A Buyer's Guide To Printers

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July 1985
Issue 25, Vol. 3, No. 7
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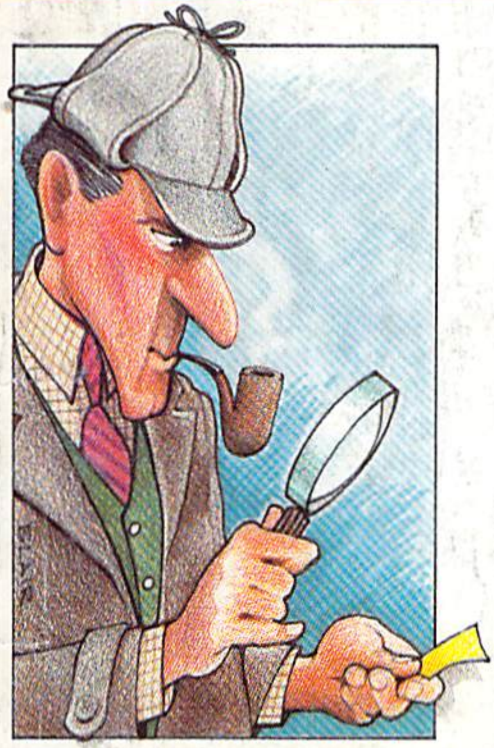
COMPUTE!'s GAZETTE

FOR COMMODORE PERSONAL COMPUTER USERS

The Turbo Loaders

TurboTape: Save and load with the speed of a disk drive!
TurboDisk: Load programs 300 percent faster on your 1541!



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ZOUNDS!

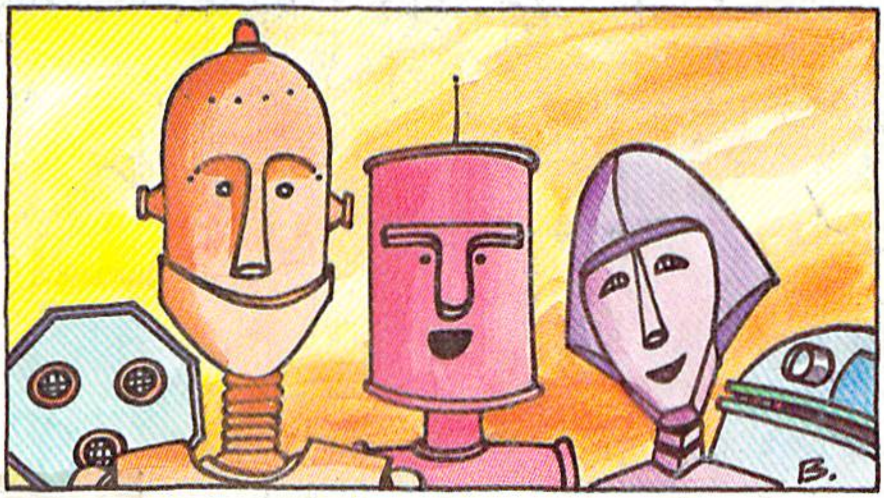
How to get spectacular sounds from your 64.

Easy Load

A great way to load programs from a menu. A step-by-step tutorial for the 64 and VIC.

Also In this Issue:

- Machine Language For Beginners
- Simple Answers To Common Questions
- User Group Update
- And More



Computing For Families

A host of new robots—educational, recreational, and even some you can program with your 64—visit Fred D'Ignazio's robot hotel.

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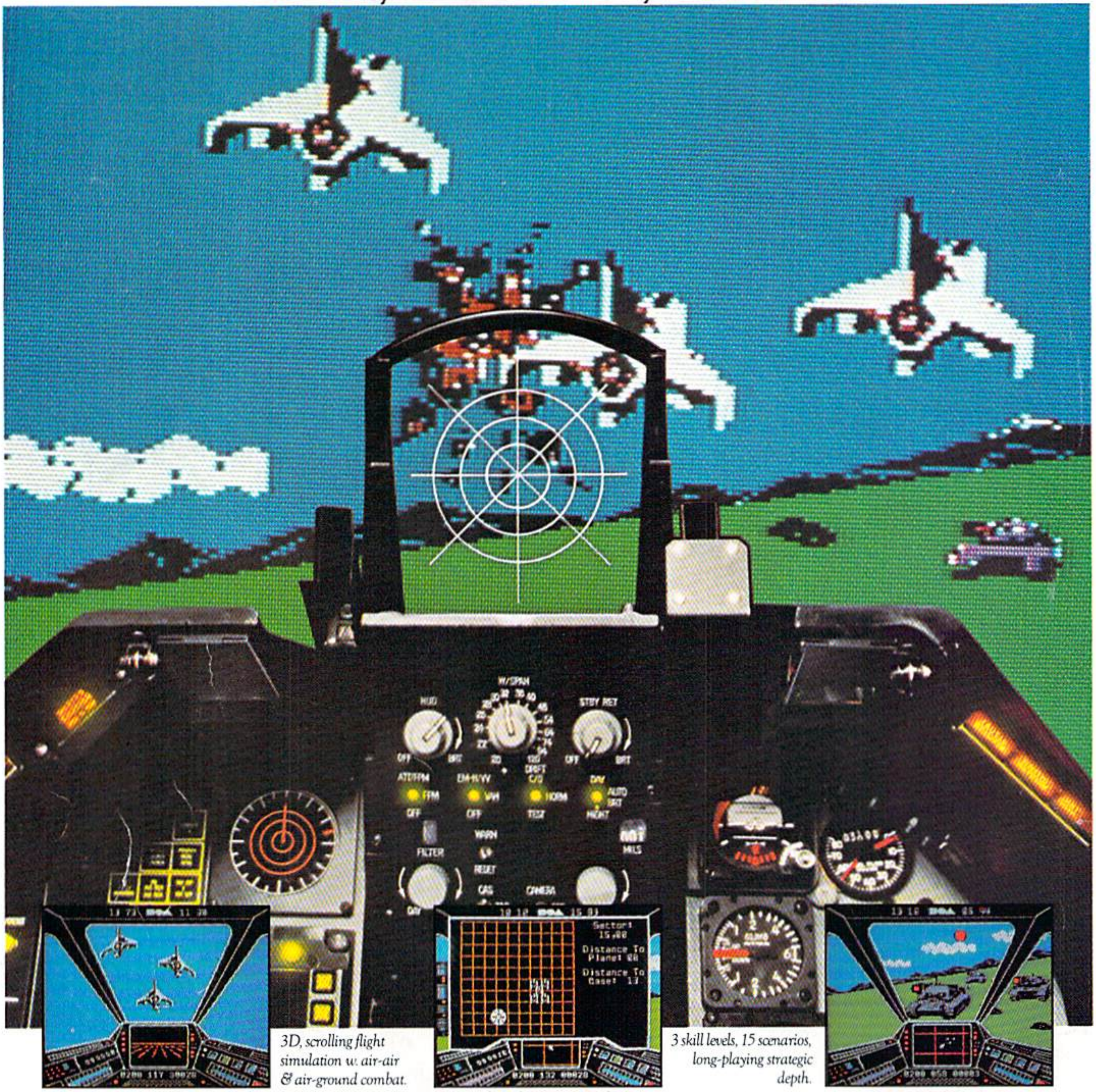

AMAZING DAISY

NOW! FULL SIZE, FULL FEATURE, LETTER QUALITY AT ONLY $353

If you have been searching for a letter quality printer you have probably found the flood of claims and counterclaims to be a real roadblock in your search. Not long ago we were in the same position. We tried to determine which daisy wheel printer had all the features our customers wanted, yet would not set them back a month's salary. Recently several manufacturers have introduced machines that had features we were seaching for. After a thorough assessment, we eliminated one model after the other for lack of one feature or another until we only had one left.

THE RESULTS ARE IN

We found the printer which has all the features anyone could want. The winner is the Aprotek Daisy 1120, a real heavy-duty workhorse printing at 20 characters per second. The manufacturer is Olympic Co. Ltd., a highly respected Japanese firm.

FEATURES GALORE

This printer has it all. To start with, it has a front panel Pitch Selector button with indicators which allows 10, 12, 15 characters per inch (CPI) or Proportional Spacing. There is a Select (Online) button (with indicator) and a Line Feed button. You can also set Top-of-Form or Form Feed with the touch of the TOF button. Other front panel indicators include Power and Alarm.

To load a sheet of paper, simply place it in the feed slot and pull the paper bail lever. PRESTO! The paper feeds automatically to a 1 inch top margin and the carriage aligns to the selected left margin. In this manner, each page can have identical margins automatically. You can continue to compute while the Daisy 1120 is printing. The built in 2K buffer frees up your computer while printing a page or two allowing you to go to your next job.

To really put your printer to work, the Cut Sheet Feeder option is great for automatic printing of those long jobs. Also available is the adjustable Tractor Feed option. Compare our option prices! Best of all the Daisy 1120 is quiet: only 57 dB-A (compare with an average of 62-65 dB-A for others).

COMPLETE COMPATIBILITY

The Daisy 1120 uses industry standard Diablo® compatible printwheels. Scores of typeface styles are available at most computer or stationary stores. You can pop in a 10, 12, 15 pitch or proportional printwheel and use paper as wide as 14". At 15 CPI you can print 165 columns—great for spreadsheets.

The Daisy 1120 uses the Diablo Hytype II® standard ribbon cartridges. Again universally available.

Not only is the hardware completely compatible, the control codes recognized by the Daisy 1120 are Diablo 630® compatible (industry standard). You can take advantage of all the great features of word processing packages like Wordstar®, pfs: Write®, Microsoft Word® and most others which allow you to automatically use superscripts, subscripts, automatic underlining, boldface (shadow printing) and doublestrike.

The printer has a set of rear switches which allow the use of standard ASCII as well as foreign character printwheels. Page length can be set to 8, 11, 12, or 15". The Daisy 1120 can also be switched to add automatic line feed if required.

THE BEST PART

When shopping for a daisy wheel printer with all these features (if you could find one), you could expect to pay $600 or $700 dollars. The options would add much more. *Not now!* We have done our homework. We can now offer this printer for only $353. Order yours today!

NO RISK OFFER

Try the Daisy 1120 for 2 weeks. If you are not satisfied for ANY reason we will refund the full price—promptly. A full 1-year parts and labor warranty is included.

THE BOTTOM LINE

Aprotek Daisy 1120 (Order#1120) $353 w/standard Centronics parallel interface and 2K buffer.

