØØ:S1=1
MF 1250 LOCATE 4,12:PRINT"** PLA
      NET TABLE **":LOCATE 5,1
      2:PRINT "---------------
      ---"
PD 1260 LOCATE 7,4:PRINT "PLANET
         DIST.  ANG. W/ SUN
        R.A."
HG 1270 LOCATE 8,4:PRINT "------
      ------------------------
      ------"
PO 1280 FOR X=1 TO 6:A2=Y1/P(X,2
      )-INT(Y1/P(X,2)):Q3=1
GE 1290 A2=(A2*36Ø)+P(X,1):IF A2
      >36Ø THEN A2=A2-36Ø
NK 13ØØ E=18Ø+A:IF E>36Ø THEN E=
      E-36Ø
JL 1310 E1=ABS(E-A2):IF E1>18Ø T
      HEN E1=36Ø-E1
MP 1320 GOSUB 156Ø:E1=E1*D9:P5=P
      (X,3):IF X=3 THEN GOSUB
      2Ø4Ø
KI 1330 P(X,4)=SQR(1+P5^2-2*P5*C
      OS(E1)):XX=((P5^2-1-P(X,
      4)^2)/(-2*P(X,4)))
NE 1340 P(X,5)=-ATN(XX/SQR(-XX*X
      X+1))+ATN(1)*2:P(X,4)=IN
      T(P(X,4)*93+.5):P(X,5)=P
      (X,5)/D9
JM 1350 P(X,5)=FNS(P(X,5)):Q1$=S
      TR$(P(X,4)):Q2$=STR$(P(X
      ,5))
QI 1360 Q1=LEN(Q1$):Q2=LEN(Q2$):
      GOSUB 166Ø
FM 1370 LOCATE X+8,4:PRINT P$(X)
      ;TAB(18-Q1);Q1$;TAB(28-Q
      2);Q2$;:IF Q3=-1 THEN PR
      INT DG$"W";
BE 1380 IF Q3=1 THEN PRINT DG$"E
      ";
KM 1390 GOSUB 171Ø:Q4$=STR$(Q4):
      Q5$=STR$(Q5):IF Q5<1Ø TH
      EN Q5$="Ø"+RIGHT$(Q5$,1)
BM 14ØØ Q5$=RIGHT$(Q5$,2):Q4$=Q4
      $+":"+Q5$:Z=LEN(Q4$)
GC 1410 PRINT TAB(32);QQ$;TAB(4Ø
      -Z);Q4$:NEXT:LOCATE 15,4
      :PRINT "* - VISIBLE AT 9
       P.M."
JA 1420 LOCATE 17,4:PRINT "SUN'S
       R.A. -------";SPC(Q8);A
      3$:LOCATE 18,4:PRINT "R.
      A. AT 9:ØØPM ---";SPC(Q9
      );A5$
FQ 1430 SL=52:LOCATE 24,2Ø:PRINT
       "-S- FOR DAY'S SKY, -D-
       FOR NEW DATE";:GOTO 198
      Ø
FD 1440 A2=K1*A/36Ø:IF A2>K1 THE
      N A2=A2-K1
HO 1450 A3=INT(A2/6Ø):A4=A2-A3*6
      Ø:A5=A3+9:IF A5>23 THEN
      A5=A5-24
PM 1460 A4=INT(A2-A3*6Ø+.5):IF A
      4=6Ø THEN A4=Ø:A3=A3+1
JO 147Ø IF A3=24 THEN A3=Ø
GH 148Ø AA=A3*6Ø+A4:GOTO 184Ø
EN 149Ø M1=((Y1/M9)-INT(Y1/M9))*
      M9+1Ø:IF M1>M9 THEN M1=M
      1-M9
PK 15ØØ GOSUB 226Ø:M8=36Ø*M2:IF
      M8>18Ø THEN L$="W"
MB 151Ø IF M8<=18Ø THEN L$="E"
KN 152Ø IF M8>18Ø THEN M8=36Ø-M8
HP 153Ø M1=FNR(M1):M8=FNR(M8):RE
      TURN
FL 154Ø YY=INT(7*(Y1/7-INT(Y1/7)
      )+.2):IF YY=Ø THEN YY=7
NH 155Ø K$=MID$(J$,(YY*3)-2,3):R
      ETURN
CN 156Ø Q3=Ø:Q1=E+18Ø:IF Q1>36Ø
      THEN 16ØØ
IE 157Ø IF A2>E AND A2<Q1 THEN 1
      59Ø
DN 158Ø Q3=1:RETURN
BA 159Ø Q3=-1:RETURN
LA 16ØØ Q1=Q1-36Ø:IF A2<=36Ø AND
       A2>E THEN 159Ø
NK 161Ø IF Q3<>Ø THEN RETURN
EM 162Ø IF A2>Ø AND A2<=Q1 THEN
      159Ø
NA 163Ø IF Q3<>Ø THEN RETURN
FD 164Ø IF A2>Q1 THEN 158Ø
JG 165Ø RETURN
NK 166Ø Q5=Q3*P(X,5)*4+AA:IF Q5<
      Ø THEN Q5=Q5+K1
NN 167Ø IF Q5>K1 THEN Q5=Q5-K1
EL 168Ø P(X,6)=Q5:Q4=INT(Q5/6Ø):
      Q5=INT(Q5-Q4*6Ø+.5):IF Q
      5=6Ø THEN Q5=Ø:Q4=Q4+1
IH 169Ø IF Q4=24 THEN Q4=Ø
JJ 17ØØ RETURN
MM 1710 SU=A5*6Ø+A4:PS=SU+36Ø:MS
      =SU-36Ø:IF PS>K1 THEN PS
      =PS-K1
MG 172Ø IF MS<Ø THEN MS=MS+K1
LE 173Ø IF MS>PS THEN 176Ø
OG 174Ø IF P(X,6)<PS AND P(X,6)>
      MS THEN 179Ø
EI 175Ø QQ$=" ":RETURN
GK 176Ø IF P(X,6)<K1 AND P(X,6)>
      MS THEN 179Ø
LJ 177Ø IF P(X,6)<PS THEN 179Ø
CB 178Ø GOTO 175Ø
LC 179Ø QQ$="*":RETURN
BH 18ØØ LL$=RIGHT$(STR$(ABS(LL))
      ,2):IF ABS(LL)<1Ø THEN L
      L$=" "+RIGHT$(LL$,1)
MK 181Ø PRINT K$;"-- ";H$;STR$(D
      );",";Y;" ";LL$;DG$;:PRI
      NT MID$("SN",(LL<Ø)+2,1)
      ;
LN 182Ø IF D<1Ø THEN PRINT " ";
JE 183Ø RETURN
MB 184Ø A4$=RIGHT$(STR$(A4),2)
NP 185Ø IF A4<1Ø THEN A4$="Ø"+RI
      GHT$(A4$,1)
NP 186Ø A3$=STR$(A3)+":"+A4$:A5$
      =STR$(A5)+":"+A4$
GJ 187Ø Q8=7-LEN(A3$):Q9=7-LEN(A
      5$):RETURN
NO 188Ø LY=Ø:IF Y/4=INT(Y/4) THE
      N LY=1
GI 189Ø IF Y/1ØØ=INT(Y/1ØØ) AND
      Y/4ØØ<>INT(Y/4ØØ)THEN LY
      =Ø
FH 19ØØ IF Y/1ØØØ=INT(Y/1ØØØ) AN
      D Y/4ØØØ=INT(Y/4ØØØ) THE
      N LY=Ø
```

```
JA 1910 RETURN
NB 1920 Y9=Y+1:IF Y9/4=INT(Y9/4)
        THEN ZY=1
LO 1930 IF Y9/100=INT(Y9/100) AN
        D Y9/400<>INT(Y9/400) TH
        EN ZY=0
QI 1940 IF Y9/1000=INT(Y9/1000)
        AND Y9/4000=INT(Y9/4000)
        THEN ZY=0
BF 1950 Y1=Y-1977:Y1=Y1*365+INT(
        Y1/4)+D1:IF Y<2000 THEN
        1970
DC 1960 Y1=Y1-INT((Y-2001)/100)+
        INT((Y-2001)/400)-INT((Y
        -1)/4000)
KC 1970 RETURN
JB 1980 GOSUB 2240
JC 1990 IF I$="D" THEN 880
JH 2000 IF (I$="S" OR I$="T") AN
        D S1=1 THEN 290
NK 2010 IF I$="P" THEN 1240
GG 2020 IF I$="L" AND S1=1 THEN
        2540
EE 2030 GOTO 1980
AB 2040 P5=1.376344:K5=A2*4
LC 2050 K5=ABS(K5-1233.73)*90/K1
        :K5=K5*D9:K5=SIN(K5)*.32
        25812:P5=P5+K5:RETURN
FP 2060 IF CC<=0 THEN CC=CC+84
CD 2070 CD$=MID$(CC$,CC-1):IF MI
        D$(CD$,2,1)<>" " AND MID
        $(CD$,3,1)=" " THEN CD$=
        " "+CD$
GC 2080 IF MID$(CD$,40,1)=" " AN
        D MID$(CD$,41,1)<>"" THE
        N CD$=MID$(CD$,2)
JF 2090 CD$=MID$(CD$,2,40):RETUR
        N
HO 2100 DATA 356.26,29.53059,59.
        818184,42.719626,262.364
        394,52.9196763
OP 2110 DATA 134.69697,218.79464
        ,87.97,224.7,686.98
PO 2120 DATA 4332.79813,10759.71
        95,30686.5884
NA 2130 DATA "MERCURY",.3871,"VE
        NUS",.7233,"MARS",1.5237
        ,"JUPITER",5.2028
GK 2140 DATA "SATURN",9.5308,"UR
        ANUS",19.182
JL 2150 DATA 4,232,229,21,237,15
        7,231
GO 2160 DATA "SA","SC","LI","VI"
        ,"LE","CA","GE","TA","AR
        ","PI","AQ","CP"
QD 2170 DATA "NEW","WAXING CRESC
        ENT","1ST QUARTER","WAXI
        NG GIBBOUS","FULL"
HI 2180 DATA "WANING GIBBOUS","3
        RD QUARTER","WANING CRES
        CENT"
HM 2190 DATA 1770,1719,1620,1500
        ,1418,1365,1335,1310,129
        0,1275,1260
PO 2200 DATA 1238,1220,1200,1178
        ,1115,915,720,660,640,62
        5,610
LI 2210 CLS:LOCATE 7,12:PRINT "*
        *** SKYSCAPE ****"
IG 2220 RETURN
NH 2230 PRINT "-N- TO RE-INPUT O
        R RETURN TO CONTINUE";
EL 2240 I$="":WHILE LEN(I$)=0:I$
        =INKEY$:WEND:IF I$>"Z" T
        HEN I$=CHR$(ASC(I$)-32)
JP 2250 RETURN
MM 2260 M2=M1/M9:IF M1<1 OR M1>2
        8.5 THEN M3=1
EL 2270 IF M1>=1 AND M1<6.9 THEN
        M3=2
IH 2280 IF M1>=6.9 AND M1<=8 THE
        N M3=3
DA 2290 IF M1>8 AND M1<14.2 THEN
        M3=4
IC 2300 IF M1>=14.2 AND M1<15.2
        THEN M3=5
OK 2310 IF M1>=15.2 AND M1<21.6
        THEN M3=6
FC 2320 IF M1>=21.6 AND M1<=22.6
        THEN M3=7
DA 2330 IF M1>22.6 AND M1<=28.5
        THEN M3=8
JO 2340 RETURN
JL 2350 B$="":IF Y<>1985 AND Y<>
        1986 THEN 730
NO 2360 IF (Y=1985 AND D1<305) O
        R (Y=1986 AND D1>149) TH
        EN 730
QM 2370 HD=D1+365:IF HD>516 THEN
        HD=HD-365
DB 2380 H1=(HD-295)/10:HD=INT(H1
        ):H1=H1-HD
MA 2390 T4=HC(HD)-HC(HD+1):T4=HC
        (HD)-H1*T4:IF T4>1440 TH
        EN T4=T4-1440
NG 2400 GOSUB 780:IF Y9=999 THEN
        730
PH 2410 GOSUB 850:IF T4>1115 AND
        T4>1200 THEN U9=U9+1
HM 2420 IF T4>1290 THEN U9=U9-1
IP 2430 IF T4>615 AND T4<1115 TH
        EN U9=U9+2
PI 2440 U(7)=U9:B$=CHR$(PP(7))+"
        HALLEY'S COMET":GOTO 680
QN 2450 INPUT "";I$:RETURN
PJ 2460 GOSUB 850
BM 2470 IF LL>=0 THEN U9=LC+10+U
        9:GOTO 2490
CL 2480 U9=LC+10-U9:Y9=39-Y9
KP 2490 RETURN
IK 2500 LL$="ØN":IF LL<0 THEN LL
        $="ØS"
IO 2510 L1=ABS(LL):IF ABS(LL)<24
        THEN L1=40
KK 2520 LC=INT((L1-40)/7+.5):D1=
        VAL(MID$(D$,(M*3)-2,3))+
        D
JP 2530 RETURN
CP 2540 LOCATE 24,20:PRINT SPC(4
        0);
EH 2550 LOCATE 7,SL:PRINT "NEW L
        ATTITUDE":LOCATE 8,SL:PR
        INT "--------------"
DO 2560 LOCATE 9,SL:PRINT "LAT (
        0-90)";:GOSUB 2450:IF I$
        <>"" THEN LL=VAL(I$)
BJ 2570 IF ABS(LL)>90 THEN LOCAT
        E 10,SL+3:PRINT OO$:GOTO
        2560
LO 2580 LOCATE 24,20:GOSUB 2230:
        IF I$="N" THEN 2540
IE 2590 LOCATE 9,SL:PRINT SPC(80
        -SL);
GK 2600 GOSUB 2500:I$="S":GOTO 2
        000
JI 2610 CI=1:C2$=""
DB 2620 C1$=MID$(CD$,CI,1):IF C1
        $<>" " THEN 2640
FA 2630 C2$=C1$+C2$:CI=CI+1:GOTO
        2650
MN 2640 C2$=MID$(CD$,CI,2)+C2$:C
        I=CI+2
IC 2650 IF CI<41 THEN 2620
LD 2660 CD$=C2$:RETURN
```

Program 4: Apple Skyscape

Version by Tim Victor, Editorial Programmer

```
1D 60 GOSUB 1940
40 70 D$ = "0000310590901201511812
        1212243273304334":K1 = 144
        0: DIM HC(22):MM$ = "04108
        1040"
84 80 M$ = "2863173450110410721021
        2133164194225255":D$(1) =
        "S":D$(2) = "N":ES = 93
23 90 A$ = "JANFEBMARAPRMAYJUNJU
        LAUGSEPOCTNOVDEC":OO$ = "O
```

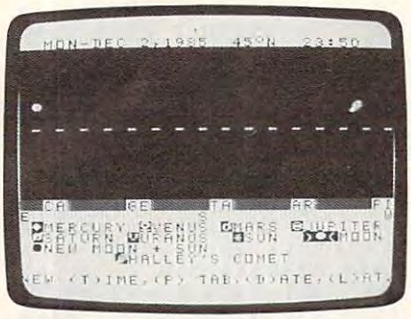
"Skyscape" on an Apple II-series computer.