Options

Auto Cut Sheet Feeder (#1110) $188
Tractor Feed (#1112) $77

Accessories

8' Cable for IBM PC® and compatibles (#1103) $26

Interface with cable: •TI-99/4A (#106) $66
•Apple II or IIe (#1104) $76
•All Commodore (except Pet) (#1105) $44
•All Atari (#1107) $66

Shipping is $11—UPS continental USA. If you are in a hurry, UPS Blue or Air Parcel Post (second day air) is $25. Canada, Alaska, Mexico and Hawaii are $30 (air). Other foreign is $60 (air). California residents add 6% tax. Prices are cash prices—VISA and M/C add 3% to total. We ship promptly on money orders, cashier's checks, and charge cards. Allow 14-day clearing for checks. No C.O.D.'s. Payment in US dollars only.

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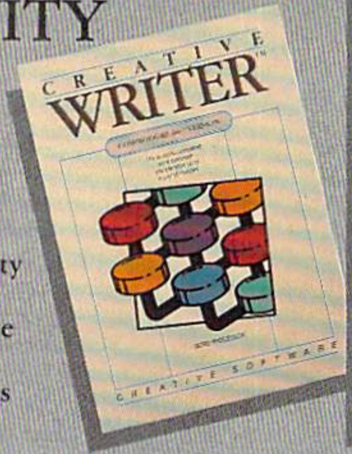

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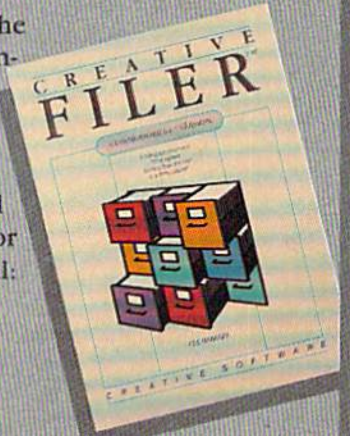

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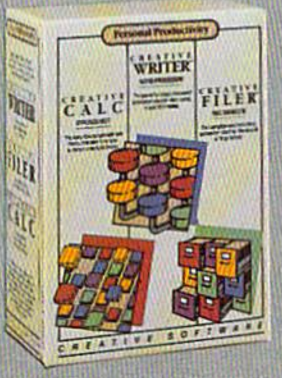

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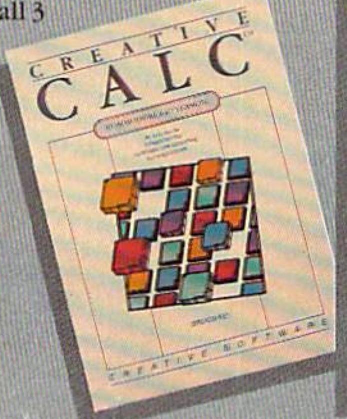

* Commodore 64 Suggested Retail Price

Commodore 64 Comparisons

Word Processors

Features/Benefits	Creative Writer	[1]PFS Write	[2]Bank St Writer	Home-Word	Cut & Paste
24 Display Lines	Yes	No	No	No	No
Search & Replace	Yes	Yes	Yes	Yes	No
Variable Margin Settings	Yes	Yes	No	Yes	No
Imbedded Print-Format Commands	Yes	No	Yes	Yes	No
Preview Document to Screen	Yes	No	No	Yes	No
Normal Cursor Operation	Yes	Yes	No	No	No
Help Screens	Yes	Yes	No	Yes	No
Delete by Sentence	Yes	No	Yes	Yes	No
Delete by Paragraph	Yes	No	Yes	Yes	No
Use Function Keys	Yes	Yes	No	Yes	Yes
Full Line Headers, Footers	Yes	Yes	No	Yes	No
Copy, Move Text	Yes	Yes	Yes	Yes	Yes
Display Directory	Yes	Yes	Yes	Yes	Yes
Justify Text	Yes	Yes	No	Yes	No
Comment Lines	Yes	Yes	No	No	No
Undo Command	Yes	No	Yes	Yes	Yes
Integrate with Filer	Yes	Yes	No	No	No
Integrate with Calc	Yes	Yes	No	No	No
Suggested Retail Price	49.95	125.00	49.95	69.95	50.00

[1]Apple II specs used.
[2]PC version specs used.

File Managers

Features/Benefits	Creative Filer	PFS Report & File	Phi Beta Filer	Data Manager II
Maximum Records per File	1300[1]	1000	250	660[5]
Maximum Fields per Record	100	50	10	20
Maximum Characters per Data Field	3920[3]	size of form	24	31[4]
Maximum Characters per Record	3920[3]	size of form	240	230
Maximum Files on Disk	144[2]	1	10	1
ISAM File for Fast Retrieval	Yes	No	No	No
Help Screens	Yes	No	No	No
Change Form Without Rewriting File	Yes	No	Yes	No
Report Writer Included	Yes	No	Yes	No
Select Records to Print	Yes	Yes	Yes	No
Derived Fields	Yes	Yes	No	No
Totals	Yes	Yes	Yes	No
User Defined Column Headings	Yes	No	No	No
Print Date and Page Number	Yes	No	No	No
View Catalog of Files	Yes	No	Yes	No
Integrate Report with Word Processor	Yes	N/A	Yes	Yes
Integrate Fields with Word Processor	Yes	N/A	No	Yes
Suggested Retail Price	49.95	149.90	49.95	49.95

[1]Limited only by capacity of disk.
[2]Limited only by number of directory entries allowed by DOS.
[3]Limited only by maximum size of form (98) lines.
[4]Longer field names also reduce amount of data that can be entered into data field.
[5]Calculated on the basis of one record per block.

Spreadsheets

Features/Benefits	Creative Calc	Multi-Plan	[1]Visi-Calc	Insta-Calc	Practi-Calc
Rows	255	255	254	30[2]	254[2]
Columns	64	63	64	20[2]	100[2]
Variable Column Width for Any Column	Yes	Yes	No	No	No
Within Cell Editing	Yes	Yes	No	No	No
12 Digit Accuracy	Yes	Yes	No	No	No
Full-word Menus	Yes	Yes	No	No	No
Free Memory for Spreadsheet	30K	10K	10K	24K[3]	16K
List Directory on Screen	Yes	No	No	Yes	No
Format Text L/R/C	Yes	Yes	No	No	No
Dynamic Memory Allocation	Yes	Yes	Yes	No	No
Auto-recalc Available	Yes	Yes	Yes	No	No
Auto-adjust on R/C Deletion	Yes	Yes	Yes	No	No
Reference Cells by Moving Cursor	Yes	Yes	Yes	No	No
Maximum Formula Length	120	105	80	40	40
Integrate with Word Processor	Yes	Yes	No	No	No
Suggested Retail Price	49.95	99.95	99.95	39.95	54.95

[1]Commodore 8032 version specs used.
[2]Size of Spreadsheet must be specified at program start–highly inflexible.
[3]Estimated.

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These comparisons were made based on programs available and/or specifications given by the manufacturers at time of publication. Creative Software is not liable for omissions or inaccuracies and makes no representation with regard to the continuing accuracy of these comparison charts.

July 1985 Vol. 3, No. 7

FEATURES

REVIEWS

GAMES

EDUCATION/HOME APPLICATIONS

PROGRAMMING

DEPARTMENTS

PROGRAM LISTINGS

* =General, **V**=VIC-20, **64**=Commodore 64, +**4**=Plus/4, **16**=Commodore 16.

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THE EDITOR'S *notes*

When you think of the major art forms, it's curious that computers aren't equally adept in each form (or that the arts aren't equally *vulnerable* to computerization, depending on your point of view).

Of all the arts, music is the most easily automated. It's an aesthetic very close to numbers, and numbers are a specialty of computers. Music is just starting to be computerized, but it's happening fast. Synthesizer music is becoming a powerful presence in popular songs and is frequently used in commercials and movie scores.

The elements of music are simply quantified—tempo, duration, attack, pitch, and timbre can be described very neatly in mathematical terms. And these elements can be quickly manipulated because they interrelate in mathematical patterns. The opening notes of a Bach fugue or Prince's "When Doves Cry" are quantifiable and adjustable in a way that the color blue in a Van Gogh painting or the words "To be or not to be," are not.

There is a new kind of computer which can control and create music to an astounding degree. It's called a sequencer. And musicians aren't limited to the use of a dedicated sequencer. There are some excellent software packages which turn the Commodore 64 into a powerful music machine. Hook up the 64 to a computerized musical instrument, a synthesizer, and you've got all the elements of music at your command.

For example, one new program for the 64, *Dr. T's Keyboard Controlled Sequencer*, gives the user considerable control over as many as 16 synthesizers at once. You can enter a melody, add harmony, invert it, run it backwards, shift it in pitch, volume, or duration, and a variety of other transformations. All this quickly and in an experimental fashion, the way you might tentatively rearrange paragraphs using a word processor. But what's important about sonic transformations is that many of them turn out to be interesting music, valid variations, often entirely new musical *ideas.* That's definitely not what happens when you transpose paragraphs.

To see how much more susceptible music is to this kind of manipulation than the other art forms, imagine playing the first few notes of a song backward: *Eleanor Rigby lived in a church* becomes *church a in lived Rigby Eleanor*. Reversing these notes you achieve an intriguing melody; play the new reversed melody against the original and you have an even more intriguing harmonic structure. In fact, much of Baroque music is based on just such inversions in pitch and reversals of time.

This theme and variations, so easily achieved by computer control over sounds, does not apply to writing. Reverse the words above and you get gibberish: *hcruhc a ni devil ybgiR ronaelE.* Nothing aesthetically worthwhile there. Likewise, mathematically vary the elements of a painting and you're likely to end up with what looks like a photographic negative, a neon nightmare, or simply an upside down painting.

Music is being captured by computerization while literature and visual arts seem, as yet, largely immune. There are, of course, word processors. They assist with writing in some ways, but certainly don't transform an essay in the same sense that sequencers can profoundly transform a song. There are, too, computers which help animate and draw, but they are still relatively crude, and the results are still essentially at the cartoon level.

The problem with painting is that it's relatively difficult to get a computer to "see" a visual field. It's far more difficult to quantify and modify a visual experience than an aural one. Compact discs contain 44,000 numbers for every second of music. That sounds like a lot, but with current technology, manipulating these numbers—even in realtime—is possible.

It's much harder to capture a picture in numbers because there are so many more numbers involved. An ordinary TV screen, which has far from the greatest visual resolution possible, has 1.2 million bits (colored dots) of information. That's a still picture. Move the picture through time and you've got to change the bits 30 times a second. There are ways to reduce the overhead, but it's still far more data to manipulate than is necessary with even the most complicated music.

But if quantifying sights and sounds seems challenging, literature is unimaginably more difficult. Writing is essentially the expression of ideas, and computerizing *thought* is still only an idea in the minds of computer scientists. It will likely be a long time, if ever, before you can write a letter, read it over, and then ask your computer to rewrite it, making it sound more cheerful.

Of course all this begs the question somewhat: a sequencer isn't *composing* its variations on a theme. It's merely making it so easy for the musician to run through dozens of alternatives (with full orchestration if desired) that the musical alternatives become both rich and varied. The musician can, in effect, hear the results of his ideas without having to hire a band.

On the other hand, instant transposition from a minor to a major scale is much like asking the computer to make a song sound more cheerful.

Richard Mansfield

Senior Editor

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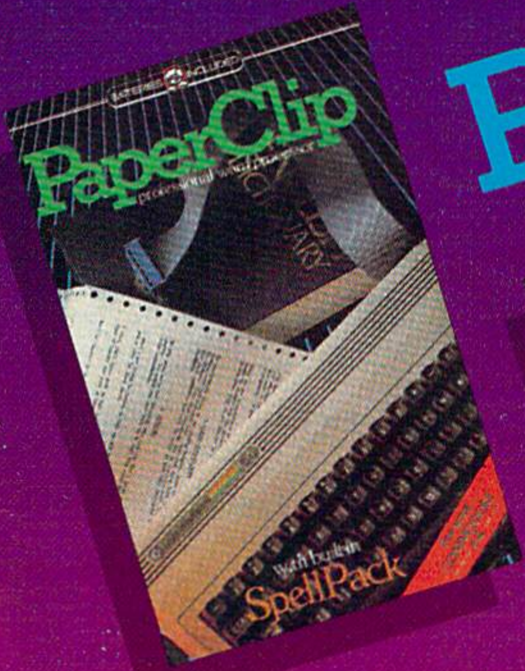

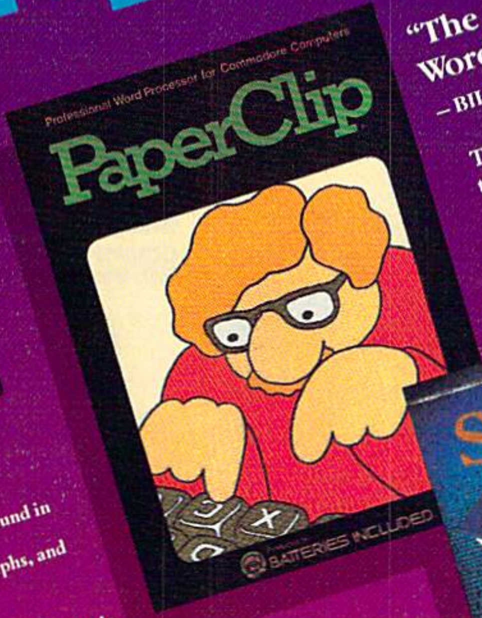

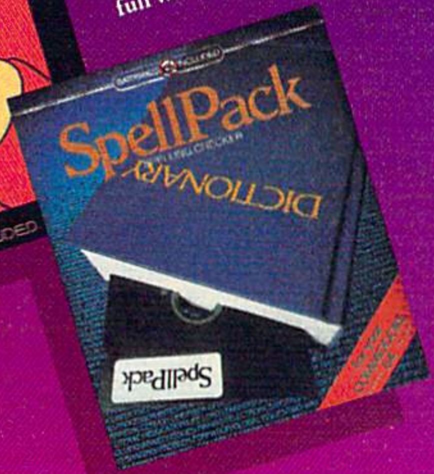

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No Telecommunications For The 16?

I recently purchased a Commodore 16 and a Datassette. Then I found out that there is no modem for the 16. Does anyone have plans to come out with one?

Mike Steinkamp

The Commodore 16 has a memory expansion port, but no user port. It also lacks the circuits for controlling a modem. It was not designed for use with a modem and no modems currently available will work with the 16. This may have been a cost-cutting move, to keep the price of the 16 low. While it's theoretically possible to design a modem that plugs into the cartridge port or the round serial port, we don't know of any such modems for the 16.

Smuggling Characters Across The Border

There is sometimes not enough room on the screen for my programs. Is there any way to print things on the border of the screen? If so, please tell me how.

Jeff Rupert

Some televisions suffer from overscan, which means they show less than a full picture. If you're watching a TV show, this isn't disastrous; part of the edge of the picture is missing and you probably don't even notice. But a computer displays letters and graphics characters, each of which is important. To compensate for overscan, Commodore computers display a colored border around the screen.

To answer your question in a word, no. The border is built in. You can change its color, even make it two different colors, but you can't print characters there. If you're running out of space on the screen, "Screen-80" from the September 1984 GAZETTE *may help; it changes the 64's 40-column screen to 80 columns. Or you may be able to rewrite your program, to fit everything within the edges of the screen.*

LISTing To The Printer

How do you tell the computer to list a program to the printer? I have a 64 and a 1526 printer.

Bassam Alefundi

First load a BASIC program into memory. Then type **OPEN4,4:CMD4:LIST**. *If you prefer to see the listing in upper/lowercase, change the first statement to* **OPEN4,4,7**. *CMD diverts output to a previously opened device, in this case the printer. After it's finished, close things up with* **PRINT#4:CLOSE4** *on a separate line (the PRINT# clears out any information that may still be in the buffer and turns off CMD). This technique should work with any Commodore computer hooked up to any Commodore printer.*

If you own a machine language monitor or disassembler, you can disassemble an ML program to the printer. First, OPEN4,4:CMD4 and SYS to the starting address of the monitor. Then use the D (disassemble) command. When the printer stops, type X (for exit) and PRINT#4:CLOSE4.

A Broken 64 Fixed For A Quarter

Many times, a broken 64 needs only a new fuse. The symptoms of a blown fuse are that the power light comes on, but nothing works. It costs only about 25 cents to buy a fuse (1 amp) at an auto supply shop. Be sure the power supply is unplugged, then remove the cover and replace the glass fuse. If you don't know much about electronics, ask a friend who does to help you.

Scott Macnab

Thanks for the tip. Readers should note that if you remove the fuse and the thin wire inside is not broken, then the fuse is not the problem. Another common cause of malfunctioning 64s is static electricity sparking against the joystick port when you reach to turn on the computer. If the voltage is high enough, you can burn out a chip, which is not as easy to fix as a blown fuse.

"Bug-Swatter" For The GAZETTE DISK

I am a GAZETTE DISK subscriber and would like to know if "Bug-Swatter" pertains to programs on the disk, or just programs listed in the magazine.

Frank J. Notaro

Sometimes yes, sometimes no. Publishing a magazine involves typesetting, proofreading, pasting up, making negatives, and so on through printing. A disk is just a piece of plastic that holds magnetic patterns. There are more things that can go wrong with a printed program listing than with a disk. Disks are more frqgile than magazines, however; the post office has been known to fold a GAZETTE DISK *to fit it into a mailbox.*

When the GAZETTE *premiered, the letter-quality printer that made program listings would occasionally throw in a superfluous question mark. And a well-meaning lithographer once covered up a comma in a program, thinking it was a scratch on the photographic negative. Problems like this affect the program, but are not really bugs in the program. They're related to the process of magazine production. In such cases, "Bug-Swatter" would not apply to disk subscribers.*

Also, some items in "Bug-Swatter" are not reports of bugs, but modifications, adding a printer option, for example, or speeding up a game. If you read "Bug-Swatter" carefully, you should be able to tell if the correction applies to the programs on the GAZETTE DISK.

A Simple Tape Directory

I've found a simple way to create a tape directory. It can be entered, saved, loaded, and run like a program:

```
0 LIST
30 "SUPERMON"
52 "PROOFREADER"
61 "ASTROPANIC,"1,1:SYS49152
73:
```

The false line numbers are actually the tape counter for where the program begins. The last line tells you where the last program ends. As you add programs, you can update the directory. To be safe, fast forward to 30 before saving the first program to a new tape.

When you put a tape in the Datassette, rewind to the beginning, set the counter to zero, and press SHIFT–RUN/STOP. The first program on tape (the directory) is loaded and run. Line 0 makes it list. You can then fast forward to slightly before the appropriate position and load the program.

David E. Wood

Thanks for this simple but elegant solution to keeping track of which programs are on which tapes.

A Subroutine Barrier

The GOSUB command does not work. It always comes up RETURN WITHOUT GOSUB, which has stopped me from finishing my programs.

Ron D. Jedlicki

A computer does things methodically, one at a time. It begins at the lowest line number and works through until either it can find no more line numbers or it reaches an END statement.

GOSUB (GO to SUBroutine) changes things temporarily. It causes the computer to jump to another part of the program. But the computer marks its place in the program, so that when it comes across a RETURN, it can go back to the line with the GOSUB. Here's a short illustration:

```
10 PRINT"MAIN ROUTINE":GOSUB500:
   PRINT"WE'RE BACK"
500 PRINT"SUBROUTINE":RETURN
```

Even though the subroutine at line 500 is called only once, the word SUBROUTINE is printed twice, followed by a RETURN WITHOUT GOSUB error. In the middle of line 10, the GOSUB transfers the program to the subroutine at 500, where a message is printed. At the end of 500, RETURN sends the program back to the middle of line 10. Another message is printed, and that should be the end of the program, right? Wrong. The computer keeps going, prints SUBROUTINE again, thinking it's part of the main program, and stops with an error message. It doesn't have a GOSUB corresponding to the RETURN. This is called "falling through to a subroutine."

To fix the program, add a line—499 END. This tells the computer that it has reached the end of the program. END acts as a fence or barrier that separates the main routine from subroutines that follow.

Extra Quotes In The Disk Directory

Somehow I saved a file to disk with an extra quotation mark in the title: ""FILENAME". Now I'd like to retrieve the data in the file. So far I've been unsuccessful. Is there any way to read the information from the file?

Martin Pastor

Finding extra quotation marks in a disk filename happens sooner or later to most disk drive owners. When it first occurs, it may be confusing. But once you understand what causes it, you can use it in some creative ways.

To save a program or create a file on disk, you must give it a name of up to 16 characters. If the filename contains more than 16 characters, the extras are truncated (chopped off) because only 16 bytes are allotted for each name. But if there are fewer than 16 characters, a 1541 disk drive will pad out the remaining space with ASCII 160s. This

character, CHR$(160), can be typed from the keyboard by holding down the SHIFT key and pressing the space bar. The drive interprets SHIFT-SPACE as an end-of-name marker, and the directory lists it as a quotation mark.

So, to read the file with the extra quotation mark, OPEN it with the name "{SHIFT-SPACE} FILENAME." Or use the question-mark wildcard: "?FILENAME". You can also use the rename command to give it a more ordinary name (see the user's manual if you're not sure how to rename a file).