```
      UT OF RANGE!!"
2A 100 MD$ = "312831303130313130
        313031":D9 = ATN (1) / 45
        : READ EE: READ M9: DIM P
        (6,6)
C0 110 DEF FN R(X) = INT (X * 10
        0 + .5) / 100
46 120 DEF FN S(X) = INT (X * 10
        + .5) / 10
08 130 FOR Y = 1 TO 2: FOR X = 1
        TO 6: READ P(X,Y): NEXT
        : NEXT :Y = 0
73 140 FOR X = 1 TO 6: READ P$(X
        ),P(X,3): NEXT
14 150 FOR X = 1 TO 7:PP(X) = X
        + 85: NEXT
1F 160 J$ = "SATSUNMONTUEWEDTHUF
        RI": FOR X = 1 TO 12: REA
        D F$
B8 170 CC$ = CC$ + "      " + F$:
        NEXT :CC$ = CC$ + CC$:F$
        = RIGHT$ (CC$,9):CC$ = F
        $ + CC$
C1 180 FOR X = 1 TO 8: READ PH$(
        X): NEXT
2E 190 FOR X = 1 TO 22: READ HC(
        X): NEXT :R$ = "0":T$ = "
        00": GOTO 720
3B 200 CC = MT - 720: IF CC < 0
        THEN CC = CC + K1
2C 210 CC = CC / 120:CD = CC - I
        NT (CC):CC = INT (CC):CD
        = INT (CD * 7 + .2):CC =
        81 - (CC * 7 + CD)
51 220 GOSUB 1770: IF LL < 0 THE
        N GOSUB 5000
92 225 VTAB 17: PRINT CD$;: RETU
        RN
DB 230 HOME : HTAB 10: PRINT "**
        DAYS SKY **": VTAB 3: GO
        SUB 1550: HTAB 31: PRINT
        R$":"T$
DF 240 VTAB 5: HTAB 1: PRINT "IN
        PUT THE TIME:": PRINT "--
        ------------"
B8 245 PRINT : PRINT "      HOUR
        (0-23) ";: GOSUB 2240: IF
        I$ < > "" THEN T1 = VAL
        (I$)
83 250 IF T1 < 0 OR T1 > 23 THEN
        PRINT OO$: GOTO 245
A3 255 PRINT : PRINT "   MINUTE
        (0-59) ";: GOSUB 2240: IF
        I$ < > "" THEN T2 = VAL
        (I$)
9D 260 IF T2 < 0 OR T2 > 59 THEN
        PRINT OO$: GOTO 255
85 270 R$ = STR$ (T1):T$ = STR$
        (T2): IF LEN (T$) = 1 THE
        N T$ = "0" + T$
E8 280 VTAB 13: PRINT "TIME-- "R
        $":"T$
AA 290 PRINT : GOSUB 2020: IF I$
        = "N" THEN 230
10 300 HOME :T3 = T1 * 60 + T2 +
        AA - 720: IF T3 < 0 THEN
        T3 = T3 + K1
```

```
2Ø 310 IF T3 > K1 THEN T3 = T3 -
       K1
B7 320 MT = T3 - 360: IF MT < Ø
       THEN MT = MT + K1
FF 330 PT = T3 + 360: IF PT > K1
       THEN PT = PT - K1
16 340 HTAB 4: GOSUB 1550: HTAB
       31: PRINT R$":"T$
F7 350 TM = VAL (R$ + "." + T$):
       IF TM > = 6 AND TM < = 1
       8 THEN INVERSE
Ø4 360 XX = 7 + LC: VTAB 3: HTAB
       1: FOR X = 1 TO 14: IF X
       = XX THEN GOTO 380
CE 370 PRINT SPC( 40);: GOTO 390
B6 380 PRINT " - - - - - - - - -
       - - - - - - - - - - ";
D2 390 NEXT X: NORMAL : GOSUB 20
       Ø: INVERSE : IF LL < Ø TH
       EN 395
31 393 IF LL > 24 THEN PRINT "E"
       SPC( 18)"S" SPC( 19)"W":
       GOTO 400
3Ø 394 PRINT "UP-NORTH" SPC( 5)"
       ----OVERHEAD" SPC( 5)"DOW
       N-SOUTH": GOTO 400
D5 395 IF LL < - 24 THEN PRINT "
       W" SPC( 18)"N" SPC( 19)"E
       ": GOTO 400
C0 397 PRINT "UP-SOUTH" SPC( 5)"
       ----OVERHEAD" SPC( 5)"DOW
       N-NORTH"
Ø9 400 T4 = AA: GOSUB 610:Y8 = 8
       88
43 410 IF Y9 = 999 THEN 450
A6 420 GOSUB 4000:Y8 = Y9: IF A1
       < Ø THEN 450
D6 430 IF U9 > 16 OR U9 < 3 THEN
       450
B0 440 VTAB U9: HTAB 40 - Y9: PR
       INT CHR$ (42)
97 450 T4 = AA + M2 * K1: IF T4
       > K1 THEN T4 = T4 - K1
EB 460 GOSUB 610: IF Y9 = 999 TH
       EN 500
97 470 MM = INT (M1 / 9.83333) +
       1: GOSUB 710
1D 480 GOSUB 4000: IF U9 > 16 OR
       U9 < 3 THEN 500
60 490 VTAB U9: HTAB 40 - Y9: PR
       INT CHR$ (MM);: IF ABS (Y
       8 - Y9) < = .5 THEN NORMA
       L : HTAB 40 - Y9: PRINT C
       HR$ (81);: INVERSE
70 500 FOR X = 1 TO 7: IF X = 7
       THEN 2140
60 510 T4 = P(X,6): GOSUB 610: I
       F Y9 = 999 THEN 560
87 520 U9 = SIN ((P(X,6) / 4) /
       (1 / D9)):U9 = INT ( - 3
       * U9 + .5)
13 530 GOSUB 4005: IF U9 < 3 OR
       U9 > 16 THEN 560
BE 540 SR = INT ((U9 - 1) / 8):Z
       = PEEK (1024 - SR * 984
       + (U9 - 1) * 128 + 39 - Y
       9): IF Z > 127 THEN Z = Z
       - 128
A0 545 IF Z < > 32 AND Z < > 45
       THEN U9 = U9 + 2 * (LL >
       = Ø) - 1: GOTO 540
2A 550 VTAB U9: HTAB 40 - Y9: PR
       INT CHR$ (PP(X));
EB 560 NEXT X: NORMAL
F3 570 VTAB 20: HTAB 1: PRINT "V
       MERCURY   WVENUS   XMARS
          YJUPITER"
2F 580 PRINT "ZSATURN    [URANUS
         *SUN       )Q(MOON"
99 590 HTAB 3: INVERSE : PRINT "
       Q";: NORMAL : PRINT "NEW
       MOON + SUN  "B$
92 600 PRINT : PRINT "T- NEW TIM
       E,P- P. TABLE,D- DATE,L-
       LAT";: GOTO 1700
7F 610 Y9 = 999: IF MT < PT THEN
       660
36 620 IF (T4 > = MT) OR (T4 < =
       PT) THEN 640
1C 630 RETURN
87 640 IF (T4 > = MT) AND (T4 <
       = K1) THEN 680
7C 650 T4 = T4 + K1: GOTO 680
C4 660 IF (T4 > = MT) AND (T4 <
       = PT) THEN GOTO 680
24 670 RETURN
7A 680 Y9 = INT ((T4 - MT) / 18
       + .5): IF Y9 = 40 THEN Y9
       = 39
2B 690 RETURN
6A 700 U9 = SIN ((T4 / 4) / (1 /
       D9)):U9 = INT ( - 3 * U9
       + .5): RETURN
56 710 MM = VAL ( MID$ (MM$,3 *
       MM - 2,3)): IF LL < Ø AND
       MM < > 81 THEN MM = ABS
       (MM - 81)
2D 715 RETURN
DA 720 HOME : VTAB 2: HTAB 7: PR
       INT "********** SKYSCAPE
       **********": VTAB 4: PRIN
       T "DATE INPUT"
56 730 PRINT "----------": IF Y
       < > Ø THEN VTAB 6: GOSUB
       1550: PRINT : PRINT
E5 740 PRINT "YEAR  ";: GOSUB 22
       40: IF I$ < > "" THEN Y =
       VAL (I$)
14 745 IF Y < 1977 THEN PRINT "M
       UST BE AFTER 1977": GOTO
       740
D3 750 GOSUB 1600: PRINT : PRINT
       "MONTH (1-12) ";: GOSUB
       2240: IF I$ < > "" THEN M
       = VAL (I$)
B5 755 IF M < 1 OR M > 12 THEN P
       RINT 00$: GOTO 750
65 760 DI = VAL ( MID$ (MD$,2 *
       M - 1,2)):DI = DI + (M =
       2) * LY:DI$ = STR$ (DI):D
       I$ = RIGHT$ (DI$,2)
3B 770 PRINT : PRINT "DAY (1-"DI
       $") ";: GOSUB 2240: IF I$
       < > "" THEN D = VAL (I$)
8A 775 IF D < 1 OR D > DI THEN P
       RINT 00$: GOTO 770
F2 780 H$ = MID$ (A$,(M * 3) - 2
       ,3) + " ": PRINT : PRINT
       "LATITUDE (Ø-90)";: GOSUB
       2240: IF I$ < > "" THEN
       LL = VAL (I$)
F8 786 GOSUB 4500
E9 790 IF ABS (LL) > 90 THEN PRI
       NT 00$: GOTO 780
68 800 PRINT : HTAB 5: GOSUB 129
       5: GOSUB 1550: PRINT : PR
       INT : GOSUB 2020: IF I$ =
       "N" THEN 720
BD 820 D2 = VAL ( MID$ (M$,(M *
       3) - 2,3)) + D: GOSUB 164
       Ø: IF M > 2 THEN D1 = D1
       + LY:Y1 = Y1 + LY
2D 830 D3 = D2 - 185: IF M = 3 A
       ND D < 20 THEN D2 = D2 +
       LY:D3 = D3 + LY
F0 840 S = Ø: IF D3 < = Ø THEN A
       = 180 * D2 / 185: GOTO 8
       60
E2 850 A = 180 * D3 / (180 + ZY)
       + 180
B2 860 IF A < > 180 THEN S = 23.
       43333333 * ( SIN (D9 * D2
       * 180 / 185))
D4 870 IF A > 180 THEN S = - 23.
       43333333 * ( SIN (D9 * D3
       ))
E9 880 IF A > = 360 THEN A = A -
       360
B3 885 A = FN R(A)
E1 890 S = FN R(S):A1 = ( SGN (L
       L) + (LL = Ø)) * S + 90 -
       ABS (LL):A1 = FN R(A1):
       GOSUB 1250: GOSUB 1200
B7 895 W = 2 - (LL < Ø): IF A1 >
       90 THEN A1 = 180 - A1:W
       = 3 - W
25 900 HOME : VTAB 2: GOSUB 1550
       : PRINT : PRINT "--------
       ----------------"
64 910 PRINT : PRINT "DAY OF THE
       YEAR----------     ";D1
12 920 PRINT "SUNS GEOCENTRIC AN
       GLE-----     ";A;"@"
8D 930 PRINT "SUNS DECLINATION--
       --------     ";S;"@"
39 940 PRINT "SUNS ALTITUDE AT N
       OON-----     ";A1;"@";D$(W
       )
48 950 PRINT "SUNS RIGHT ASCENSI
       ON------     ";A3$
55 960 PRINT "R.A. AT 9:00PM----
       --------     ";A5$
8E 970 PRINT "MOONS AGE---------
       --------     ";M1;"DY"
FB 980 PRINT "MOONS ELONGATION--
       --------     ";M8;"@";L$
0E 990 PRINT "MOONS PHASE - "PH$
       (M3)
63 1000 VTAB 17: PRINT "-P- PLAN
       ET TABLE ,-D- NEW DATE":
       GOTO 1700
F3 1010 HOME : HTAB 11: PRINT "*
       * PLANET TABLE **": VTAB
       3: GOSUB 1550:S1 = 1
CE 1020 VTAB 5: HTAB 1: PRINT "P
       LANET   DIST.  ANG. W/ S
       UN    R.A"
AA 1030 VTAB 6: PRINT "---------
       ------------------------
       -----"
D4 1040 FOR X = 1 TO 6:A2 = Y1 /
       P(X,2) - INT (Y1 / P(X,
       2)):Q3 = 1
19 1050 A2 = (A2 * 360) + P(X,1)
       : IF A2 > 360 THEN A2 =
       A2 - 360
01 1060 E = 180 + A: IF E > 360
       THEN E = E - 360
FD 1070 E1 = ABS (E - A2): IF E1
       > 180 THEN E1 = 360 - E
       1
24 1080 GOSUB 1310:E1 = E1 * D9:
       P5 = P(X,3): IF X = 3 TH
       EN GOSUB 1750
1D 1090 P(X,4) = SQR (1 + P5 ^ 2
       - 2 * 1 * P5 * COS (E1)
       ):XX = ((P5 ^ 2 - 1 - P(
       X,4) ^ 2) / ( - 2 * P(X,
       4)))
7D 1100 P(X,5) = - ATN (XX / SQR
       ( - XX * XX + 1)) + ATN
       (1) * 2:P(X,4) = INT (P
       (X,4) * 93 + .5):P(X,5)
       = P(X,5) / D9
56 1110 P(X,5) = FN S(P(X,5)):Q1
       $ = STR$ (P(X,4)):Q2$ =
       STR$ (P(X,5))
D8 1120 Q1 = LEN (Q1$):Q2 = LEN
       (Q2$): GOSUB 1410
0B 1130 PRINT P$(X); TAB( 14 - Q
       1);Q1$; TAB( 24 - Q2);Q2
       $;: IF Q3 = - 1 THEN PRI
       NT "@W";
DA 1140 IF Q3 = 1 THEN PRINT "@E
       ";
78 1150 GOSUB 1460:Q4$ = STR$ (Q
       4):Q5$ = STR$ (Q5): IF Q
       5 < 10 THEN Q5$ = "0" +
       RIGHT$ (Q5$,1)
9D 1160 Q5$ = RIGHT$ (Q5$,2):Q4$
       = Q4$ + ":" + Q5$:Z = L
       EN (Q4$)
71 1170 PRINT TAB( 28)QQ$ TAB( 3
       6 - Z)Q4$: NEXT : VTAB 1
       4: PRINT "* - VISIBLE AT
       9 P.M."
```

```
5F 1180 VTAB 17: PRINT "SUNS R.A
. --------" SPC( Q8)A3$:
PRINT "R.A. AT 9:00PM -
--" SPC( Q9)A5$
15 1190 VTAB 21: PRINT "-S- FOR
DAYS SKY -D- FOR NEW DAT
E": GOTO 1700
D4 1200 A2 = K1 * A / 360: IF A2
> K1 THEN A2 = A2 - K1
77 1210 A3 = INT (A2 / 60):A4 =
A2 - A3 * 60:A5 = A3 + 9
: IF A5 > 23 THEN A5 = A
5 - 24
27 1220 A4 = INT (A2 - A3 * 60 +
.5): IF A4 = 60 THEN A4
= 0:A3 = A3 + 1
93 1230 IF A3 = 24 THEN A3 = 0
0C 1240 AA = A3 * 60 + A4: GOTO
1560
BD 1250 M1 = ((Y1 / M9) - INT (Y
1 / M9)) * M9 + 10: IF M
1 > M9 THEN M1 = M1 - M9
BC 1260 GOSUB 2050:M8 = 360 * M2
: IF M8 > 180 THEN L$ =
"W"
B4 1270 IF M8 < = 180 THEN L$ =
"E"
EE 1280 IF M8 > 180 THEN M8 = 36
0 - M8
56 1290 M1 = FN R(M1):M8 = FN R(
M8)
0B 1295 YY = INT (7 * (Y1 / 7 -
INT (Y1 / 7)) + .2): IF
YY = 0 THEN YY = 7
4B 1300 K$ = MID$ (J$,(YY * 3) -
2,3): RETURN
14 1310 Q3 = 0:Q1 = E + 180: IF
Q1 > 360 THEN 1350
61 1320 IF A2 > E AND A2 < Q1 TH
EN 1340
D2 1330 Q3 = 1: RETURN
10 1340 Q3 = - 1: RETURN
6E 1350 Q1 = Q1 - 360: IF A2 < =
360 AND A2 > E THEN 134
0
BD 1360 IF Q3 < > 0 THEN RETURN
6A 1370 IF A2 > 0 AND A2 < = Q1
THEN 1340
95 1380 IF Q3 < > 0 THEN RETURN
44 1390 IF A2 > Q1 THEN 1330
D9 1400 RETURN
F8 1410 Q5 = Q3 * P(X,5) * 4 + A
A: IF Q5 < 0 THEN Q5 = Q
5 + K1
BC 1420 IF Q5 > K1 THEN Q5 = Q5
- K1
92 1430 P(X,6) = Q5:Q4 = INT (Q5
/ 60):Q5 = INT (Q5 - Q4
* 60 + .5): IF Q5 = 60
THEN Q5 = 0:Q4 = Q4 + 1
29 1440 IF Q4 = 24 THEN Q4 = 0
ED 1450 RETURN
D8 1460 SU = A5 * 60 + A4:PS = S
U + 360:MS = SU - 360: I
F PS > K1 THEN PS = PS -
K1
96 1470 IF MS < 0 THEN MS = MS +
K1
5A 1480 IF MS > PS THEN 1510
26 1490 IF P(X,6) < PS AND P(X,6
) > MS THEN 1540
D2 1500 QQ$ = " ": RETURN
DE 1510 IF P(X,6) < K1 AND P(X,6
) > MS THEN 1540
46 1520 IF P(X,6) < PS THEN 1540
6A 1530 GOTO 1500
A3 1540 QQ$ = "*": RETURN
80 1550 PRINT K$"-- "H$;D","Y;"
";: IF LL < 10 THEN PRI
NT " ";
AB 1555 PRINT ABS (LL);LL$;: RET
URN
EF 1560 A3$ = STR$ (A3):A3$ = RI
GHT$ (A3$,2):A4$ = STR$
(A4):A4$ = RIGHT$ (A4$,2
)
42 1570 IF A4 < 10 THEN A4$ = "0
" + RIGHT$ (A4$,1)
3D 1580 A3$ = A3$ + ":" + RIGHT$
(A4$,2):A5$ = STR$ (A5)
:A5$ = RIGHT$ (A5$,2) +
":" + A4$
EB 1590 Q8 = 7 - LEN (A3$):Q9 =
7 - LEN (A5$): RETURN
5D 1600 LY = 0: IF Y / 4 = INT (
Y / 4) THEN LY = 1
49 1610 IF Y / 100 = INT (Y / 10
0) AND Y / 400 < > INT (
Y / 400) THEN LY = 0
CF 1620 IF Y / 1000 = INT (Y / 1
000) AND Y / 4000 = INT
(Y / 4000) THEN LY = 0
E9 1630 RETURN
4B 1640 Y9 = Y + 1: IF Y9 / 4 =
INT (Y9 / 4) THEN ZY = 1
0B 1650 IF Y9 / 100 = INT (Y9 /
100) AND Y9 / 400 < > IN
T (Y9 / 400) THEN ZY = 0
CB 1660 IF Y9 / 1000 = INT (Y9 /
1000) AND Y9 / 4000 = I
NT (Y9 / 4000) THEN ZY =
0
BB 1670 Y1 = Y - 1977:Y1 = Y1 *
365 + INT (Y1 / 4) + D1:
IF Y < 2000 THEN 1690
DC 1680 Y1 = Y1 - INT ((Y - 2001
) / 100) + INT ((Y - 200
1) / 400) - INT ((Y - 1)
/ 4000)
02 1690 RETURN
5D 1700 GET I$
F1 1710 IF I$ = "D" THEN 720
F9 1720 IF (I$ = "S" OR I$ = "T"
) AND S1 = 1 THEN 230
A9 1730 IF I$ = "P" THEN 1010
06 1735 IF I$ = "L" AND S1 = 1 T
HEN 4550
76 1740 GOTO 1700
EB 1750 P5 = 1.376344086:K5 = A2
* 4
97 1760 K5 = ABS (K5 - 1233.73)
* 90 / K1:K5 = K5 * D9:K
5 = SIN (K5) * .32258122
4:P5 = P5 + K5: RETURN
B5 1770 IF CC < = 0 THEN CC = CC
+ 84
47 1780 CD$ = MID$ (CC$,CC - 1)
0F 1785 IF MID$ (CD$,2,1) < > "
" AND MID$ (CD$,3,1) = "
" THEN CD$ = " " + CD$
3D 1786 IF MID$ (CD$,41,1) = " "
AND MID$ (CD$,42,1) < >
" " THEN CD$ = MID$ (CD
$,2)
D3 1788 CD$ = MID$ (CD$,2,40): R
ETURN
8D 1790 DATA 365.26,29.53059,59.
818184,42.719626,262.364
4,52.916763
91 1800 DATA 134.69697,218.79464
,87.97,224.7,686.98
39 1810 DATA 4332.79813,10759.71
95,30686.5884
25 1820 DATA "MERCURY",.3871,"VE
NUS",.7233,"MARS",1.5237
,"JUPITER",5.2028
06 1830 DATA "SATURN",9.5308,"UR
ANUS",19.182
A5 1890 DATA "SA","SC","LI","VI"
,"LE","CA","GE","TA","AR
","PI","AQ","CP"
15 1900 DATA "NEW","WAXING CRESC
ENT","1ST QUARTER","WAXI
NG GIBBOUS","FULL"
E4 1910 DATA "WANING GIBBOUS","3
RD QUARTER","WANING CRES
CENT"
05 1920 DATA 1770,1719,1620,1500
,1418,1365,1335,1310,129
0,1275,1260
4A 1930 DATA 1238,1220,1200,1178
,1115,915,720,660,640,625
,610
D4 1940 PRINT CHR$ (17): HOME :
VTAB 7: HTAB 12: PRINT "
**** SKYSCAPE ****"
F7 1950 RETURN
AC 2020 PRINT "-N- TO RE-INPUT O
R RETURN TO CONTINUE"
6F 2030 GET I$: RETURN
36 2050 M2 = M1 / M9: IF M1 < 1
OR M1 > 28.5 THEN M3 = 1
CA 2060 IF M1 > = 1 AND M1 < 6.9
THEN M3 = 2
36 2070 IF M1 < = 8.0 AND M1 > =
6.9 THEN M3 = 3
D9 2080 IF M1 > 8.0 AND M1 < 14.
2 THEN M3 = 4
BB 2090 IF M1 > = 14.2 AND M1 <
= 15.2 THEN M3 = 5
69 2100 IF M1 > 15.2 AND M1 < 21
.6 THEN M3 = 6
6F 2110 IF M1 > = 21.6 AND M1 <
= 22.6 THEN M3 = 7
34 2120 IF M1 > 22.6 AND M1 < =
28.5 THEN M3 = 8
E0 2130 RETURN
12 2140 B$ = "": IF Y < > 1985 A
ND Y < > 1986 THEN 560
41 2150 IF (Y = 1985 AND D1 < 30
5) OR (Y = 1986 AND D1 >
149) THEN 560
AB 2160 HD = D1 + 365: IF HD > 5
16 THEN HD = HD - 365
D2 2170 H1 = (HD - 295) / 10:HD
= INT (H1):H1 = H1 - HD
FA 2180 T4 = HC(HD) - HC(HD + 1)
:T4 = HC(HD) - H1 * T4:
IF T4 > 1440 THEN T4 = T
4 - 1440
A8 2190 GOSUB 610: IF Y9 = 999 T
HEN 560
3A 2200 GOSUB 700: IF T4 > 1115
AND T4 < 1200 THEN U9 =
U9 + 1
07 2210 IF T4 > 1290 THEN U9 = U
9 - 1
A3 2220 IF T4 > 615 AND T4 < 111
5 THEN U9 = U9 + 2
6E 2230 U(7) = U9:B$ = CHR$ (PP(
7)) + "HALLEY'S COMET":
GOTO 530
4D 2240 INPUT I$: RETURN
BB 2250 VTAB 17: PRINT CD$;: RET
URN
2F 4000 GOSUB 700
27 4005 IF LL > = 0 THEN U9 = LC
+ 9 + U9: GOTO 4008
EE 4006 U9 = LC + 9 - U9:Y9 = 39
- Y9
15 4008 RETURN
A8 4500 LL$ = "@N": IF LL < 0 TH
EN LL$ = "@S"
F3 4510 L1 = ABS (LL): IF L1 < 2
4 THEN L1 = 40
44 4515 LC = INT ((L1 - 40) / 7
+ .5):D1 = VAL ( MID$ (D
$,(M * 3) - 2,3)) + D
EA 4530 RETURN
53 4550 HOME : VTAB 2: HTAB 7: P
RINT "********** SKYSCAP
E **********": VTAB 4: P
RINT "LATTITUDE CHANGE"
E9 4555 PRINT "---------------"
BJ 4560 VTAB 8: PRINT "ENTER NEW
LATTITUDE";: GOSUB 2240
: IF I$ < > "" THEN LL =
VAL (I$)
C9 4565 IF ABS (LL) > 90 THEN PR
INT 00$: GOTO 4560
E2 4570 GOSUB 2020: IF I$ = "N"
THEN 4550
AB 4580 GOSUB 4500:I$ = "S": GOT
O 1720
28 5000 CI = 1:C2$ = ""
25 5010 C1$ = MID$ (CD$,CI,1): I
F C1$ < > " " THEN 5030
AA 5020 C2$ = C1$ + C2$:CI = CI
```

```
    + 1: GOTO 5040
85 5030 C1$ = MID$ (CD$,CI,2):C2
    $ = C1$ + C2$:CI = CI +
    2
F8 5040 IF CI < 41 THEN 5010
58 5050 CD$ = C2$: RETURN
```



The TI-99/4A version of "Skyscape."

Program 5: TI-99/4A Skyscape

Version by Patrick Parrish, Programming Supervisor

```
100 GOTO 130
110 PK=PK-1023 :: PKROW=I
    NT(PK/40)-1 :: PKCOL=
    PK-(PKROW+1)*40 :: RE
    TURN
120 FOR I=1 TO LEN(QQ$)::
     CALL HCHAR(ROW,COL+I
    ,ASC(SEG$(QQ$,I,1))):
    : NEXT I :: RETURN
130 MM$="098108099" :: CA
    LL CLEAR :: CALL SCRE
    EN(15):: DISPLAY AT(1
    1,6):"**** SKYSCAPE *
    ***" :: DISPLAY AT(22
    ,8):"INITIALIZING..."
140 D$="0000310590901201 5
    1181212243273304334"
    :: K1=1440 :: DIM HC(
    22):: M$="28631734501
    1041072102133164194225255"
150 ES=93 :: D1$(1)="S" :
    : D1$(2)="N"
160 A$="JANFEBMARAPRMAYJU
    NJULAUGSEPOCTNOVDEC"
    :: OO$="OUT OF RANGE!
    !" :: MD$="3128313031
    3031313031303131" :: D9
    =PI/180 :: READ EE,M9
170 DIM P(6,6):: DEF R(X)
    =INT(X*100+.5)/100 ::
     DEF S(X)=INT(X*10+.5
    )/10
180 FOR Y=1 TO 2 :: FOR X
    =1 TO 6 :: READ P(X,Y
    ):: NEXT X :: NEXT Y
    :: Y=0
190 FOR X=1 TO 6 :: READ
    P$(X),P(X,3):: NEXT X
200 FOR X=1 TO 7 :: PP(X)
    =X+99 :: NEXT X
210 J$="SATSUNMONTUEWEDTH
    UFRI" :: CALL SCREEN(
    12):: FOR X=1 TO 12 :
    : READ F$
220 CC$=CC$&RPT$(CHR$(128
    ),5)&F$ :: NEXT X ::
    CC$=CC$&CC$ :: F$=SEG
    $(CC$,LEN(CC$)-8,9)::
     CC$=F$&CC$
230 FOR X=1 TO 8 :: READ
    PH$(X):: NEXT X :: FO
    R X=1 TO 22 :: READ H
    C(X):: NEXT X :: GOSU
    B 2300 :: GOTO 830