Knowing that shifted spaces are translated to quotation marks suggests some interesting ideas. If you have a program called SPACEGAME, try saving it with the name "A{SHIFT-SPACE}SPACEGAME." When you list the directory, it will appear as "A"SPACEGAME and you can simply LOAD"A",8 rather than typing the entire name. If it's written in machine language and needs, say, a SYS36864 to start, you could name it "SPACEGAME{SHIFT-SPACE}36864." The directory will show it as "SPACEGAME"36864. It's like writing a note to yourself about the SYS number.

Turning Off VIC Memory Expansion

I have a 16K memory expander for my VIC-20. Some programs require the additional memory while others will not work with it. I worry that the constant insertion and removal may cause damage to the contacts. Is there some simple way I could add a switch to turn off the expansion?

Glen Reid

You don't have to add a hardware switch; you can reconfigure the VIC through software. Memory expansion of 8K or more changes three things inside the VIC: the start of BASIC, the start of color memory, and the start of screen memory. The following program will reset the VIC to its normal, unexpanded configuration.

```
10 POKE44,16:POKE4096,0:POKE36869,240:POK
   E36866,150:POKE648,30:PRINT"{CLR}":NEW
```

A second way to disable a cartridge without removing it is to use an expansion board. These motherboards, as they are often called, allow you to plug in many cartridges at once. They have switches to let you turn any cartridge on or off.

Getting Used To Using GET

I can't seem to make the GET command work. My computer ignores it as if it weren't there. I haven't had a problem with any other BASIC command.

Martin Ronan

If you learned BASIC on an Apple computer, you may not realize that Commodore BASIC has a slightly different version of GET. On Apples, GET stops the program until a key is pressed. Commodore computers, on the other hand, look for a keypress and continue the program whether or not the user has actually typed anything. If nothing was typed, the variable after GET holds a null string—a string containing nothing at all, with a length of zero.

If you want the program to wait for a key, use this syntax: **400 GET G$: IF G$="" THEN GOTO 400**. *The pair of double quotes with nothing between them is a null string (hold down the SHIFT key and press 2 twice). If the GET statement finds that nothing has been typed (a null string), it loops back to the same line, GETting over and over until a keystroke is detected.*

In addition, you can't use GET (or INPUT) in immediate mode. GET must be part of a program line.

How Do You PEEK Paddles?

In a previous issue, you printed the PEEK locations for reading joysticks in ports 1 and 2. I've tried these locations with my paddles, to no avail. Can you give me the PEEKs for reading paddles?

David Malecki

On a 64, you use two registers in the SID chip to read the paddles. PEEK location 54297 for paddles 1 and 3, and 54298 for paddles 2 and 4. The paddle buttons are read using the following equations:

IF (PEEK(56321)AND4)=0 THEN button 1 is pressed
IF (PEEK(56321)AND8)=0 THEN button 2 is pressed
IF (PEEK(56320)AND4)=0 THEN button 3 is pressed
IF (PEEK(56320)AND8)=0 THEN button 4 is pressed

You'll face a problem when reading the paddles from BASIC, though, because the keyboard scan routine is changing these locations 60 times a second. The following relocatable machine language program briefly turns off the keyboard scan, and checks the paddles. The starting address of the program is contained in the variable SA and can be changed to any free memory location.

To read the paddles, type SYS SA. The value of the paddles can be determined using the following expressions. The values will range from 0 to 255.

P1 = PEEK(2)
P2 = PEEK(3)
P3 = PEEK(4)
P4 = PEEK(5)

```
10 SA=828
20 FORB=SATOSA+41:READA:POKEB,A:NEXT:END
40 DATA 162,0,173,0,220,72,120,169,64,141
   ,0,220,160,0
50 DATA 234,136,208,252,173,25,212,149,2,
   173,26,212,149,3
60 DATA 169,128,232,232,224,4,208,229,104
   ,141,0,220,88,96
```

Photographing The Screen

I'd like to know what kind of monitor you use and how you have it hooked up. The pictures of

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programs look very clear—better than any monitor I've seen hooked up to a 64.

Lawrence Ethier

The photographs printed in the GAZETTE *are taken with a 35 millimeter camera, Ektachrome color slide film (ASA 64), and a Commodore 1701 monitor, using the three rear connections. The screen usually looks a lot better if you use the three plugs in the back because the color and brightness (chroma and luma) are separated, giving a clearer signal.*

The camera is mounted on a tripod, with the middle of the lens pointing exactly at the middle of the screen (if the camera is not square with the screen, the screen will look twisted). The darker the room the better; we use a room with no windows. Sometimes the color is turned up slightly for a brighter picture. The exposure is set for one second, with the f-stop somewhere between 8 and 16, depending on how light or dark the screen is. And the action on the screen is frozen. We usually take three or four pictures at different f-stops and pick the one that looks best.

Cancelling Double Width Characters

When I use PRINT#4,CHR$(14) in a program for the printer, is there a way to change back to regular characters without having to open up another channel?

Joe Sylvia

The CHR$(14) code sends a Commodore printer into enhanced mode, where the characters printed are double width. To cancel it, and go back to normal characters, add a PRINT#4,CHR$(15) to your program.

A Do-Nothing Command?

I believe I've found a keyword that the BASIC interpreter does not detect as a syntax error: RESTORE. When typed in direct mode, the machine returns no error message, nor does anything seem to occur. Why does the computer accept but not act on this command?

Timothy Bereman

The RESTORE keyword does *do something, as the following program demonstrates:*

```
10 READA$:PRINTA$
20 GOTO 10
30 DATA FIRST,SECOND
```

Line 10 reads a string from a DATA statement and prints it. Line 20 puts the program into an endless loop, forever reading and printing, except that there are only two items to read. Ordinarily, DATA statements can be read only once. The third time, there's nothing left, yielding an **OUT OF DATA** *error in line 10, even though there's nothing wrong with line 10. The problem is there are no more DATA items in the program.*

Add this line: **15 RESTORE** *and you'll find the first DATA item printed over and over. RESTORE resets a pointer, allowing you to reread information from DATA lines. RESTORE is a weaker cousin of CLR, which clears out all variables, undimensions all arrays, resets the DATA pointer, and destroys RETURN addresses created by GOSUBs.*

Clock Arithmetic

I'm taking a college class in FORTRAN. One of the commands is MOD, which returns the remainder of two numbers when the first is divided by the second. For example, MOD(4,2) is 0 and MOD(8,3) is 2. Is there a similar command in Commodore BASIC, or is a special program needed?

Scott Sprouse

MOD is short for modulo, an essential function in "clock arithmetic." At some point, the numbers on the clock wrap around, back to the beginning. For example, if it's 10:00 and you're going to meet someone in four hours, the rendezvous time will be 2:00, not 14:00, because there are no numbers higher than 12 on a regular clock (military time is similar, but wraps around at 24). So, on a 12-hour clock, five times eight would equal four because 40 modulo 12 = 4. In other words, 40 divided by 12 is 3, with a remainder of 4.

In a way, computer memory works like clock arithmetic, because if you increment a byte, the number in that byte will go up to 255 and then wrap around to zero. Each byte is a clock with 256 numbers.

You can define a modulo function on a Commodore computer with **DEF FN M(X)=N1−(X*(INT(N1/X)))**. *Later in the program, you could find MOD(16,5) with this line:* **N1=16:PRINT FN M(5)**.

Although the defined function FN M can handle small numbers, larger numbers may be affected by rounding errors. Another, somewhat slower, method is to use a short subroutine that subtracts the second number from the first until the second is higher:

```
500 T=N1
510 IF T>=N2 THEN T=T-N2:GOTO 510
520 RETURN
```

To find MOD(16,5), use **N1=16:N2=5:GOSUB500:PRINTT**.

Multiple Border Colors

Is there a way to place different colors on the outside border area of the screen? I own a commercial game with a cyan border at the top, light blue below that, then dark blue and black. If you know how to do this, please don't keep it a secret.

T. D. Obert

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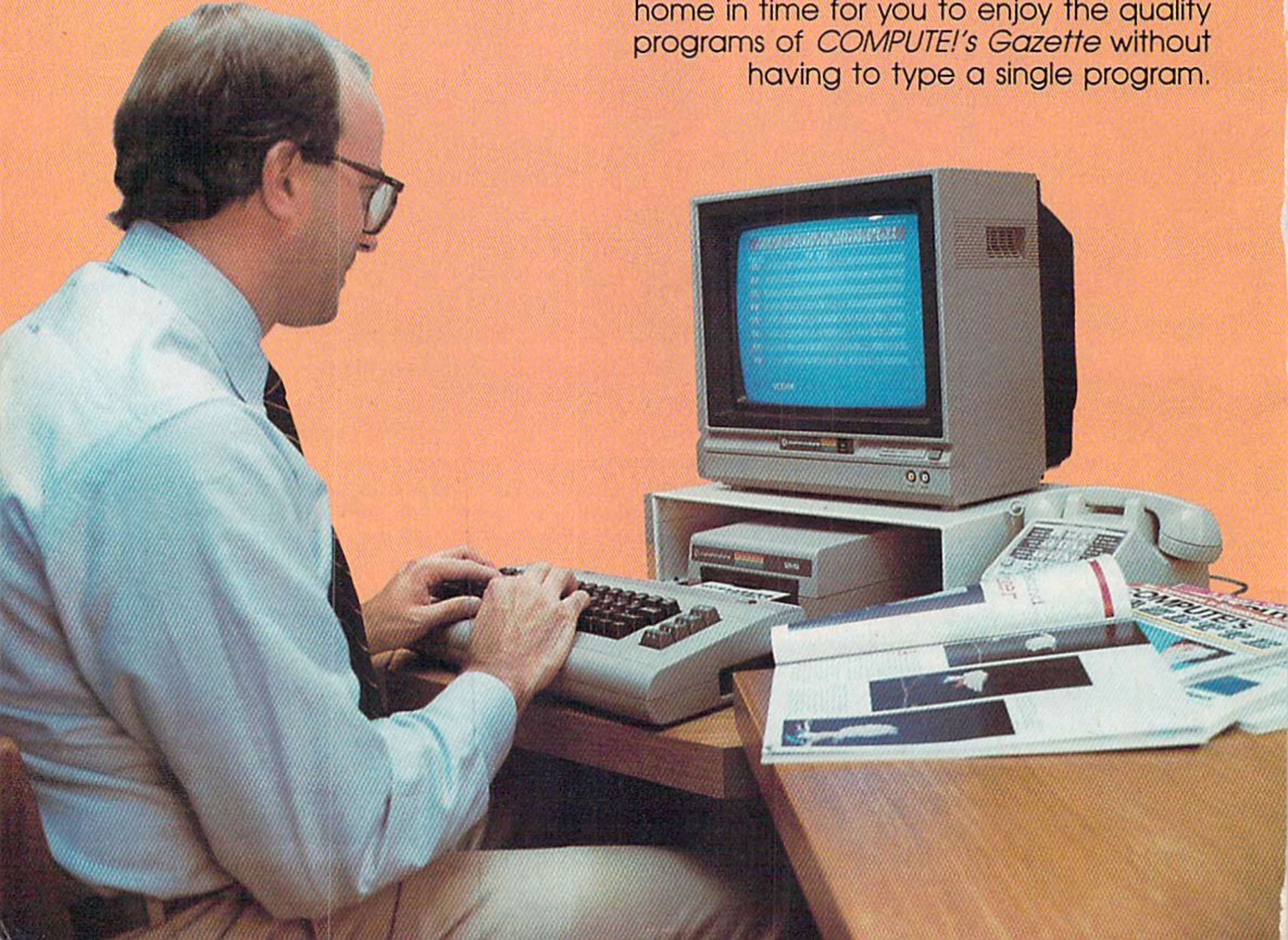

What you're asking for is a raster interrupt. *The screen of your television or monitor displays 525 raster lines from top to bottom (European TVs have a different standard, with 100 more lines). An electron gun spits electrons at the screen, creating patterns of light and dark on these lines.*

The 525 lines are paired up into 262 double lines for your 64 to keep track of. By PEEKing location 53266, you can find out which line is currently being drawn. The screen is drawn very quickly, so machine language is needed to change the border color when a certain line is reached. This program, which can be added to your own BASIC programs, sets up an interrupt to change the border color at a specific line:

```
10 FORA=828TO893:READB:POKEA,B:NEXT:SYS82
   8:END
20 DATA 120,169,88,141,20,3
30 DATA 169,3,141,21,3,169
40 DATA 129,141,26,208,169,27
50 DATA 141,17,208,169,127,141
60 DATA 13,220,88,96,169,1
70 DATA 141,25,208,166,4,160
80 DATA 0,173,18,208,197,2
90 DATA 176,4,166,3,164,2
100 DATA 142,32,208,140,18,208
110 DATA 173,13,220,74,144,3
120 DATA 76,49,234,76,188,254
```

After you run the program, POKE location 2 with the line number (0–255) where you want the border color to change. The top of the inner text screen is 50, the bottom 249. Next, POKE 3 with the color you want at the top and POKE 4 with the color you want at the bottom.

Writing Machine Language With DATA Statements

I'm new to machine language (ML) and can't seem to understand how to write a machine language program using DATA statements.

Frank Aiello, Jr.

As a beginner, you should start with an ML monitor, a special program that translates mnemonics like LDA or STA into the numbers that make up an ML program. There are several good monitors (Micromon *and* Supermon, *for example) available in the public domain and in computer books. Later, you can graduate to an assembler, which makes ML programming even easier.*

Usually, when you see a long list of DATA statements, it means the program was written with either a monitor or an assembler. Only after it was finished was it converted to DATA statements. Translating an ML program into DATA statements, which is called hand assembly, is possible but can be very time-consuming. Let's see how it works with an extremely short program for the 64.

To change the screen color to white in BASIC, POKE 53281,1, which means place the number one in memory location 53281. Machine language works much the same, except that decimal numbers like 53281 are out. When assembling by hand, you should think of 53281 as hexadecimal $D021.

The ML equivalent of POKE 53281,1 is:

```
LDA  #$01
STA  $D021
RTS
```

There are several registers that can hold numbers inside the 6510 chip, one of them is the Accumulator (A). LDA # means LoaD Accumulator with the number following the LDA instruction. This is called immediate mode. After this happens, there's a one in the A register. STA means STore A (copy the number in A) in the appropriate absolute address. ReTurn from Subroutine (RTS) ends the ML program. The Programmer's Reference Guide *lists the hexadecimal equivalents of the instructions (load A immediate, store A absolute, RTS):*

```
$A9  $01
$8D  $21  $D0
$60
```

Note that the address $D021 has been changed to a low-byte/high-byte number ($21 $D0). Next, the hex numbers are converted to decimal and POKEd into memory:

```
10 FOR J=828 TO 833:READ A:POKE J,A:NEXT:SYS
   828
20 DATA 169,1,141,33,208,96
```

Run this program on a 64 and you should see the screen turn white. Assembling by hand takes a lot of time, and is error prone. If you're learning ML, a machine language monitor is almost a necessity.

The Most Obscure Function

What is the USR function used for?

Marc A. Sims

USR, like SYS, starts up an ML program, but it is a function, so you need to follow it with a number in parentheses. This number is translated to a floating point number and stored in the floating point accumulator. The computer looks for the starting address of the ML program in the USR jump vector in standard low-byte/high-byte format at locations 785–786 on a 64, locations 1–2 on a VIC. After the ML program finishes, the number in the FP accumulator is transferred to the function. For example, if you have a machine language program that multiplies a floating point number by two and you POKE the USR vector to point to your routine, X=USR(5) would multiply five times two and put the value in X.

It's an obscure function, almost never used. For more about floating point numbers, see this month's "Machine Language for Beginners" column. For examples of how to use USR, see The VIC-20 and Commodore 64 Tool Kit: BASIC *from COMPUTE! Books.*

A Buyer's Guide To Printers

It's not getting any easier. Shopping for a printer used to mean trying to find one that didn't cost hundreds of dollars more than you paid for your computer. Many peripheral manufacturers, even mainstream appliance companies, have added computer printers to their product lines over the last year. And the intense competition has driven the prices way down. It's a buyer's market.

The following chart lists key information about printers under $500 that are compatible with Commodore computers. We've included all the printers we could find information about in that price range; any omission is not an editorial judgment of quality.

Here's a brief explanation of some of the chart's categories:

Compatibility. Commodore computers use a unique serial data communications format that is not compatible with either standard serial or parallel printer formats. In the past, the only way you could avoid compatibility problems was by buying a Commodore printer. Within the last year, several manufacturers have developed interfaces for their printers that plug directly into a Commodore computer. If you're interested in one of these "Commodore-ready" printers, be sure to find out if there is an additional charge for the cable. Even if the printer does not include a Commodore interface, you can buy third-party interfaces to attach most parallel printers.

Print Technology. There are three types in this price range: impact, thermal, and ink-jet. *Impact* printers form characters by striking the paper through an inked ribbon, either with a *daisywheel* (a small wheel whose spokes have letters and numbers at their tips), or with a printhead containing a column of tiny wires or pins that form characters and graphics (dot-matrix). *Thermal* printers use either a column of hot pads to change the color of heat-sensitive paper, or a column of tiny spark plugs that evaporate a special aluminum coating onto the paper, revealing an underlying dark surface. Thermal printers therefore require special paper, which often costs more than ordinary paper, but they don't need a ribbon. *Thermal transfer* printers do not need special paper, but they do use a ribbon; the heat from the printhead melts a waxlike ink onto the paper. *Ink-jet* printers spray ink onto the paper through tiny holes.

In this price range, you'll need a daisywheel printer if you want letter-quality type. Many dot-matrix printers, however, offer *near-letter-quality (NLQ)* mode, that comes so close to daisywheel print that you have to look quite closely to see the dots that comprise a character.

And if graphics are important to you, you'll do best to consider a dot-matrix printer.

Speed. How fast does the printer print? This can vary if the printer offers different modes. *Draft mode* is usually the fastest, but produces rougher, fainter type. Near letter quality or *correspondence* quality takes longer, but is more readable. Some printer speeds vary depending on the type of *font* (i.e., pica or elite) used.

Pitch. How many characters fit on a line, measured in characters per inch (cpi) or characters per line (cpl). This can also vary if you're printing larger or smaller characters than normal.

Graphics capabilities. Dot-matrix and thermal printers offer the best in this price range, since they are not limited by the characters on a daisywheel. If you plan to print graphics extensively, find out exactly what the printer can and cannot do. We've only listed highlights on our chart.

Special character sets. Some printers can print special symbols used in foreign languages (like the German *umlaut*), or mathematical or scientific symbols.

Buffer. A buffer is an area of memory in the printer that can store a certain amount of text while the printer is working, freeing up the computer for other work. Most printers in this price range have very small buffers, so if you'll be doing many long printing jobs, you may want to consider buying an add-on buffer.

Feed type. *Friction-feed* printers grip the paper and move it around the platen much like a typewriter does, while *tractor-feed* printers actually grab the holes at the edge of printer roll paper with tiny teeth at either edge of the platen. Many printer manufacturers offer add-on tractors, usually at an additional cost.

For more details on printers, see "Getting Started with a Printer," elsewhere in this issue.