240 CC=MT-720 :: IF CC<0
    THEN CC=CC+K1
250 CC=CC/120 :: CD=CC-IN
    T(CC):: CC=INT(CC)::
    CD=INT(CD*7+.2):: CC=
    81-(CC*7+CD)
260 GOSUB 1890 :: QQ$=CD$
    :: ROW=16 :: COL=0 :
    : GOSUB 120
270 IF LL>=0 THEN RETURN
280 FOR I=1 TO 16 :: CALL
     GCHAR(16,I,Z):: CALL
     GCHAR(16,33-I,Z1)::
    CALL HCHAR(16,I,Z1)::
     CALL HCHAR(16,33-I,Z
    ):: NEXT I
290 FOR I=1 TO 31 :: CALL
     GCHAR(16,I,Z):: IF Z
    =128 THEN 310
300 CALL GCHAR(16,I+1,Z1)
    :: CALL HCHAR(16,I,Z1
    ):: CALL HCHAR(16,I+1
    ,Z):: I=I+1
310 NEXT I :: RETURN
320 CALL CLEAR :: DISPLAY
     AT(2,9):"** DAYS SKY
    **" :: Q=1 :: GOSUB
    1680
330 DISPLAY AT(6,1):"INPU
    T THE TIME:" :: DISPL
    AY AT(7,1):"---------
    ------" :: T1,T2=0
340 DISPLAY AT(9,4):"HOUR
     (0-23) ?" :: ACCEPT
    AT(9,18):T1 :: IF T1<
    0 OR T1>23 THEN Q=10
    :: GOSUB 2290 :: GOTO
     340
350 DISPLAY AT(11,4):"MIN
    UTE (0-59) ?" :: ACCE
    PT AT(11,20):T2 :: IF
     T2<0 OR T2>59 THEN Q
    =12 :: GOSUB 2290 ::
    GOTO 350
360 R$=STR$(T1):: T$=STR$
    (T2):: IF LEN(T$)=1 T
    HEN T$="0"&T$
370 DISPLAY AT(15,1):"TIM
    E-- ";R$;":";T$
380 GOSUB 2050 :: IF Z$="
    R" THEN 320
390 CALL CLEAR :: T3=T1*6
    0+T2+AA-720 :: IF T3<
    0 THEN T3=T3+K1
400 IF T3>K1 THEN T3=T3-K
    1
410 MT=T3-360 :: IF MT<0
    THEN MT=MT+K1
420 PT=T3+360 :: IF PT>K1
     THEN PT=PT-K1
430 DISPLAY AT(1,1):K$;"-
    ";TEM$;STR$(Y);TAB(17
    );STR$(ABS(LL));LL$;"
     ";R$;":";T$;
440 CALL COLOR(9,1,5,10,1
    ,5):: TM=VAL(R$&"."&T
    $):: IF TM<6 OR TM>18
     THEN CALL COLOR(9,1,
    2,10,1,2)
450 FOR X=2 TO 15 :: CALL
     HCHAR(X,1,107,32)::
    NEXT X :: XX=7+LC ::
    FOR I=2 TO 32 STEP 2
    :: CALL HCHAR(XX+1,I,
    96):: NEXT I
460 GOSUB 240 :: ROW=17 :
    : COL=0 :: IF LL<0 TH
    EN 490
470 IF LL>24 THEN QQ$="E
    (14 SPACES)S
    (15 SPACES)W" :: GOSUB
     120 :: GOTO 510
480 QQ$="UP-N(6 SPACES)-O
    VERHEAD-(6 SPACES)DOW
    N-S" :: GOSUB 120 ::
    GOTO 510
490 IF ABS(LL)>24 THEN QQ
    $="W(14 SPACES)N
    (15 SPACES)E" :: GOSUB
     120 :: GOTO 510
500 QQ$="UP-S(6 SPACES)-O
    VERHEAD-(6 SPACES)DOW
    N-S" :: GOSUB 120
510 T4=AA :: GOSUB 710 ::
     Y8=888 :: IF Y9=999
    THEN 550
520 Y8=Y9 :: GOSUB 2380 :
    : IF A1<0 THEN 550
530 IF PK>1703 OR PK<1144
    THEN 550
540 GOSUB 110 :: IF PKCOL
    >4 AND PKCOL<37 THEN
    CALL HCHAR(PKROW,PKCO
    L-4,97)
550 T4=AA+M2*K1 :: IF T4>
    K1 THEN T4=T4-K1
560 GOSUB 710 :: IF Y9=99
    9 THEN 600
570 MM=INT(M1/9.83333)+1
    :: GOSUB 810 :: IF Y9
    =999 THEN 600
580 GOSUB 2380 :: IF PK>1
    703 OR PK<1144 THEN 6
    00
590 GOSUB 110 :: IF PKCOL
    >4 AND PKCOL<37 THEN
    CALL HCHAR(PKROW,PKCO
    L-4,MM):: IF ABS(Y8-Y
    9)<=.5 THEN CALL HCHA
    R(PKROW,PKCOL-4,108)
600 FOR X=1 TO 7 :: IF X=
    7 THEN 2170
610 T4=P(X,6):: GOSUB 710
    :: IF Y9=999 THEN 67
    0
620 U9=SIN(P(X,6)*D9/4)::
     U9=-3*U9+.5 :: U9=IN
    T(U9):: U(X)=U9*40
630 PK=1423-Y9+U(X)+LB ::
     GOSUB 2390 :: IF PK>
    1703 OR PK<1144 THEN
    670
640 GOSUB 110
650 IF PKCOL>4 AND PKCOL<
    37 THEN CALL GCHAR(PK
    ROW,PKCOL-4,Z):: IF Z
    <>107 AND Z<>96 THEN
    PK=PK+1023+SGN(LL)*40
    +(LL=0)*40 :: GOTO 64
    0
660 IF PKCOL>4 AND PKCOL<
    37 THEN CALL HCHAR(PK
    ROW,PKCOL-4,PP(X))
670 NEXT X :: QQ$="dMERCU
    RY eVENUS fMARS gJUPI
    TER" :: ROW=18 :: COL
    =1 :: GOSUB 120
680 QQ$="hSATURN iURANUS
     aSUN  blcMOON" :: RO
    W=19 :: GOSUB 120 ::
    QQ$="mNEW MOON + SUN
    " :: ROW=20 :: GOSUB
     120
690 IF B$<>"" THEN QQ$=B$
    :: ROW=21 :: COL=8 :
    : GOSUB 120
700 QQ$="NEW (T)IME,(P) T
    AB,(D)ATE,(L)AT." ::
    ROW=23 :: COL=0 :: GO
    SUB 120 :: GOTO 1810
710 Y9=999 :: IF MT<PT TH
    EN 760
720 IF T4>=MT OR T4<=PT T
    HEN 740
```

```
730 RETURN
740 IF T4>=MT AND T4<=K1
    THEN 780
750 T4=T4+K1 :: GOTO 780
760 IF T4>=MT AND T4<=PT
    THEN 780
770 RETURN
780 Y9=INT((T4-MT)/18+.5)
    :: IF Y9=40 THEN Y9=3
    9
790 RETURN
800 U9=SIN(T4/4*D9):: U9=
    INT(-3*U9+.5)*40 :: R
    ETURN
810 MM=VAL(SEG$(MM$,3*MM-
    2,3)):: IF LL<0 AND M
    M<>108 THEN MM=197-MM
820 RETURN
830 Q=1
840 CALL CLEAR :: DISPLAY
     AT(2,6):"**** SKYSCA
    PE ****" :: DISPLAY A
    T(4,1):"DATE INPUT" :
    : DISPLAY AT(5,1):"--
    ---------" :: S1=0
850 IF Y<>0 THEN GOSUB 16
    80
860 DISPLAY AT(Q+5,1):"YE
    AR?" :: ACCEPT AT(Q+5
    ,7):Y :: IF Y>=1977 T
    HEN 880
870 DISPLAY AT(Q+5,14):"M
    UST BE >1977" :: FOR
    I=1 TO 250 :: NEXT I
    :: GOTO 860
880 GOSUB 1730 :: DISPLAY
     AT(Q+7,1):"MONTH (1-
    12)?" :: ACCEPT AT(Q+
    7,15):M :: IF M<1 OR
    M>12 THEN Q=Q+8 :: GO
    SUB 2290 :: Q=Q-8 ::
    GOTO 880
890 DI=VAL(SEG$(MD$,2*M-1
    ,2)):: DI=DI-(M=2)*LY
     :: DI$=STR$(DI)
900 DISPLAY AT(Q+9,1):"DA
    Y (1-";DI$;")?" :: AC
    CEPT AT(Q+9,13):D ::
    IF D<1 OR D>DI THEN Q
    =Q+10 :: GOSUB 2290 :
    : Q=Q-10 :: GOTO 900

910 H$=SEG$(A$,M*3-2,3)
920 DISPLAY AT(Q+11,1):"L
    ATITUDE (-90 TO 90)?"
     :: ACCEPT AT(Q+11,23
    ):LL :: IF ABS(LL)>90
     THEN Q=Q+12 :: GOSUB
     2290 :: Q=Q-12 :: GO
    TO 920
930 GOSUB 2410
940 TEM$=H$&" "&STR$(D)&"
    ," :: DISPLAY AT(Q+14
    ,8):TEM$;Y :: GOSUB 2
    050 :: IF Z$="R" THEN
     Q=4 :: GOTO 840
950 D2=VAL(SEG$(M$,M*3-2,
    3))+D :: GOSUB 1760 :
    : IF M>2 THEN D1=D1+L
    Y :: Y1=Y1+LY
960 D3=D2-185 :: IF M=3 A
    ND D<20 THEN D2=D2+LY
     :: D3=D3+LY
970 S5=0 :: IF D3<=0 THEN
     A=180*D2/185 :: GOTO
     990
980 A=180*D3/(180+ZY)+180
990 IF A<>180 THEN S5=23.
    43333333*SIN(D9*D2*18
    0/185)
1000 IF A>180 THEN S5=-23
    .43333333*SIN(D9*D3)
1010 IF A>=360 THEN A=A-3
    60
1020 A=R(A):: S5=R(S5)::
    A1=(SGN(LL)-(LL=0))*
    S5+90-ABS(LL):: A1=R
    (A1):: GOSUB 1380 ::
     GOSUB 1330
1030 W=1-(SGN(LL)<0):: IF
     A1>90 THEN A1=180-A
    1 :: W=ABS(W-3)
1040 CALL CLEAR :: PRINT
    :: PRINT K$;"-";TEM$
    ;Y;TAB(19);ABS(LL);L
    L$ :: PRINT RPT$("-"
    ,28)
1050 PRINT :: PRINT "DAY
    OF THE YEAR---  ";ST
    R$(D1):: PRINT :: PR
    INT "SUN'S DATA:": :
1060 PRINT "GEOCENTRIC AN
    GLE--  ";STR$(A);"@"
1070 PRINT "DECLINATION--
    -----  ";STR$(S5);"@
    "
1080 PRINT "ALTITUDE AT N
    OON--  ";STR$(A1);"@
    ";D1$(W)
1090 PRINT "RIGHT ASCENSI
    ON---  ";A3$
1100 PRINT "R.A. AT 9:00
    PM---  ";A5$ :: PRIN
    T :: PRINT "MOON'S D
    ATA:": :
1110 PRINT "AGE----------
    -----  ";STR$(M1);"
    ";"DY";
1120 PRINT "ELONGATION---
    -----  ";STR$(M8);"@
    ";L$
1130 PRINT "PHASE -  ";PH
    $(M3): : : :
1140 PRINT "(P)LANET TABL
    E OR NEW (D)ATE" ::
    PRINT :: GOTO 1810
1150 CALL CLEAR :: PRINT
    TAB(6);"** PLANET TA
    BLE **" :: PRINT ::
    PRINT K$;"-- ";TEM$;
    Y;TAB(20);STR$(ABS(L
    L));LL$ :: PRINT ::
    S1=1
1160 PRINT "PLANET  DIST.
     ANG.W/SUN R.A." ::
    PRINT RPT$("-",28):
    :
1170 FOR X=1 TO 6 :: A2=Y
    1/P(X,2)-INT(Y1/P(X,
    2)):: Q3=1
1180 A2=A2*360+P(X,1):: I
    F A2>360 THEN A2=A2-
    360
1190 E=180+A :: IF E>360
    THEN E=E-360
1200 E1=ABS(E-A2):: IF E1
    >180 THEN E1=360-E1
1210 GOSUB 1440 :: E1=E1*
    D9 :: P5=P(X,3):: IF
     X=3 THEN GOSUB 1870
1220 P(X,4)=SQR(1+P5^2-2*
    P5*COS(E1)):: XX=(P5
    ^2-1-P(X,4)^2)/(-2*P
    (X,4))
1230 P(X,5)=-ATN(XX/SQR(-
    XX*XX+1))+PI/2 :: P(
    X,4)=INT(P(X,4)*ES+.
    5):: P(X,5)=P(X,5)/D
    9
1240 P(X,5)=S(P(X,5)):: Q
    1$=STR$(P(X,4)):: Q2
    $=STR$(P(X,5))
1250 Q1=LEN(Q1$):: Q2=LEN
    (Q2$):: GOSUB 1540
1260 PRINT P$(X);TAB(13-Q
    1);Q1$;TAB(20-Q2);Q2
    $;:: IF Q3=-1 THEN P
    RINT "@W";
1270 IF Q3=1 THEN PRINT "
    @E";
1280 GOSUB 1590 :: Q4$=ST
    R$(Q4):: Q5$=STR$(Q5
    ):: IF Q5<10 THEN Q5
    $="0"&Q5$
1290 Q4$=Q4$&":"&Q5$ :: Z
    =LEN(Q4$)
1300 PRINT TAB(22);QQ$;TA
    B(29-Z);Q4$;:: NEXT
    X :: PRINT :: PRINT
    :: PRINT :: PRINT "*
     - VISIBLE AT 9 P.M.
    "
1310 PRINT :: PRINT :: PR
    INT "SUN'S R.A. ----
    ------  ";A3$ :: PRI
    NT "R.A. AT 9:00 P.M
    . ---  ";A5$
1320 PRINT :: PRINT TAB(3
    );"DAYS (S)KY
    {3 SPACES}NEW (D)ATE
    " :: GOTO 1810
1330 A2=K1*A/360 :: IF A2
    >K1 THEN A2=A2-K1
1340 A3=INT(A2/60):: A4=A
    2-A3*60 :: A5=A3+9 :
    : IF A5>23 THEN A5=A
    5-24
1350 A4=INT(A2-A3*60+.5):
    : IF A4=60 THEN A4=0
     :: A3=A3+1
1360 IF A3=24 THEN A3=0
1370 AA=A3*60+A4 :: GOTO
     1690
1380 M1=(Y1/M9-INT(Y1/M9)
    )*M9+10 :: IF M1>M9
    THEN M1=M1-M9
1390 GOSUB 2080 :: M8=360
    *M2 :: IF M8>180 THE
    N L$="W"
1400 IF M8<=180 THEN L$="
    E"
1410 IF M8>180 THEN M8=36
    0-M8
1420 M1=R(M1):: M8=R(M8):
    : YY=INT(7*(Y1/7-INT
    (Y1/7))+.2):: IF YY=
    0 THEN YY=7
1430 K$=SEG$(J$,YY*3-2,3)
    :: RETURN
1440 Q3=0 :: Q1=E+180 ::
    IF Q1>360 THEN 1480
1450 IF A2>E AND A2<Q1 TH
    EN 1470
1460 Q3=1 :: RETURN
1470 Q3=-1 :: RETURN
1480 Q1=Q1-360 :: IF A2<=
    360 AND A2>E THEN 14
    70
1490 IF Q3<>0 THEN RETURN
1500 IF A2>0 AND A2<=Q1 T
    HEN 1470
1510 IF Q3<>0 THEN RETURN
1520 IF A2>Q1 THEN 1460
1530 RETURN
1540 Q5=Q3*P(X,5)*4+AA ::
     IF Q5<0 THEN Q5=Q5+
    K1
1550 IF Q5>K1 THEN Q5=Q5-
    K1
1560 P(X,6)=Q5 :: Q4=INT(
    Q5/60):: Q5=INT(Q5-Q
    4*60+.5):: IF Q5=60
    THEN Q5=0 :: Q4=Q4+1
1570 IF Q4=24 THEN Q4=0
1580 RETURN
1590 SU=A5*60+A4 :: PS=SU
    +360 :: MS=SU-360 ::
     IF PS>K1 THEN PS=PS
    -K1
1600 IF MS<0 THEN MS=MS+K
    1
1610 IF MS>PS THEN 1640
1620 IF P(X,6)<PS AND P(X
    ,6)>MS THEN 1670
1630 QQ$=" " :: RETURN
```