Mfr/Dist.	Model Name/No.	Compatibility	Print Tech	Speed	Pitch Range	Graphics Capabilities	Special Char Sets	Buffer	Feed Type	Warranty	Suggested Retail Price	Comments
Alphacom, Inc, 2323 S Bascom Ave, Campbell, CA 95008	Aero	Parallel and serial avail	Impact (dot-matrix)	130 cps	5, 15 cpi	Supports Epson RX-80 protocol	Greek, math symbols, European char; 96 downloadable char	2K	Friction and tractor std	1 yr parts/labor	$249.95	6 fonts std
Alphacom, Inc	Alphapro 101	Parallel and serial avail	Impact (daisywheel)	20 cps	10, 12, 15 cpi	None	None	93 bytes	Friction and tractor avail	1 yr parts/labor	$399.95	
Apropos Technology, 1071-A Avenida Acaso, Camarillo, CA 93010	GP-550CP	Commodore ready	Impact (dot-matrix)	86 cps	5, 6, 8.5, 10, 12, 17 cpi	Prints Commodore graphics set	International	1 line	Friction and tractor std	1 year	$259.95	NLQ mode
Axiom Corporation, 1014 Griswold Ave, San Fernando, CA 91340	Elite 5CD	Commodore-ready	Impact (daisywheel)	10–12 cps	10 cpi	None	None	2K	Friction std; tractor opt	1 yr	$359	
Axiom Corporation	Elite 10CD	Commodore-ready	Impact (daisywheel)	20 cps	10 cpi	None	None	2K	Friction std; tractor opt	1 yr	$359	15 in. carriage
Axiom Corporation	GP550-CD	Commodore-ready	Impact (dot-matrix)	50 cps (draft); 25 cps (NLQ)	10, 12, 17 cpi	Supports full Commodore char set	International	2K	Tractor and friction avail	1 yr	$339	
Axiom Corporation	SLP-CD	Commodore-ready	Impact (dot-matrix)	50 cps	10 cpi	Supports full Commodore char set	International; 5 user-designated	None	Friction std; tractor opt	1 yr	$339	NLQ print; lap portable (weighs 6 lb)
Axonix, 417 Wakara Way, Salt Lake City, UT 84108	Thinprint 80	Parallel and serial avail	Thermal	40 cps	10, 16.5 cpi	Reads teleprinter code	None	2K	Friction std	90 days	$339	Battery-powered opt; price includes cable
Axonix	Thintype 80	Parallel std; serial avail	Impact (daisywheel)	15 cps	10 cpi	None	None	1 line	Friction std	90 days parts/labor	$429	
Axonix	Thinwrite	Parallel and serial avail	Impact (dot-matrix)	50 cps (draft); 15 cps (NLQ)	10, 16.5 cpi	Yes	48 foreign char, 16 math char	1 line	Friction std; tractor opt ($20)	90 days	$449	
Blue Chip Electronics, 2 W Alameda Dr, Tempe, AZ 85282	M120/10	Parallel std; serial and Commodore-ready opt	Impact (dot-matrix)	120 cps	10, 12.5, 15 cpi	Supports full Commodore char set; dot-addressable graphics	9 international	3-line, expandable to 4K	Friction and tractor std	180 days	$299	Commodore interface list price is $59
C Itoh Digital Products, Inc, 19750 S Vermont Ave, Suite 220, Torrance, CA 90502	Prowriter 7500 EP	Parallel std	Impact (dot-matrix)	105 cps	5, 8.25, 10, 16.5 cpi	240 × 144 dpi	8 international	2K	Tractor and friction std	1 yr parts/labor	$289	
C Itoh Digital Products, Inc	Prowriter 7500AP	Parallel standard	Impact (dot-matrix)	105 cps	5, 6, 8.5, 10, 12, 17 cpi	240 × 144 dpi	8 international	2K	Tractor and friction std	1 yr parts/labor	$289	
C Itoh Digital Products, Inc	Prowriter 7500AR	Serial std	Impact (dot-matrix)	105 cps	5, 6, 8.5, 10, 12, 17 cpi	240 × 144 dpi	8 international	2K	Tractor and friction std	1 yr parts/labor	$329	
C Itoh Digital Products, Inc	Prowriter 8510AP	Parallel std	Impact (dot-matrix)	120 cps	5, 6, 8.5, 10, 12, 17 cpi	Block and dot-addressable graphics; 240 × 144 dpi	13 international	2K, expandable to 8K	Friction and tractor std	1 yr	$429	Prowriter 8510AP+ offers NLQ mode at 25 cps ($449)
C Itoh Digital Products, Inc	Starwriter Y10-20	Serial and parallel avail	Impact (daisywheel)	22 cps	10 cpi	None	None	2K, expandable to 8K	Friction std; tractor opt	1 yr parts/labor	$489	Parallel interface $89; price for serial interface unavail
CAL-ABCO, Legend Peripheral Products, 14722 Oxnard St, Van Nuys, CA 91401	Legend 880	Parallel std; serial opt	Impact (dot-matrix)	80 cps	5–16.5 cpi	7 x 8 in 8 x 9 matrix field	International	None	Friction and tractor std	90 days parts/labor; lifetime on printhead	$279	NLQ mode
CAL-ABCO	Legend 1080	Parallel std; serial opt	Impact (dot-matrix)	100 cps	5–16.5 cpi	7 × 8 in 8 × 9 matrix field; downloadable char	International	2K or 4K (optional)	Friction and tractor std	90 days parts/labor; lifetime on printhead	$339	NLQ mode
CAL-ABCO	Legend 1380	Parallel std; serial opt	Impact (dot-matrix)	130 cps	5–16.5 cpi	7 × 8 in 8 × 9 matrix field	International	2K or 4K (optional)	Friction and tractor std	90 days parts/labor; lifetime on printhead	$379	NLQ mode
CAL-ABCO	Legend 1385	Parallel std; serial opt	Impact (dot-matrix)	160 cps	5–16.5 cpi	7 × 8 in 8 × 9 matrix field	International	2K std; 4K opt	Friction and tractor std	90 days parts/labor; lifetime on printhead	$449	NLQ mode; wide carriage (15 in.)
Cardco, Inc, 300 S Topeka, Wichita, KS 67202	LQ/3	Commodore-ready	Impact (daisywheel)	13 cps	10 cpi	None	None	None	Friction std; tractor opt	90 days	$439.97	

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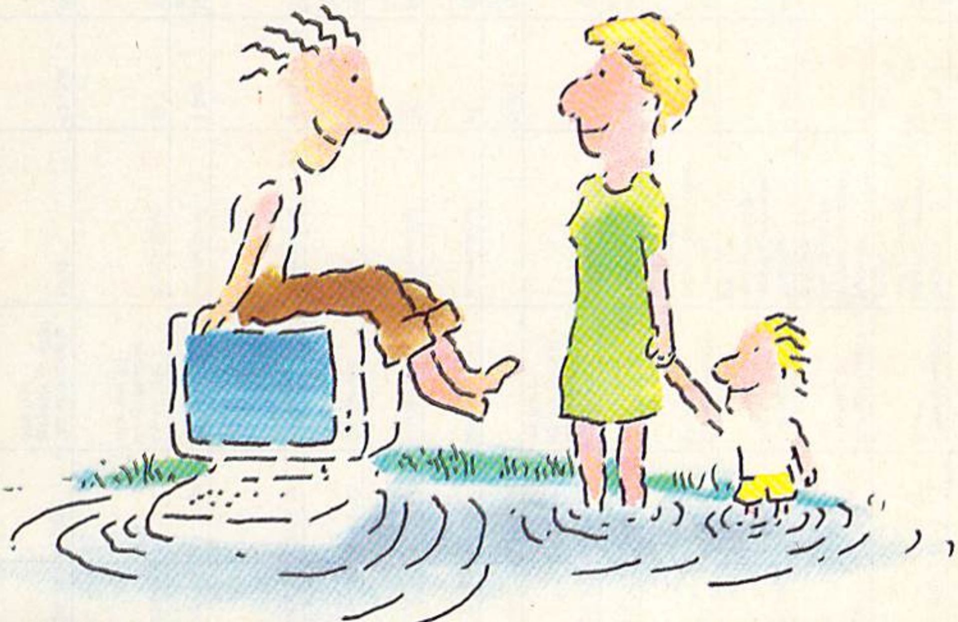

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Mfr/Dist.	Model Name/No.	Compatibility	Print Tech	Speed	Pitch Range	Graphics Capabilities	Special Char Sets	Buffer	Feed Type	Warranty	Suggested Retail Price	Comments
Centronics Data Computer Corp, 1 Wall St, Hudson, NH 03051	GLP-3101	Parallel std; serial opt	Impact (dot-matrix)	50 cps (draft); 12 cps (NLQ)	5, 8.5, 10, 17 cpi	Supports IBM block graphics	International and mathematical	2K	Tractor std	1 yr	$299	Portable
Citizen America Corp, 1710 22nd St, Santa Monica, CA 90404	MSP-10	Parallel std; serial opt	Impact (dot-matrix)	160 cps	5–20 cpi	240 × 216 dpi	International	1K std; 8K opt	Tractor std	18 months parts/labor	$499	Draft and correspondence mode; Epson print-code compatible
Commodore Business Machines, 1200 Wilson Dr, West Chester, PA 19380	1526	Commodore-ready	Impact (dot-matrix)	45 ln/min	10 cpi	1 downloadable char	Business (upper/lowercase) and uppercase graphics	1 line	Friction and tractor std	90 days	Under $300	
Commodore Business Machines	MPS-801	Commodore-ready	Impact (dot-matrix)	50 cps	10 cpi	Dot-addressable graphics	Business (upper/lowercase) and uppercase graphics	1 line	Tractor std	90 days	$199	
Commodore Business Machines	MPS-802	Commodore-ready	Impact (dot-matrix)	45 ln/min	10 cpi	1 downloadable char	Business (upper/lowercase) and uppercase graphics	1 line	Friction and tractor std	90 days	$239	
Commodore Business Machines	MPS-803	Commodore-ready	Impact (dot-matrix)	60 cps	10 cpi	Dot-addressable graphics	Business (upper/lowercase) and uppercase graphics	1 line	Friction std; tractor opt	90 days	$199	
Comrex, 3701 Skypark Dr, Torrance, CA 90505	CR-IIe	Parallel and serial avail	Impact (daisywheel)	20 cps	10, 12, 15 cpi	None	None	3K	Friction std; tractor opt	90 days	$499	
DAK Industries, Inc, 8200 Remmet Ave, Canoga Park, CA 91304	Gorilla Banana	Parallel and serial avail	Impact (dot-matrix)	50 cps	10 cpi	480-dot horizontal and 63-dot vertical resolution	3 international	1 line	Tractor std	6 months	$129	No true descenders; 30 days free trial
Dataport, 5525 Olinda Rd, El Sobrante, CA 94803	DMX	Parallel std; serial opt	Impact (dot-matrix)	180 cps	142 cpi max			None	Friction and tractor std	1 yr	$285	200 type fonts
Dataport	LQ	Parallel std	Impact (daisywheel)	15.3 cps	12 cpi	None	International	8K	Friction std	1 yr	$295	Opt inker device with five colors; lightweight (3.8 lb)
Epson America, Inc, 2780 Lomita Blvd, Torrance, CA 90505	FX-80	Parallel std; serial opt	Impact (dot-matrix)	160 cps	10, 12 cpi	60–240 dpi	International	2K	Friction and tractor std	1 yr	$499	
Epson America, Inc	Homewriter 10	Commodore 64 Printer Interface Cartridge (PIC) avail	Impact (dot-matrix)	100 cps (draft); 16 cps (NLQ)	5, 8.6, 10, 12, 17 cpi	50–240 dpi	None	1K	Friction std; tractor opt	1 yr	$269	Price of PIC $60
Epson America, Inc	RX-80	Parallel std; serial opt	Impact (dot-matrix)	100 cps	10, 12 cpi	60–240 dpi	International	1 line	Tractor std	1 yr	$269	128 user-selectable typestyles; RX-80 F/T offers std friction and tractor feed ($369)
Epson America, Inc	RX-100	Parallel std, serial opt	Impact (dot-matrix)	100 cps	10, 12 cpi	60–240 dpi	International	1 line	Friction and tractor std	1 yr	$499	136 columns wide
Fujitsu America, Inc, 3055 Orchard Dr, San Jose, CA 95134	DotMax 9	Parallel std, serial opt	Impact (dot-matrix)	25–180 cps	10, 12, 17 cpi	Up to 255 downloadable char (on 9I)	International	2K	Friction std	90 days	$499	9I compatible with IBM Graphics Printer; 9F compatible with Epson FX-80
Ergo Systems, Inc, 1360 Willow Rd, Menlo Park, CA 94025	HUSH-80	Parallel, serial, and Commodore-ready avail	Thermal	80 cps	10 cpi	Dot-addressable graphics @ 4800 dots/in.^{2}	None	92 char	Friction std	6 months; then fixed-fee repair rate	$139.99 (Commodore-ready, including cable)	$159.99 for parallel and serial versions
Everett-Charles Marketing Services, Inc, 6101 Cherry Ave, Fontana, CA 92335	CP-80	Parallel std; serial opt	Impact (dot-matrix)	80 cps	5–17 cpi	Semi- and bit-image graphics	None	2K	Friction and tractor std	90 days	$250	
Facit, Inc, 9 Executive Park Dr, PO Box 334, Merrimack, NH 03054	4510	Parallel and serial std	Impact (dot-matrix)	120 cps	10, 12, 17 cpi	Block and pin graphics	11 international	2K	Friction and tractor std	90 days	$495	
General Electric, GE Consumer Electronics, Electronics Park, Syracuse, NY 13221	3-8100	Parallel std; Commodore-ready interface avail	Thermal transfer	50 cps (draft); 25 cps (LQ)	24 cpi	Block graphics and special graphics char avail	International and scientific	2K	Friction std	2 yr	$299.95	Commodore interface $89.95; can use regular or thermal paper

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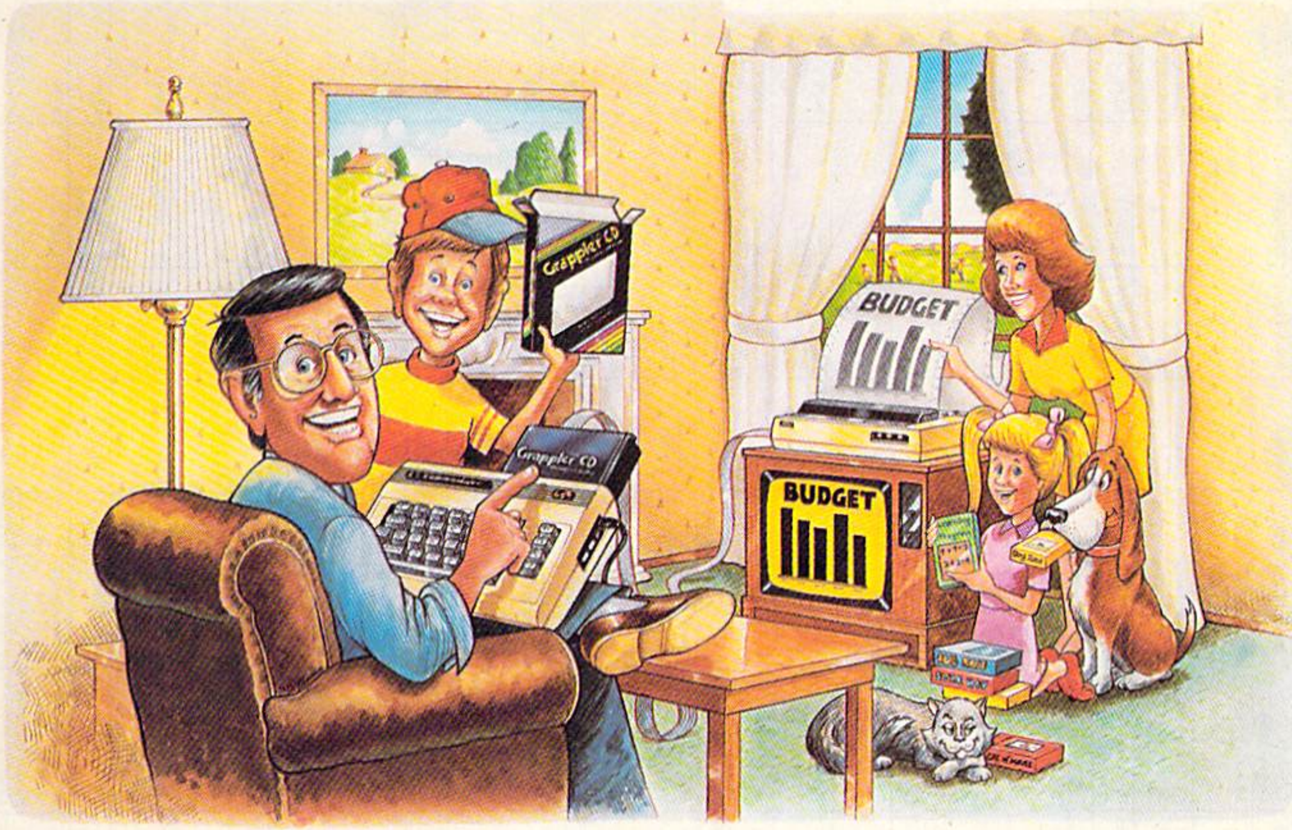

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Mfr/Dist.	Model Name/No.	Compatibility	Print Tech	Speed	Pitch Range	Graphics Capabilities	Special Char Sets	Buffer	Feed Type	Warranty	Suggested Retail Price	Comments
Hewlett-Packard, 3000 Hanover St, Palo Alto, CA 94304	ThinkJet	Parallel std	Inkjet	150 cps	6, 10.7, 12, 21.3 cpi	192 × 192 dpi	International and ISO	1.5K	Friction and pin std	90 days	$495	
Inforunner, Airport Business Center, 431 N Oak St, Inglewood, CA 90302	R64	Parallel and Commodore-ready	Impact (dot-matrix)	120 cps	5, 10, 17 cpi	32 Commodore block graphics	5 international	1 line	Friction and pin std	1 yr	$349	
Inforunner	Riteman C+	Commodore-ready	Impact (dot-matrix)	105 cps	5, 10, 17 cpi	82 Commodore graphics char	International	1 line	Friction and pin std	1 yr	$299	Front loads any paper
Inforunner	Riteman LQ	Parallel std	Impact	12 cps	12 cpi	None	None	None	Friction std	1 yr	$299	Portable (6.5 lb)
Inforunner	Riteman +	Parallel std; serial opt	Impact (dot-matrix)	120 cps	5, 10, 17 cpi	Yes	5 international	1 line	Friction and pin std; tractor opt	1 yr	$299	
Juki Industries of America, Inc, 299 Market St, Saddlebrook, NJ 07662	Juki 6000	Parallel, serial, and Commodore 64 interfaces avail	Impact (daisywheel)	10 cps	10, 12, 15 cpi	None	None	None	Friction std	Limited 90 days	$295	
Mannesmann Tally, 8301 S 180th, Kent, WA 98032	Spirit 80	Parallel std; serial opt ($98)	Impact (dot-matrix)	80 cps	5, 8.25, 10, 16.5 cpi	7 × 8 block graphics in 9 × 8 matrix field	Symbols	2K	Friction and tractor std	90 days	$269	
Memotech Corporation, 99 Cabot St, Needham, MA 02194	DMX80	Parallel std; serial opt ($100)	Impact (dot-matrix)	80 cps Pica, 96 cps Elite	10, 12 cpi	6 × 7 matrix	International	2K std; 4K with serial interface	Friction and tractor std	1 yr	$299	
MicroD, 14706 Mt Cliffwood Circle, Fountain Valley, CA 92708	Abati LQ-20	Parallel std; serial opt	Impact (daisywheel)	18 cps	10, 12, 15 cpi	None	None	1.5K	Friction std; tractor opt	1 yr	$479	Qume-compatible
NEC Home Electronics (USA), Inc, Personal Computer Division, Elk Grove Village, IL 60007	8027	Parallel std	Impact (dot-matrix)	105 cps	6–17 cpi	Downloadable char	Greek	2K	Friction and pin std	90 days	$499	
NEC Home Electronics (USA), Inc	PR103	Parallel std	Impact (dot-matrix)	110 cps (Elite); 92 cps (draft Pica); 46 cps (NLQ Pica)	6–17 cpi	Yes	Greek and math	None	Friction and pin std	90 days	$499	
Okidata, 532 Fellowship Rd, Mt Laurel, NJ 08054	Microline 92	Parallel and serial std	Impact (dot-matrix)	40–160 cps	10–17.1 cpi	Dot-addressable graphics	International	2K	Friction and pin std	1 yr parts/labor	$499	
Okidata	Microline 182	Parallel std; serial opt	Impact (dot-matrix)	60–120 cps	5–17.1 cpi	Dot-addressable graphics	5 international	1 line	Friction and pin std	1 yr parts/labor	$299	Okidata 120 has these same specifications, but is strictly Commodore-compatible
Okidata	Microline 192	Parallel std; serial opt	Impact (dot-matrix)	33–160 cps	5–17.1 cpi	Bit-image graphics	None	8K	Friction and pin std	1 yr parts/labor	$499	
Okidata	Okimate 10	Commodore-ready	Thermal transfer	60 cps (draft); 18 cps (graphics)	5–17 cpi	Commodore graphics char	None	None	Friction and pin std	1 yr parts/labor	$239 (includes interface)	Prints up to 16 Commodore screen colors; can print on any kind of paper
Panasonic, One Panasonic Way, Secaucus, NJ 07094	KX-P1091	Parallel std; serial opt	Impact (dot-matrix)	120 cps	10 cpi	Yes	None	1K std; 4K opt	Friction and tractor std	1 yr parts/labor	$499	
Royal Consumer Business Products, 550 Marshall Phelps Rd, Windsor, CT 06095	LetterMaster	Parallel std	Impact (daisywheel)	12 cps	12 cpi (Elite), 10 cpi (Pica)	None	None	1 line	Friction std	90 days labor; 1 yr parts	$299.95	Bold type and underlining
Sakata USA Corporation, 651 Bonnie Ln, Elk Grove Village, IL 60007	SP-1000	Parallel std	Impact (dot-matrix)	100 cps	10 cpi	Bit-image graphics	None	Yes	Friction and tractor std	1 yr parts/labor	$369	
Sakata USA Corporation	SP-1200	Serial std	Impact (dot-matrix)	120 cps	10 cpi	Single- and double-resolution graphics	International	Yes	Pin and friction std	1 yr parts/labor	$399	
Smith-Corona, New Canaan, CT 06840	Fastext-80	Parallel std; serial opt	Impact (dot-matrix)	80 cps	5–16.7 cpi	Yes	International	1 line	Friction std; tractor opt	1 yr parts; 90 days labor	$259	No true descenders
Star Micronics, 200 Park Ave, New York, NY 10166	Gemini 10-X	Parallel std; serial opt	Impact (dot-matrix)	120 cps	5, 6, 8.5, 10, 12, 17 cpi	Bit-image and block graphics; 96 downloadable char	International	4K or 8K	Tractor std	1 yr	$399	