```
1640 IF P(X,6)<K1 AND P(X
     ,6)>MS THEN 1670
1650 IF P(X,6)<PS THEN 16
     70
1660 GOTO 1630
1670 QQ$="*" :: RETURN
1680 DISPLAY AT(Q+3,1):K$
     ;"-- ";TEM$;Y;TAB(20
     );STR$(ABS(LL));LL$;
     :: RETURN
1690 A3$=STR$(A3):: IF A3
     <10 THEN A3$=" "&A3$
1700 A4$=STR$(A4):: IF A4
     <10 THEN A4$="0"&A4$
1710 A3$=A3$&":"&A4$ :: A
     5$=STR$(A5):: IF A5<
     10 THEN A5$=" "&A5$
1720 A5$=A5$&":"&A4$ :: Q
     8=7-LEN(A3$):: Q9=7-
     LEN(A5$):: RETURN
1730 LY=0 :: IF Y/4=INT(Y
     /4)THEN LY=1
1740 IF Y/100=INT(Y/100)A
     ND Y/400=INT(Y/400)A
     ND Y/1000=INT(Y/1000
     )AND Y/4000=INT(Y/40
     00)THEN LY=0
1750 RETURN
1760 Y9=Y+1 :: IF Y9/4=IN
     T(Y9/4)THEN ZY=1
1770 IF Y9/100=INT(Y9/100
     )AND Y9/400<>INT(Y9/
     400)AND Y9/1000=INT(
     Y9/1000)AND Y9/4000=
     INT(Y/4000)THEN ZY=0
1780 Y1=Y-1977 :: Y1=Y1*3
     65+INT(Y1/4)+D1 :: I
     F Y<2000 THEN 1800
1790 Y1=Y1-INT((Y-2001)/1
     00)+INT((Y-2001)/400
     )-INT((Y-1)/4000)
1800 RETURN
1810 CALL KEY(0,KK,SS)::
     IF SS=0 THEN 1810
1820 I$=CHR$(KK):: IF I$=
     "D" THEN Q=4 :: GOTO
      840
1830 IF (I$="S" OR I$="T"
     )AND S1=1 THEN 320
1840 IF I$="P" THEN 1150
1850 IF I$="L" AND S1=1 T
     HEN 2460
1860 GOTO 1810
1870 P5=1.376344086 :: K5
     =A2*4
1880 K5=ABS(K5-1233.73)*9
     0/K1 :: K5=K5*D9 ::
     K5=SIN(K5)*.32258122
     4 :: P5=P5+K5 :: RET
     URN
1890 IF CC<=1 THEN CC=CC+
     84
1900 CD$=SEG$(CC$,CC+3,34
     )
1910 IF SEG$(CD$,2,1)<>CH
     R$(128)AND SEG$(CD$,
     3,1)=CHR$(128)THEN C
     D$=SEG$(CD$,1,32)::
     GOTO 1940
1920 IF SEG$(CD$,33,1)<>C
     HR$(128)AND SEG$(CD$
     ,32,1)=CHR$(128)THEN
      CD$=SEG$(CD$,3,32):
     : GOTO 1940
1930 CD$=SEG$(CD$,2,32)
1940 RETURN
1950 DATA 365.26,29.53059
     ,59.818184,42.719626
     ,262.364294,52.91676
     3
1960 DATA 134.69697,218.7
     9464,87.97,224.7,686
     .98
1970 DATA 4332.79813,1075
     9.7195,30686.5884
1980 DATA "MERCURY",.3871
     ,"VENUS",.7233,"MARS
     ",1.5237,"JUPITER",5
     .2028
1990 DATA "SATURN",9.5308
     ,"URANUS",19.182
2000 DATA "SA","SC","LI",
     "VI","LE","CA","GE",
     "TA","AR","PI","AQ",
     "CP"
2010 DATA "NEW","WAXING C
     RESCENT","1ST QUARTE
     R","WAXING GIBBOUS",
     "FULL"
2020 DATA "WANING GIBBOUS
     ","3RD QUARTER","WAN
     ING CRESCENT"
2030 DATA 1770,1719,1620,
     1500,1418,1365,1335,
     1310,1290,1275,1260
2040 DATA 1238,1220,1200,
     1178,1115,915,720,66
     0,640,625,610
2050 DISPLAY AT(20,3):"(R
     )E-INPUT OR (C)ONTIN
     UE"
2060 CALL KEY(0,KK,SS)::
     IF SS=0 THEN 2060
2070 Z$=CHR$(KK):: RETURN
2080 M2=M1/M9 :: IF M1<1
     OR M1>28.5 THEN M3=1
2090 IF M1>=1 AND M1<6.9
     THEN M3=2
2100 IF M1<=8 AND M1>=6.9
      THEN M3=3
2110 IF M1>8 AND M1<14.2
     THEN M3=4
2120 IF M1>=14.2 AND M1<=
     15.2 THEN M3=5
2130 IF M1>15.2 AND M1<21
     .6 THEN M3=6
2140 IF M1>=21.6 AND M1<=
     22.6 THEN M3=7
2150 IF M1>22.6 AND M1<=2
     8.5 THEN M3=8
2160 RETURN
2170 B$="" :: IF Y<>1985
     AND Y<>1986 THEN 670
2180 IF (Y=1985 AND D1<30
     5)OR(Y=1986 AND D1>1
     49)THEN 670
2190 HD=D1+365 :: IF HD>5
     16 THEN HD=HD-365
2200 H1=(HD-295)/10 :: HD
     =INT(H1):: H1=H1-HD
2210 T4=HC(HD)-HC(HD+1)::
      T4=HC(HD)-H1*T4 ::
     IF T4>K1 THEN T4=T4-
     K1
2220 GOSUB 710 :: IF Y9=9
     99 THEN 670
2230 GOSUB 800 :: IF T4>1
     115 AND T4<1200 THEN
      U9=U9+40
2240 IF T4>1290 THEN U9=U
     9-40
2250 IF T4>615 AND T4<=11
     15 THEN U9=U9+80
2260 U(7)=U9 :: B$="jHALL
     EY'S COMET" :: GOTO
     630
2270 B$=" HALLEY'S COMET"
2280 GOTO 630
2290 DISPLAY AT(Q,1):OO$
     :: FOR I=1 TO 250 ::
      NEXT I :: CALL HCHA
     R(Q,3,32,14):: RETUR
     N
2300 CALL CHAR(64,"384444
     443800000000",128,RPT$
     ("0",16))
2310 FOR I=0 TO 3 :: READ
      SS :: CALL CHARPAT(
     SS,QQ$):: CALL CHAR(
     I+96,QQ$):: NEXT I
2320 DATA 45,42,41,40
2330 FOR I=0 TO 9 :: READ
      QQ$ :: CALL CHAR(10
     0+I,QQ$):: NEXT I ::
      CALL COLOR(13,2,9)
2340 DATA 0010387C7C38100
     0,3C7E66663C187E18,0
     3063C6666663800
2350 DATA 003C427E7E423C0
     0,033E6E76667CC080,0
     0666666241800000,0A15
     2A352A74F8E0
2360 DATA 0000000000000000
     0,003C7E7E7E3C00,FFC
     381818181C3FF
2370 RETURN
2380 GOSUB 800 :: PK=1423
     -Y9+U9+LB
2390 IF LL<0 THEN PK=2247
     +80*XX-PK
2400 RETURN
2410 LL$="@N" :: IF LL<0
     THEN LL$="@S"
2420 L1=ABS(LL):: IF ABS(
     LL)<24 THEN L1=40
2430 LC=INT((L1-40)/7+.5)
     :: LB=LC*40 :: D1=VA
     L(SEG$(D$,M*3-2,3))+
     D
2440 IF ABS(LL)<24 THEN L
     B=40*INT(ABS(LL)/7+.
     5)
2450 RETURN
2460 GOSUB 2510 :: DISPLA
     Y AT(6,1):"LATITUDE
     CHANGE" :: DISPLAY A
     T(7,1):RPT$("-",16)
2470 DISPLAY AT(9,1):"INP
     UT NEW LATITUDE:" ::
      ACCEPT AT(9,21):LL
2480 IF ABS(LL)>90 THEN 2
     470
2490 GOSUB 2050 :: IF Z$=
     "R" THEN 2410
2500 GOSUB 2410 :: I$="S"
      :: GOTO 1830
2510 CALL CLEAR :: DISPLA
     Y AT(2,6):"**** SKYS
     CAPE ****" :: Q=1 ::
      GOSUB 1680 :: RETUR
     N
```

Crossword Magic

Karen McCullough

Requirements: Apple II-series computer with at least 48K RAM (or Apple III in emulation mode); Apple Macintosh; Commodore 64/128; IBM PC/PCjr with at least 128K RAM; or an Atari 400/800, XL, or XE (memory requirements not available at presstime). All versions require a disk drive, and a printer is recommended. The Apple II version was reviewed; other versions are similar.

Crossword Magic does for the process of creating crossword puzzles what a word processor does for writing. It can't replace the thinking, planning, and research needed to create a satisfying puzzle, but it does simplify the process of organizing and moving the material from brain to paper. *Crossword Magic* lets you create a puzzle on the screen, edit it in various ways, play it, and print it out. The program's authors have provided ways to do everything you can think of with a crossword puzzle.

The program comes on a two-sided disk. One side is called the Maker Disk, and the other the Player Disk. The Maker disk contains the options for creating, editing, printing, deleting, and moving puzzles. The Player disk lets you play a previously created puzzle, or create a new storage disk.

When you start to create a new puzzle, the program first asks if you want automatic sizing. If you answer no, you must enter the size of the grid you desire. However, automatic sizing provides more flexibility, since it allows the grid to grow from its initial size as needed.

Each word you enter is placed in a suitable position on the display grid, highlighted so you always know which word was placed last. Words that don't fit into the grid are added to a list of unused words. If adding a word later allows any unused word to fit into the puzzle, that word is placed on the display and highlighted along with the word just entered. If you don't like where the program placed your word, you can press a key to make the program search for another suitable place, or press another key to remove it.

Menus And Help Screens

A group of special functions also are available at the touch of a key. You can save a partial or complete puzzle; gain access to a help screen that explains your options; return to the main menu (you lose whatever work you've just done on the screen if you don't save it first, however); look at the list of unused words; start entering clues; or go into manual mode. Manual mode lets you add, remove, or change letters in the puzzle.

Crossword Magic comes with a 23-page manual, well-written but not as well organized. Each menu function has its own section in the manual, with clear, comprehensive explanations and directions—until you get to the explanation of the special functions. At that point, each section merely gives you a list of the functions and refers you to a separate section of the manual that explains them in greater detail. The manual would be easier to use if the special functions were explained at the end of each section, even at the expense of some duplication. Also, the special function section begins in the middle of a page, making it difficult to find without referring to the index.

Aside from this, *Crossword Magic* deserves top marks for ease of use, smooth functioning, and good error-handling. It works quickly, finding places for words in seconds, even on large grids. Everything works exactly as described, and the program never failed; it resolutely ignores inappropriate actions. After only a few minutes with the manual, I pulled out a review list of basic Spanish vocabulary words and created a puzzle. However, it's a good idea to read the list of helpful hints in the back of the manual before creating a puzzle; there's a lot of valuable information there.

Crossword Magic is ideal for schools. It's an excellent tool for testing and reinforcing vocabulary in subjects such as English, foreign languages, and science. And anyone who enjoys working with crossword puzzles will find the program a pleasant pastime.

Crossword Magic
Mindscape
3444 Dundee Road
Northbrook, IL 60062
$49.95

Colorasaurus

Steve Hudson

Requirements: Commodore 64 with a disk drive and a joystick; or an Atari 400/800, XL, or XE computer with at least 48K RAM, a disk drive, and a joystick. The Atari version was reviewed.

If you ask a child what makes a good computer game, the answer will probably be that it has to be fun. Ask a parent the same question, and you'll hear words like "enriching" and "educational." But why not get both by creating a game that's captivating enough to hold a child's attention, but stimulating enough to help develop a young mind?

One such game is *Colorasaurus*, an educational program aimed at the three- to six-year-old set. Its goals are straightforward—to help young children develop color discrimination and visual memory skills—and it achieves them with style.

The program actually offers three games in one, and each features lively graphics and ear-catching sound. The first game, "Match," allows the child to match a brightly colored dinosaur (the so-called colorasaurs) with one of three appropriately colored landscapes. Each round presents three new colorasaurs,

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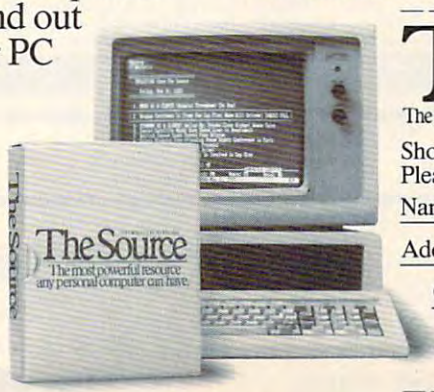

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SPECIFICATIONS

(IBM - Commodore)

Printing Method
Impact dot matrix

Printing Speed
160 CPS at standard character printing
27 CPS at NLQ character printing

Printing Direction
Text Mode — Bi-directional
Graphic Mode — Unidirectional

Print Head Life
100 million characters

Printing Characters
Standard 11 x 9 dot matrix
NLQ 23 x 18 dot matrix
Character size: 2 x 2.42 mm (standard)
Character set: Full ASCII character set (96), 32 special European characters

(Apple - Atari - Etc.)

Down Loading
11 x 9 dot matrix; NLQ 23 x 18 dot matrix optional

Print Buffer
2K-byte utility buffer

Image Printing
Image Data: Vertical 8, 9 and/or 16 dot
Resolution: Horizontal 60 dots/inch
Horizontal 120 dots/inch (double density)
Horizontal 240 dots/inch (quadruple density)

Interface
8-bit parallel interface (Centronics type)

Paper
Plain paper, Roll paper, Single sheet, Fanfold, Multipart paper: max. 3 sheets (original plus 2)

Ink Ribbon Cartridge
Ribbon Life: 3 million characters/cartridge

Maximum Number of Characters

Standard:	10 cpi	80 cpl
Enlarged:	5 cpi	40 cpl
Condensed:	17.1 cpi	136 cpl
Condensed enlarged:	8.5 cpi	68 cpl
Elite:	12 cpi	96 cpl
Elite enlarged:	6 cpi	48 cpl
NLQ pica:	10 cpi	80 cpl
NLQ pica enlarged:	5 cpi	40 cpl

Physical Dimensions
Size: 15¾" x 12 5/8" x 4 3/8" (10")
Weight: 17.6 lbs. (10")

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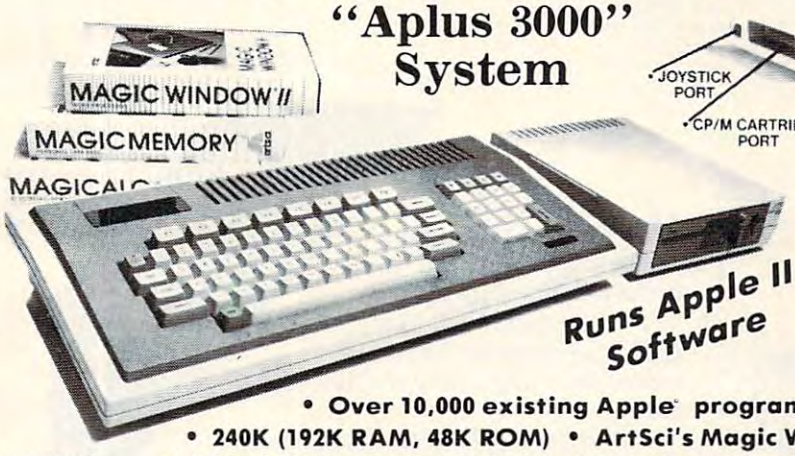

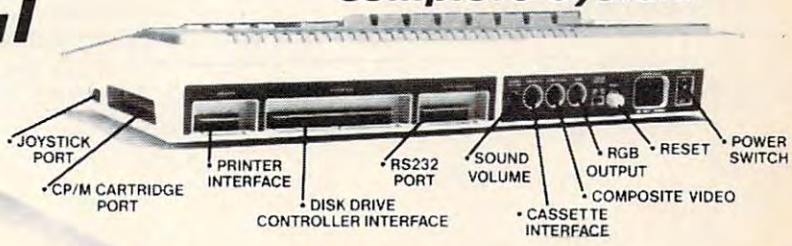

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- **RGB (80 columns in color) and composite included**

SPECIFICATIONS

A plus 3000 is a complete, self-contained computer based on the popular 6502A microprocessor and can tap into the tremendous software library of Apple II. Features include 192K Bytes RAM, 32KB Enhanced Microsoft BASIC, 80 column text, 560H X 192V color graphic display, 81 key sculptured keyboard and high efficiency switching power supply. Also included as standard are Centronics bus printer interface, Cassette interface, 4 channel sound generator, and 5¼" Apple Compatible Disk Drive.

- **TEXT**
  - 40 columns X 24 rows or 80 columns X 24 rows software selectable.
  - 5 X 7 characters in 7 X 8 matrix.
  - Upper and lower case characters.
  - One of Eight colors for characters/graphics and background, Red, Green, Blue, Cyan, Magenta, Yellow, Black and White.
  - Character set with normal, inverse and flashing capabilities.
- **GRAPHICS**
  - 280H X 192V 6 colors — Black, White, Violet, Green, Blue, Orange.
  - 280H X 192V 8 colors bit image — Black, White, Red, Green, Blue, Cyan, Magenta, Yellow.
  - 560H X 192V 6 colors — Black, White, Violet, Green, Blue, Orange. (High resolution color monitor required)

More Features than Apple® for less than Commodore®

Features	Aplus 3000	Apple IIe	Commodore 128
RAM	**192K**	64K	128K
Runs Apple II Software	**Yes**	Yes	No
Function Keys	**24**	None	16
4 Voice, 6 Octave Sound	**Yes**	No	Yes
Composite Video	**Yes**	Yes	Yes
Disk Drive	**included**	Extra Cost	Extra Cost
Numeric Keypad	**included**	Extra Cost	Included
Video Cable	**included**	Extra Cost	Extra Cost
RGB Color Card	**included**	Extra Cost	Included
80 Column Card	**included**	Extra Cost	Included
Centronics Printer Interface	**included**	Extra Cost	Extra Cost
Drive Controller	**included**	Extra Cost	Included
$150 Wordprocessor (Magic Window)	**included**	Extra Cost	Extra Cost
$150 Spreadsheet (MagiCalc)	**included**	Extra Cost	Extra Cost
$60 Database prg. (Magic Memory)	**included**	Extra Cost	Extra Cost
Your Cost	**$499.00**	$1745.00	$1117.90

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R/F Modulator (TV hookup)	$ 29.95	$ 19.95
RGB cable (RGB Monitor hookup)	$ 24.95	$ 19.95
Centronics cable (for Centronics printer)	$ 34.95	$ 24.95
Technical reference manual	$ 29.95	$ 19.95
Comstar 10x 120-140 CPS dot matrix printer	$399.00	$189.00
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and (as the child's responses improve) the three colors become increasingly similar.

The second game, "Find," carries the idea one step further. Like "Match," it asks the child to match colors. However, there are six landscapes instead of three. In addition, it encourages the child to relocate the colorasaurs by recalling which colors were involved. Again, the difficulty increases with the accuracy of the child's responses.

Painting Dinosaurs

The third game, "Colorasaurus," gives the child a chance to personally color a colorasaurus. The child can dip paint from various "paint pots" and then apply it to a large (and by then familiar) colorasaurus that dominates the screen. It's even possible to mix colors or to lighten or darken them (by adding white or black). That gives the child virtually complete control over the resulting colors. The result? Captivated fascination, a great deal of fun, and some worthwhile learning, too.

Each game is controlled with the joystick. Even a young child can move the large, easy-to-see cursor and effectively play any of the games.

The program also uses the keyboard for two special commands. The question mark (?) is a help key that calls up onscreen instructions. Another key returns the player to the main menu. Using either key, it's possible for the child to select various play options—a valuable feature that some educational programs still lack.

Although it's designed for a particular age range, *Colorasaurus* may prove captivating to younger children, too. Although my 17-month-old is too young to manipulate the joystick herself, she loves to sit in my lap and watch the colorasaurs while listening to the dinosaurish music. It's entertaining for older children, too, including us Daddy-types. There's just something about multicolored dinosaurs that appeals to young and old alike.

Colorasaurus
The Learning Company
545 Middlefield Road, Suite 170
Menlo Park, CA 94025
$29.95

Grolier Online Encyclopedia

Dan Gutman

Requirements: Virtually any computer with a modem, telecommunications software, and access to one of 11 major telecommunications services (including CompuServe, The Source, Dow Jones, Dialog, and others).

I just looked up LINCOLN, ABRAHAM in the encyclopedia. There's nothing particularly amazing about that, except that I don't *own* an encyclopedia. With an "electronic encyclopedia" on a mainframe computer that I can tap into anytime I want with my personal computer, I don't need one.

The *Academic American Encyclopedia* from Grolier can be accessed easily on any of 11 different online services by anyone with a modem and a computer. After you log on and hit a few keys, you're dropped into an encyclopedic wonderland of 30,000 articles and 10 million words. Just type SE (for SEarch) and the item you want to look up. The text jumps on the screen in seconds.

An electronic encyclopedia has a few big advantages over a paper one. I can't look up JACKSON, MICHAEL in my parents' old encyclopedia, because he wasn't even born when it was written. Grolier's encyclopedia gets updated every three months. In fact, a week after Leonid Brezhnev died, they had a listing for ANDROPOV, YURI. Also, with the Grolier encyclopedia, I can print out entire articles in seconds on my printer.

On the other hand, while Andropov is covered, there are no listings for LASERDISK, OPTICAL MEMORY, COMPACT DISC, or INTERACTIVE FICTION—terms you'd expect to find in an up-to-date electronic reference source for the 1980s. Michael Jackson gets a paragraph, but you'll find nothing more about recent idols—Prince and Madonna. And the encyclopedia refers to the canceled IBM PCjr as "among the nation's best-selling computers." Of course, any encyclopedia has its limitations.

No Pictures—Yet

There are a few other disadvantages to the Grolier online encyclopedia that are related to its medium. The retrieval commands are picky, so if you misspell a subject you're looking up, the computer may mistakenly tell you there is no listing. For example, if you look up NEWSPAPERS, you'll find nothing. But there *is* a listing for NEWSPAPER. With a printed encyclopedia, you would discover that by flipping through the pages. Also, because of the wide variety of incompatible computers and the limitations of modem communications, the online encyclopedia can't give you the photographs or illustrations you see in a printed encyclopedia.

Someday this may change. Grolier recently announced it is publishing the encyclopedia in the new CD-ROM format (Compact Disc-Read Only Memory). The CD-ROM version, scheduled for release this fall for $199, is quite similar to the online version, except it's stored on a single 4.7-inch compact disc. It requires a special CD-ROM player connected to your computer, such as the one announced last summer by Atari (see "Report from the Summer Consumer Electronics Show" and "Monster Memory," COMPUTE!, August 1985). The CD-ROM encyclopedia has all the search and retrieval features of the online encyclopedia and more—plus it's faster. And although the initial CD-ROM version is text-only, there is plenty of room on the disc to add graphics and digitized illustrations in the future.

Still, even with its current limitations, the Grolier online encyclopedia is worthy of consideration. A conventional encyclopedia might cost $600 or more. On the CompuServe Information Service, Grolier's costs $50 per year plus the regular connect time rates. Depending on how often you access the encyclopedia and how long you stay online, it might take several years before you've spent as much as the conventional encyclopedia would cost. By that time, much of the information in the paper encyclopedia would be out of date and you'd have to buy another one anyway.

If you have school-age children, or if you do a lot of research at home, consider Grolier's online encyclopedia. The convenience of looking things up in seconds is incredible. This is one of the true practical uses for a computer in the home. Besides, think of all the trees you'll save.

Grolier Electronic Publishing
95 Madison Avenue
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(Cost varies among information services)

Amiga Software Dealers
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All Wherehouse stores.
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West Los Angeles: Software Supermarket.
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Redlands: Brown Knows Computer.
Riverside: Software Service Center.
San Bruno: Home Computer Center.
San Diego: Computer Age, Byte Shop, Computerland.
San Francisco: Access to Software.
San Jose: Affordable Computer Systems.
San Leandro: Home Computer Center.
Santa Ana: The Home Computer Store.
Santa Rosa: Software First.
Thousand Oaks: Thor Audio Video.

Colorado
Aurora: Sobernheim Enterprises.
Colorado Springs: Softwareland, Renaissance Computerware.
Westminister: Colorado Computer Systems.
Denver: Contemporary Computer Concepts.
Lakewood: Micro World.

Florida
St. Petersburg: New Age Electronics.
Tampa: Computer Corner-Sound Trader.

Georgia
Augusta: Future Systems.
Gainesville: Preferred Systems.

Hawaii
Honolulu: Data One Microcomputer.

Indiana
Ft. Wayne: Bytrex, Inc.
New Albany: Kwik Service Electronics.

Massachusettes
Acton: Instant Software.
Boston: Instant Software.
Littleton: Software Plus.
Wellesley: Instant Software.

Michigan
Okemos: Pro Video.
Plymouth: Strom Computer.

Minnesota
Brooklyn Center: Zim Computers, Inc.
Roseville: Softwaire Center Int'l.

New York
Albany: France Enterprises of Northway
New York: Computerland, Leighs Computer, Computer Factory.
Oyster Bay: Pine Hollow Video.

New Jersey
Wyckoff: Yudins.

New Mexico
Albuquerque: Page One.

New Hampshire
Hudson: Instant Software.
Keene: Instant Software.
Manchester: Wayne Green Enterprises.
Nashua: Instant Software.

North Carolina
Raleigh: Audio Buys, Inc.
Winston-Salem: Triad Computers.

Ohio
Fairborn: Fairborn Home Computer.

Oregon
Beaverton: Softwaire Centre Int'l.
Eugene: Software Express.
Portland: Computron Business Systems, IB Computers.

Pennsylvania
Hershey: East Coast Software.
McMurray: Toy Store.
Norristown: Electronics Boutique.

Rhode Island
Warwick: Software Connections.

South Carolina
Charleston: Software Solutions.
Charleston Heights: Software Haus.
Greenville: Horizon Computers.

Tennessee
Nashville: Software First.

Texas
Tyler: Computer Time.

Washington
Battleground: Software Express.
Everett: Com-Soft
Kent: Computer Software Warehouse.
Renton: A.P.P.L.E. Coop.
Spokane: Bits, Bytes & Nibbles.
Tacoma: Nybbles & Bytes.
Tukwila: Programs Plus, Software Centre Int'l.

Wisconsin
Oshkosh: Fox Valley Personal Computers.

BASIC Lightning & White Lightning For Commodore 64

Roark Dority

Requirements: Commodore 64 and a 1541 disk drive or a tape drive.

You've probably heard of several different software packages which enhance or extend your Commodore 64's BASIC language. *BASIC Lightning*, a graphics development system for the 64, is one of the most exciting such programs I've seen.

BASIC Lightning is much more than a BASIC extension. It's practically a whole new language. Besides all the usual Commodore BASIC commands, *BASIC Lightning* offers more than 150 new commands. They make structured programming possible, let you run up to five parts of a BASIC program simultaneously, and may change your attitude toward using graphics and sound on the 64.

If you've ever programmed in Pascal or a similar language, you'll be happy to know that *BASIC Lightning* includes all the control commands found in Pascal. Control structures include IF–THEN–ELSE, REPEAT –UNTIL, WHILE-WEND, CASE-OF, and procedures and functions with full parameter-passing.

The graphics commands in *BASIC Lightning* are in a class all their own. You can create up to 255 sprites of any size, and these sprites can be scrolled, spun, rotated 90 degrees, enlarged, contracted, and mirrored vertically and horizontally. You can individually design each sprite, place them anywhere on the screen, move part of one sprite into another, copy part of the screen into a sprite, or copy an entire sprite into another.

There are also commands for combining *two* sprites at once in four different ways, and commands to control the sprite colors when two sprites are combined. Another useful feature is the ability to print characters and double-sized characters inside the sprites.

However, I did find it difficult to design sprites with the sprite editor. You can edit only one 8 × 8 grid at a time, and the editor reacts slowly to commands. To design sprites larger than 8 × 8 pixels, the grid must be copied to a larger area on the screen. After several grids have been placed side by side, your sprite begins to take form. Then it's possible to edit more sprites, and even show them in sequence to simulate animation.

Multitasking In BASIC

What *BASIC Lightning* does for graphics, it does for sound as well. For example, music data can be stored in sprites and played in the background with the commands PLAY and RPLAY. This means your music can be playing while the rest of your program is doing other things.

One of the most exciting features of *BASIC Lightning* is its multitasking capability. The TASK command allows up to five things in your program to happen at once. Each task has its own set of variables which are independent of the others. Special commands let you pass values between tasks.

Another product from Oasis Software is *White Lightning*, a Forth-based language. If you have some background in Forth, or are willing to learn a new language, *White Lightning* is certainly a worthwhile package. (Incidentally, *White Lightning* includes *BASIC Lightning*, with all the commands mentioned above.)

BASIC Lightning and *White Lightning* both include a disk and two tapes, so tape users as well as disk users can program with the packages. *BASIC Lightning* is especially ideal for anyone who writes programs in BASIC and is interested in structured programming, sprite graphics, and sound. It's easy to use, too. In minutes it's possible to know enough to handle the screen windows, and everything appears and changes faster than in Commodore BASIC with the POKE commands. *White Lightning* takes longer to learn because it's an entirely different language.

If you're interested in machine language programming, Oasis Software also makes *Machine Lightning*, an advanced machine language system.

Oasis Software
377 Oyster Point Blvd.
Unit 15
San Francisco, CA 94080
BASIC Lightning *$39.95*
White Lightning *$49.95*
Machine Lightning *$84.95*

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Gato For Apple And IBM

Michael B. Williams

Requirements: Apple IIe or IIc with a disk drive; Apple Macintosh; IBM PC with at least 128K RAM and color/graphics adapter; or an Enhanced Model PCjr. The Apple II version was reviewed; other versions are similar.

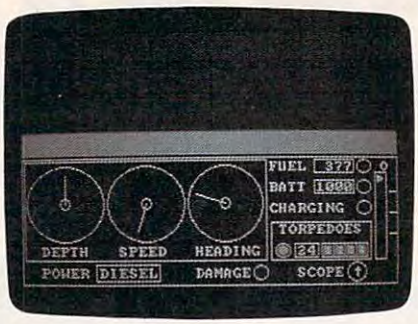
Just as flight simulators take the danger out of flying while retaining much of the excitement, *Gato* lets you fight for your country in a submarine from the safety of your desktop. You patrol the South Pacific in your Gato-class submarine, a type of ship actually deployed during World War II.

Your mission begins with a coded message detailing your assignment in enemy territory. At *Gato*'s higher difficulty levels (there are ten), the message is transmitted in Morse code; it's up to you to decipher it. (A Morse code table is included in the manual, but you won't have time to use it without memorizing it first.) You may be ordered to intercept an enemy fleet, cut off enemy supply lines, or rescue allies from enemy territory.

Your patrol area covers 20 allied, enemy, and neutral quadrants of the South Pacific. The patrol chart display offers a view of this entire area, including your sub, the allied subtender, enemy ships, and the area's dozen islands, although not all this information is available on the upper difficulty levels. You can view your position within a quadrant with the quadrant chart, which also shows in greater detail the islands and their surrounding shoals and reefs.

Other displays are the radar screen, the damage report screen, the captain's log (which holds data for eight players), and the main control screen. The damage screen shows a port-side view of your sub, highlighting the damage in any of eight major areas. The main screen demands most of your attention—it contains depth, speed, and heading gauges as well as a full-color view of objects in your area. The Apple version of *Gato* displays these graphics in the extended high-resolution mode; the graphics are adequate, but could be improved.

A nice touch in *Gato* is the fake spreadsheet screen: You can flip to this display to make it look as if you're working whenever the boss strolls by.



Coming Up For Air

Gato promises realism, and it delivers. While the lower difficulty levels are excellent for learning to control the submarine, the upper levels offer extreme challenge and give you no unfair advantages over the enemy as the lower levels do. Attention to detail is very good. You run aground if you get too near an island, and the sub's speed is affected by the ship's depth, the periscope position, and whether the torpedo tube doors are open or closed. Because oxygen is constantly consumed below depths of 20 feet, you must surface occasionally to prevent your crew from suffocating. In addition, depth and speed play a role in how soon you are detected by enemy ships during sneak attacks.

The extensive list of factors the program must calculate and recalculate inevitably slows down the game. The screen updates only about once per second, and takes even longer when ships or islands are nearby.

If one of your torpedos finds its target, you can see the explosions on the display if you're surfaced. The explosion graphics are fair, although the sound effects could use some improvement. Each time you sink a ship, the program updates your captain's log to credit your achievement. The log is reset every time you are sunk—it goes down with the ship.

Gato also includes screens with historic and technical information, plus a demonstration mode (the demo mode explains the submarine but does not show actual game play). The manual moves quickly in an effort to be thorough, including a discussion of strategy and tactics against the five different types of enemy ships. It offers help on attack patterns, defense tactics, avoiding depth charges, and using the radar and periscope.

Gato requires a serious approach if you want to play it well. For those willing to commit themselves to service in the Pacific Fleet, *Gato* lives up to its claims. Just don't expect to sink the entire Japanese fleet on your first (or even fifth) mission.

Gato
Spectrum HoloByte, Inc.
1050 Walnut, Suite 325
Boulder, CO 80302
$39.95 Apple/IBM
$49.95 Macintosh

Atari *PaperClip*

Robert L. Riggs

Requirements: Atari 400/800, XL, or XE with at least 48K RAM, a disk drive, and a printer.

Word processors for Atari computers are reaching an amazing level of sophistication. In many ways, the Atari version of *PaperClip* from Batteries Included is the most sophisticated to date.

Besides all the usual features we've come to expect, *PaperClip* offers a number of capabilities not found in most other Atari word processors. These range from major features such as multiple windows to lesser ones such as character- and word-swap commands. The windows are particularly useful: You can load and edit two different documents simultaneously, and cut and paste text between them.

Typical of the program's flexibility is a configuration menu that lets you customize your own version of *PaperClip*. For instance, you can change the screen background and character colors; choose the screen line length—from 15 to 132 characters—and then determine whether the entire screen window will scroll or just the line being typed; change the left screen margin to correct for TV sets which overscan; elect to use the cursor keys without pressing CTRL; and switch the XL/XE key click and alarm bell on or off. You can even tell *PaperClip* to automatically save the text file you're working on after a predetermined number of keystrokes.

Once you've customized *PaperClip*, you can save it on disk for future use. The program disk isn't copy-protected, so you can make as many backups as you need. You can, for example, create several *PaperClip* disks with different configurations and preferences. To prevent this feature from

being abused by software pirates, *PaperClip* comes with a key that must be plugged into a joystick port to make it work.

The configuration menu offers other choices, too, such as a mini-DOS and options to create, save, and load macro files. A macro is a block of previously defined text—such as a letterhead—that can be placed on the screen with a single keystroke. You can define several macro files, each containing blocks of frequently used text.

PaperClip does not come with a quick reference card for its many commands, but pressing CTRL-SHIFT-? calls up either a disk menu or the online help files (assuming the disk containing these files is inserted in the default drive). The help files contain a list of all *PaperClip* commands necessary for file manipulation, printer control, and screen editing.

Math And Graphics

PaperClip can manipulate numbers and pictures as well as letters. Its built-in calculator can add, subtract, multiply, and divide, printing the answer at the appropriate place in the document. And a screen dump utility on the program disk prints out images created with any of the well-known graphics programs, including the KoalaPad and Atari Touch Tablet or Light Pen. If you want, these pictures can be embedded in your documents, and the program disk contains *B/Graph* and KoalaPad files for practice.

Other useful utilities are included on the disk, too. One program converts *AtariWriter* word processor files to *PaperClip* format. *PaperClip*—like *AtariWriter* and most other Atari word processors—saves text in standard ASCII format, but there are differences between formatting codes and so forth. The conversion utility automatically replaces the *AtariWriter* codes with appropriate *PaperClip* codes.

There's also a mail-merge feature, a typewriter mode which is ideal for addressing envelopes, a word counter, and the ability to search and replace up to six pairs of text strings in a single pass.

One extra feature of *PaperClip* which I especially enjoyed was the rapid cursor movement. The cursor begins repeating sooner when you hold down a cursor key, and it zips across the screen considerably faster than your average Atari cursor.

Versatile Printing

PaperClip is flexible enough to work with virtually any printer. The program disk contains printer drivers for more than 30 of the most popular models. If necessary, you can create your own printer driver by using a program which lets you modify an existing driver or build one from scratch. Therefore, *PaperClip* should be compatible with any future printers.

During my testing, I found that *PaperClip* did not fully support the proportionally spaced font of the Atari 825 printer. *PaperClip* would print the proportional font, but without proportional spacing. However, I was using the early version 1.0 of the program; Batteries Included says the newer version 1.1 does add microspacing for proportional printing, though it still cannot handle true proportional spacing with this printer.

PaperClip has several printing features that will be appreciated for specialized applications—such as a table of contents creator, an option to print any range of pages in a document, the ability to print multiple copies, and a batch-file capability for printing several documents in sequence. It's also the only Atari word processor I've seen that can print in double-column format without forcing you to roll the paper back into the printer—great for newsletters.

Future Features

Because *PaperClip* has such a large number of commands and capabilities, it takes a while to master. The manual is lengthy, and the original edition needs an index and more assistance for first-time users. Batteries Included says a new edition of the manual corrects these deficiencies and adds the much-needed index. It is being shipped with later copies of *Paperclip* 1.1.

Even newer versions of *PaperClip* were scheduled for release this fall. Version 1.2 supports the full 128K RAM in the Atari 130XE, treating the four extra 16K banks as one continuous block of memory. The text area is about 90K long, and the windowing feature lets you load two documents up to 45K long. *PaperClip* 1.2 also will support the extra memory in any future XE models, such as the 256K XE that Atari has hinted about. If this computer ever becomes a reality, *PaperClip* 1.2 would allow more than 200K for text memory.

Batteries Included also planned to make *PaperClip* work with its announced 80-column cartridge, the B.I. 80, but the cartridge was recently canceled due to chip supply problems.

Updates to newer versions of *PaperClip*, incidentally, are available to owners for $10.

Overall, *PaperClip* is without doubt a superb word processor for Atari computers. You won't be sorry you bought it.

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Commodore 64 3-D Animated Graphics

Christian-Marc Panneton

This BASIC enhancement for the Commodore 64 makes it easy to draw and animate impressive three-dimensional graphic figures. While the commands are designed for creating 3-D shapes, they're useful in any high-resolution graphics application.

Nearly everyone has seen three-dimensional computer drawings, but have you ever tried to create one yourself? Since complex math is needed to calculate a 3-D shape and plot it on the high-resolution screen, BASIC takes a long time to draw even relatively simple objects. For this reason, 3-D animation is rarely seen, even in commercial software.

With "3-D Graphics Package," however, you can add several new commands to BASIC for creating sophisticated 3-D graphics—even if you're not a programming wizard.

Type in Program 1 using "MLX," the machine language entry program published elsewhere in this issue. Read the MLX instructions carefully before typing the program, and be sure to save a copy when you're done. Here are the addresses required for MLX:

Starting address: 34000
Ending address: 39381

Because this is a machine language (ML) program, you'll need to load it with LOAD"FILENAME",8,1 for disk or LOAD"FILENAME",1,1 for tape. Activate it by typing SYS 34000 and pressing RETURN. A startup message at the top of the screen reminds you that an enhanced version of BASIC is present. Now type in and save Program 2, a short 3-D graphics demonstration. You *must* activate Program 1 before typing in Program 2. If the enhanced BASIC is not present, the special graphics commands won't work, even if you later reload Program 2 with the enhanced BASIC.

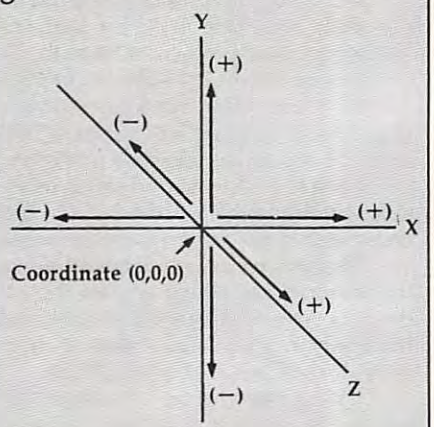
3-D Animation

Program 2 displays two complex, multicolored objects rotating around a common axis. When a rotation is finished, the objects are redisplayed and rotated in a different plane. Notice how short the program is. If you've never tried creating such displays in BASIC, it's difficult to appreciate just how fast and efficient these new commands are. Although objects of this complexity usually take several minutes to draw in BASIC, the ML routines draw and redraw them quickly enough to create a convincing illusion of movement in three-dimensional space.

This program will be easier to use if you understand a few simple concepts. Three-dimensional objects are usually defined in terms of three dimensions or planes relative to you, the observer. The X plane defines horizontal location. The Y plane defines vertical location. The Z plane defines depth. You can locate any point in this system by specifying a *coordinate* for each of the three planes.

As shown in the figure, coordinate (0,0,0) defines the spot where all three planes intersect. In the X plane, negative coordinates lie to the left of the X axis and positive coordinates to the right. In the Y plane, positive coordinates are up and negative ones down. And positive Z coordinates are nearer to you than negative ones.

The 3-D drawing grid is composed of three dimensions or planes. Each point in space has three coordinates on the grid.



Don't worry if that sounds a bit confusing. The best way to learn about these commands is to experiment. Since they all work in direct mode (when you're not running a program), you can type in one command at a time and see the result right away. If it's not what you expect, change one or two values and try again. After a while you'll learn how to draw what you want, even if you're not an expert in geometry.

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June 1981: Computer Using Educators (CUE) on Software Pricing, Apple II Hires Character Generator, Ever Expanding Apple Power, Color Burst for Atari, Mixing Atari Graphics Modes 0 and 8, Relocating PET BASIC Programs, An Assembler in BASIC for PET Quadra PET: Multitasking?, Mapping Unknown Machine Language, RAM/ROM Memory, Keeping Tabs on a Printer.

July 1981: Home Heating and Cooling, Animating Integer BASIC Lores Graphics, The Apple Hires Shape Writer, Adding a Voice Track to Atari Programs, Machine Language Atari Joystick Driver, Four Screen Utilities for the PET, Saving Machine Language Programs on PET Tape Headers, Commodore ROM Systems, Using TAB, SPC, and LEN.

August 1981: Minimize Code and Maximize Speed, Apple Disk Motor Control, A Cassette Tape Monitor for the Apple, Easy Reading of the Atari Joystick, Blockade Game for the Atari, Atari Sound Utility, TI CBM "Fat 40," Keyword for PET, CBM/PET Loading, Chaining, and Overlaying, Adding a Programmable Sound Generator, Converting PET BASIC Programs to ASCII Files.

October 1981: Automatic DATA Statements for CBM and Atari, VIC News, Undeletable Lines on Apple, PET, and VIC; Budgeting on the Apple, Atari Cassette Boot-tapes, Atari Variable Name Utility, Atari Program Library, Train Your PET to Run VIC Programs, Interface a BSR Remote Control System to PET, A General Purpose BCD to Binary Routine, Converting to Fat-40 PET.

December 1981: Saving Fuel $$ (multiple computers), Unscramble Game (multiple computers), Maze Generator (multiple computers), Animating Applesoft Graphics, A Simple Atari Word Processor, Adding High Speed Vertical Positioning to Atari P/M Graphics, OSI Supercursor, A Look at SuperPET, Supermon for PET/CBM, PET Mine Maze Game, Replacing the INPUT # Command, Foreign Language Text on the Commodore Printer, File Recovery.

January 1982: Invest (multiple computers), Developing a Business Algorithm (multiple computers), Apple Addresses, Lowercase with Unmodified Apple, Cryptogram Game for Atari, Superfont: Design Special Character Sets on Atari, PET Repairs for the Amateur, Micromon for PET, Self-modifying Programs in PET BASIC, Tinymon: A VIC Monitor, VIC Color Tips, VIC Memory Map, ZAP: A VIC Game.

May 1982: VIC Meteor Maze Game, Atari Disk Drive Speed Check, Modifying Apple's Floating Point BASIC, Fast Sort for PET/CBM, Extra Atari Colors Through Artifacting, Life Insurance Estimator (multiple computers), PET Screen Input, Getting the Most out of VIC's 500 Bytes.

August 1982: The New Wave of Personal Computers, Household Budget Manager (multiple computers), Word Games (multiple computers), Color Computer Home Energy Monitor, A VIC Light Pen for Under $10, Guess That Animal (multiple computers), PET/CBM Inner BASIC, VIC Communications, Keyprint Compendium, Animation with Atari, VIC Curiosities, Atari Substring Search, PET and VIC Electric Eraser.

September 1982: Apple and Atari and the Sounds of TRON, Commodore Automatic Disk Boot, VIC Joysticks, Three Atari GTIA Articles, Commodore Disk Fixes, The Apple PILOT Language, Sprites and Sound on the Commodore 64, Peripheral Vision Exerciser (multiple computers), Banish INPUT Statements (multiple computers), Charades (multiple computers), PET Pointer Sort, VIC Pause, Mapping Machine Language, Commodore User-defined Functions Defined, A VIC Bug.

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October 1983: Computer Games by Phone, Coupon File (multiple computers), Dragon Master and Moving Maze (multiple computers), Merging Programs from Commodore Disks, Atari Master Disk Directory, Sprites in TI Extended BASIC, Commodore EXEC, Multicolor Atari Character Editor, High Speed Commodore Mazer, Apple Sounds, Extra Instructions (multiple computers), Commodore DOS Wedges, Invisible Disk Directory for VIC and 64.

February 1984: What Makes a Good Game, Circus (multiple computers), Quatrainment (multiple computers), Commodore 3-D Drawing Master (Apple version also included), Speedy BASIC for VIC and 64, Dr. Video 64.

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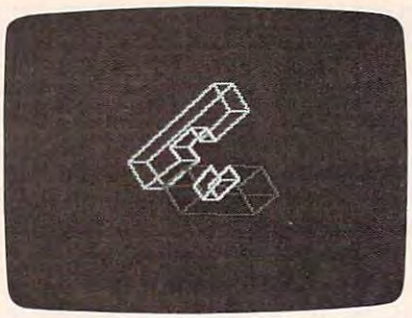


These figures are redrawn rapidly at different angles to create the illusion of rotation in space.

Following is a description of what each command does. Except for SWAP, every command must be followed by one or more numeric values (numbers or numeric variables).

Large-Scale Commands

These commands are used to prepare the computer for drawing and to perform other general tasks:

SCREEN determines which of three screens is displayed. SCREEN 0 selects the normal text screen. SCREEN 1 switches you to the first graphics screen, and SCREEN 2 displays the second graphics screen. Switching to a graphics screen automatically sets up multicolor high-resolution mode. Animation is simulated by flipping back and forth between the two graphics screens. For instance, you can display a figure on screen 1 while redrawing it on screen 2, then display screen 2 while redrawing the shape on screen 1, and so on. SCREEN 0 restores the text screen when a program is finished.

It's important to remember which screen you're working on. When a graphics screen is displayed, drawing commands appear on that screen. When you're using the text screen, drawing commands take effect on the last graphics screen shown.

Use the function keys f1, f3, and f5 to switch from one screen to another in direct mode. For instance, try pressing f1. The computer prints SCREEN0 followed by a carriage return to execute that command (if you're already in the text screen, nothing changes). Press f3 to perform SCREEN1, f5 to perform SCREEN2, and f1 to return to the text screen. Don't press these keys while a program is running.

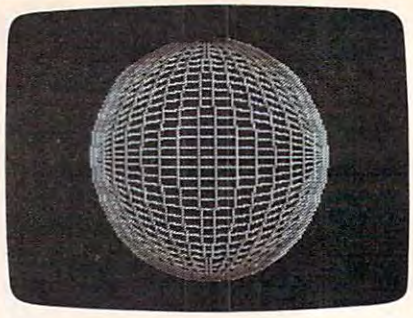
DCLEAR clears a graphics screen. Use DCLEAR 1 to erase graphics screen 1 and DCLEAR 2 to clear screen 2. Both screens are cleared when you start up the program.

COLOR sets the screen and drawing colors, using color numbers from 0–15 as listed in the 64 manual. This command is followed by five values in the general form COLOR BO,BA,C1,C2,C3. The first two values (BO and BA in this case) set the screen border and background colors. The last three values select drawing colors. In multicolor hi-res mode you can draw in up to three different colors. Thus, COLOR 0,0,1,3,6 sets the border and background colors to black and sets the drawing colors 1, 2, and 3 to white, cyan, and green, respectively. Since drawing commands refer to the drawing colors by number (1, 2, or 3), you should always execute a COLOR command before drawing.

ANGLE is an important command that sets the *observation angles*—your (the observer's) position in space relative to the X-Y-Z grid. Look at the figure again and imagine a cube is drawn there. If you remain stationary and rotate the grid—or if the grid remains stationary and you change your position—the cube's appearance changes. (Since the positioning is relative, you can visualize the change either way.)

ANGLE takes three values, which refer to the Y plane, X plane, and Z plane, respectively. These values represent degrees of rotation around the axis of each plane and must each be in the range −360–360. Program 3 demonstrates a simple use of ANGLE. By redrawing the same shape at different observation angles, you can achieve the illusion of movement in space. Note that ANGLE changes the effect of subsequent drawing commands. It does not change the appearance of existing objects.

PARAM sets four general parameters and should also be used before you begin to draw. It takes four values in the general form PARAM X,Y,SC,DI. The first two values (X and Y in this example) locate the *origin* or center of the 3-D grid on the screen. Coordinate (0,0,0) of the grid is located wherever you put the origin. Since the graphics screen contains 160 horizontal pixels (screen dots) and 200 vertical pixels, the X value must be in the range 0–159 and the Y value must be in the range 0–199. Use an X value of 80 and a Y value of 100 to center the origin in the middle of the screen.



Only three program lines are needed to draw this spherical surface.

The third PARAM value (SC) is *scale*, which controls the overall size of the image. The larger the scale, the bigger the picture, and vice versa. This number must be in the range 0–100; a scale value of 20 works well in many cases. The final PARAM value (DI) is the *distortion* value, a number in the range of 0–250. On most monitors and TVs the pixels are actually wider than they are high, causing a mathematically perfect circle to look elliptical on the screen. This value adds a correction factor to eliminate the distortion. A distortion value of 165 works well in most instances. If your circles still look squashed, experiment with other values.

Drawing Commands

These commands draw points, straight lines, and circles or ellipses:

DPLOT draws a point on the current graphics screen and is followed by four values. The first three values set coordinates for the point in Z-X-Y order, and the fourth selects one of the three drawing colors defined in an earlier COLOR command.

DLINE draws a line from one point to another. It requires seven values: three coordinates for the starting point, three coordinates for the ending point, and the drawing color. Both sets of coordinates are in

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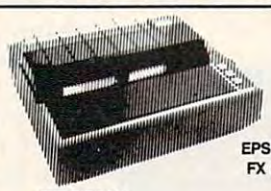

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Z-X-Y order. The following program demonstrates a simple use of DLINE:

```
10 COLOR0,0,1,10,3:PARAM80,100
   ,20,165:DCLEAR1:SCREEN1:FOR
   J=0TO360STEP5
20 ANGLEJ,90,0:DLINE3500,0,0,4
   500,0,0,3:NEXT
```

Press f1 to return to screen 0 when the program is finished. Change the 90 in line 20 to 12 and run it again to see how a different observation angle affects the object's appearance.

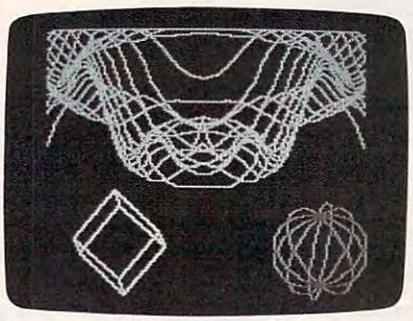
DDRAW works like DLINE but starts drawing at the point where a previous DPLOT, DLINE or DDRAW command left off. Since the beginning point is already defined, this command needs only four values: three coordinates for the ending point and a drawing color. For example, DDRAW −500,0,0,1 draws a line from the previous point to (−500,0,0) in color 1.

DCIRCLE draws a circle or ellipse and requires eight values. The first three values are Z-X-Y coordinates that define the center of the circle. The fourth value sets the *radius*, or distance from the center to the circle's edge. The next three values define orientation angles for the circle, and the last value sets the drawing color.

This command takes the general form DCIRCLE Z,X,Y,R,AY, AZ,AX,C. As with ANGLE, the DCIRCLE orientation angles control which way the circle faces. When all three angles are zero, the circle is drawn in the Z-Y plane. Increasing the value of AY causes a counterclockwise rotation around the Y axis. If AY is 90, AZ is 0, and AX is 0, the circle is drawn in the X-Y plane. Increasing the value of AZ rotates the circle counterclockwise around the Z axis. When AY is 0, AZ is 90, and AX is 0, the circle is drawn in the X-Z plane. Increasing the value of AX rotates the circle counterclockwise around the X axis.

DCIRCLE uses integer computations to speed up the drawing process. Though the command accepts noninteger (fractional) values, it only uses the integer part of the number. This program shows how a spherical surface can be formed out of many circles.

```
10 COLOR0,0,1,10,3:PARAM80,100
   ,20,165:DCLEAR1:SCREEN1
20 FORJ=90TO 0STEP-5:ANGLE0,J,
   0:DCIRCLE0,0,0,4500,0,90,0,
   2:NEXT
30 FORJ=5TO75STEP10:ANGLE0,90,
   0:DCIRCLE0,0,0,4500,0,J,0,3
   :NEXT
```



"3-D Graphics Package" helps you draw complex shapes like these.

Animation Commands

This group of commands simplifies the process of drawing and redrawing complex objects:

ANIM stands for *animate* and takes one value corresponding to the screen you want to affect. ANIM 1 displays graphics screen 2, clears screen 1, and lets you draw on screen 1. ANIM 2 does the reverse: Screen 1 is displayed, screen 2 is cleared, and you're ready to draw on screen 2. Program 2 demonstrates a typical use of ANIM.

SWAP exchanges the contents of screen 1 and screen 2, providing another means of animation. For instance, you might display screen 1 at all times, redrawing the figure on screen 2 (which is not seen), then quickly move the new figure into screen 1 with SWAP. This command requires no parameters.

FSET is a very powerful command that lets you define up to three figures. Once a figure is defined, it can be drawn quickly at any time with a FIGURE command (see below). A figure consists of a series of drawing instructions, and each use of FSET lets you add one drawing instruction to the figure.

The general form of the command is FSET FN,Z,X,Y,C,I. In this example, FN sets the figure number that determines which of the three possible figures you are working on. Z, X, Y, and C represent three coordinates and a drawing color, and I represents the drawing instruction. The instruction can be either a DPLOT or a DLINE command. If I is 0, then FSET performs DPLOT, drawing a point at (Z,X,Y) in the color C. If I is 1, FSET performs DLINE, drawing a line from the last coordinate defined to the point (Z,X,Y) in the color C. The first of the three figures defined by FSET may contain up to 120 separate drawing instructions. Figures 2 and 3 are limited to 80 instructions each.

FIGURE is used to draw an entire figure previously defined with an FSET command. It takes a single value corresponding to the figure number. For instance, FIGURE 1 draws the first figure defined with FSET. FIGURE 2 draws the second, and so on.

FCLEAR clears any of the three figure definitions, permitting you to create new figures with FSET. FCLEAR 1 clears the figure 1, FCLEAR 2 clears the figure 2, and so on.

Memory Allocation

Here are the various memory areas used by this program:

32768–33791	Screen 2 color memory
33792–40959	Program code
40960–49151	Screen 2 bitmap
49152–52223	Figure definitions
52224–53247	Screen 1 color memory
57344–65535	Screen 1 bitmap

Quick Reference Table

```
ANGLE Y,X,Z
ANIM N
COLOR BO,BA,C1,C2,C3
DCIRCLE Z,X,Y,R,AY,AZ,AX,C
DCLEAR N
DDRAW Z,X,Y,C
DLINE Z,X,Y,Z1,X1,Y1,C
DPLOT Z,X,Y,C
FCLEAR FN
FIGURE FN
FSET FN,Z,X,Y,C,I
PARAM X,Y,SC,DI
SCREEN N
SWAP
```

Program 1: 3-D Graphics Package

Please refer to the "MLX" article in this issue before entering the following listing.

```
34000 :032,189,137,032,193,137,160
34006 :032,015,153,032,036,153,123
34012 :032,055,153,169,000,141,002
34018 :084,003,141,085,003,141,171
34024 :086,003,141,087,003,141,181
34030 :088,003,141,089,003,032,082
34036 :101,141,169,080,141,099,207
34042 :003,169,100,141,100,003,254
34048 :169,010,141,101,003,169,081
```