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Mfr/Dist.	Model Name/No.	Compatibility	Print Tech	Speed	Pitch Range	Graphics Capabilities	Special Char Sets	Buffer	Feed Type	Warranty	Suggested Retail Price	Comments
Star Micronics	Powertype	Parallel and serial std	Impact (daisywheel)	18 cps	10, 12, 15 cpi	None	None	1 line	Friction std; tractor opt	1 yr	$499	
Star Micronics	SD-10	Parallel std	Impact (dot-matrix)	160 cps (draft), 40 cps (NLQ)	5, 6, 8.5, 10, 12 17 cpi	Block and bit-image graphics; downloadable char	International	16K	Friction and tractor std	1 yr	$449	
Star Micronics	SG-10	Parallel std	Impact (dot-matrix)	120 cps (draft), 30 cps (NLQ)	5, 6, 8.5, 10, 12, 17 cpi	Block and bit-image graphics; downloadable char	International	2K, expandable to 6K	Friction and tractor std	1 yr	$299	16K buffer on wide carriage (15 in.) model
Star Micronics	SG-10C	Commodore-ready	Impact (dot-matrix)	120 cps (draft), 30 cps (NLQ)	5, 6, 8.5, 10, 12, 17 cpi	Block and bit-image graphics; downloadable char	International	2K, expandable to 6K	Friction and tractor std	1 yr	$299	
Star Micronics	SG-15	Parallel std	Impact (dot-matrix)	120 cps (draft), 30 cps (NLQ)	8, 10.1, 14.5, 17, 20.4, 29.1 cpi	Block and bit-image graphics; downloadable char	International	16K	Friction and tractor std	1 yr	$499	
Star Micronics	STX-80	Parallel std	Thermal	60 cps	5, 10 cpi	Block and bit-image graphics	International	1 line	Friction std	1 yr	$199	Requires special thermal paper
Westrex OEM Products, A Division of Litton Industries, 51 Penn St, Fall River, MA 02724	Westrex 1	Parallel and serial avail	Impact (dot-matrix)	140 cps	5, 6.25, 8.3, 10, 12.5, 16.7 cpi	Bit-image graphics	International	2K	Friction and tractor std	1 yr	$499	

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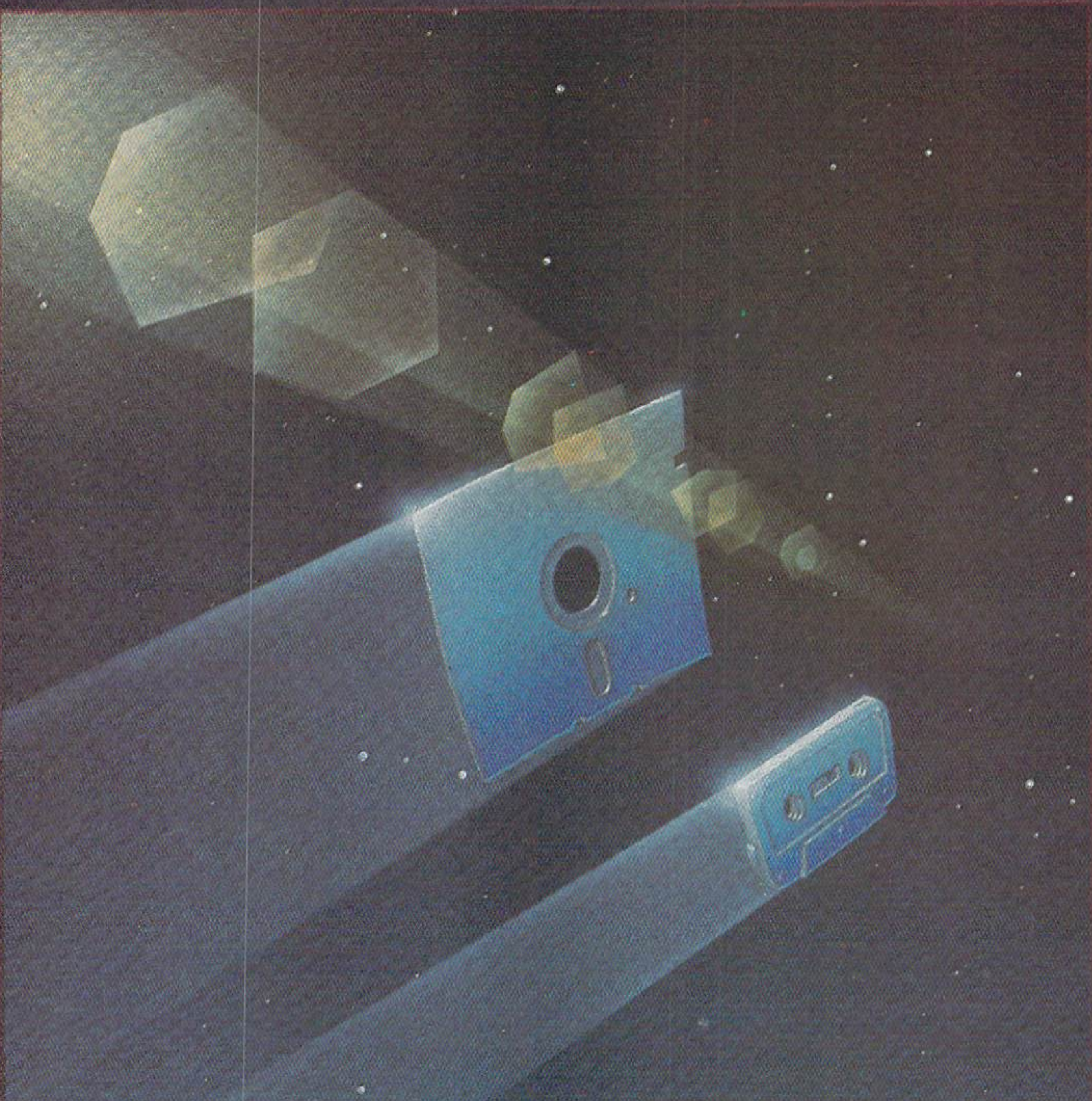

The Turbo Loaders:

High Speed For Tape And Disk

COMPUTE!, our sister magazine, recently published two of the most significant utilities ever offered to owners of the Commodore 64 and VIC-20. These breakthrough programs are so powerful and valuable that we're republishing them here in the GAZETTE for the benefit of those who might not have seen them in COMPUTE!.

Impossible as it seems, "TurboTape" allows cassette recorders to save, load, and verify with the speed of a 1541 disk drive. And "TurboDisk" speeds up the 1541's loading time 300 percent or more—in fact, the longer the program, the more the gain.

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KAMPFGRUPPE™, a grand-tactical advanced game, re-enacts armored warfare of the Eastern Front (1941-45). Hit probabilities and ratings are provided for practically every tank, tank destroyer, assault gun, anti-tank gun, & self-propelled artillery. Other highlights include HQ command control and a simple line-of-sight feature. APPLE[1] ATARI[2] C-64[3] $59.95.
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[1] On 48K diskette for the Apple II with Applesoft ROM, Apple II+, IIe, and IIc.
[2] On 48K diskette for Atari Home Computers.
[3] On 64K diskette for the Commodore 64.
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TurboTape

Harrie De Ceukelaire

There are very few absolute rules in computing, but one of them has always been that tape drives are inherently slower than disk drives. Long programs that take only seconds to load into the computer with a disk drive have always required many minutes of waiting with a tape drive. Until now.

"TurboTape" rewrites the rules. It's a utility program that turbocharges tape saving, loading, and verifying on your Commodore 64 or VIC-20. It requires no modifications to your computer or tape drive. It works with BASIC programs and machine language programs. It's easy enough for anyone to use, including beginners. It even lets you load Turbo-saved tapes at TurboTape speeds without using the utility.

Typing TurboTape

TurboTape is written entirely in machine language. The BASIC programs presented here are generator programs which create a copy of TurboTape on either disk or tape. Be sure to type in the correct program for your computer (Program 1 for the 64 or Program 2 for the VIC). We recommend that you enter the program with "The Automatic Proofreader" (published frequently in the GAZETTE) and save the TurboTape generator before running it for the first time, since the program resets important memory pointers as it runs. That way, if a typing error causes your computer to lock up, you can reset the computer by turning it off then on again, load it, and start checking for the typo.

Since the TurboTape data goes into the area of memory where BASIC programs normally reside, you'll need to reconfigure memory before loading and running the TurboTape generator programs. For the 64, type:

```
POKE 44,14:POKE 14*256,0:NEW
```

Then press RETURN and load Program 1. Use these POKEs only when you're first running the generator program. Once the generator has created a copy of TurboTape, you don't need them.

To use the VIC version, you'll need at least 8K of memory expansion (TurboTape works on expanded and unexpanded VICs, but the Generator program needs the extra memory). Before loading the program, enter the following lines in direct mode (no line number), pressing RETURN after each line:

```
POKE 44,32:POKE 32*256,0:NEW
POKE 648,30:SYS 58648
```

Again, these POKEs are needed only when you first use the Generator program to make a copy of TurboTape. Before running it, check line 10. In both VIC and 64 versions, the contents of FI$ determine the name of the copy of TurboTape that will be created. Change this if you prefer a different name. Also, if you want to create your copy of TurboTape on disk instead of tape, change the D=1 in that line to D=8. Be sure that the tape or disk on which you wish TurboTape to be stored is in the drive before you run the generator program.

Once you've used the generator program to create a copy of TurboTape on tape or disk, you don't need the generator program again. The version of TurboTape you create (called TURBO/64 or TURBO/VIC, unless you change the names in line 10 of the generator programs) can be loaded and run like a BASIC program. It's not necessary to use the ,1 suffix (as in LOAD *"filename"*,8,1 or ,1,1) when loading TurboTape. Once created, VIC TurboTape can be loaded and run on a VIC with any memory configuration.

Easy To Use

Here are the main features of TurboTape:

- It stores itself safely out of the way of your normal BASIC programs.
- It protects any memory configurations you might be using. Only during the Turbosaving and Turboverifying is the Commodore 64's BASIC ROM exchanged for BASIC RAM. Following these operations, your previous configuration is restored.
- TurboTape can be used with other programming aids such as *Simons' BASIC*, *Supermon*, and *PAL*.
- TurboTape safely handles very large programs (up to 49K on the Commodore 64). However, some programs which barely fit into memory before may not fit when using TurboTape (it subtracts 639 bytes of available RAM from the VIC and 642 bytes from the 64).
- Filenames can be the usual 16 characters long.
- In addition to handling BASIC programs, TurboTape will save, load, or verify data from any part of RAM memory

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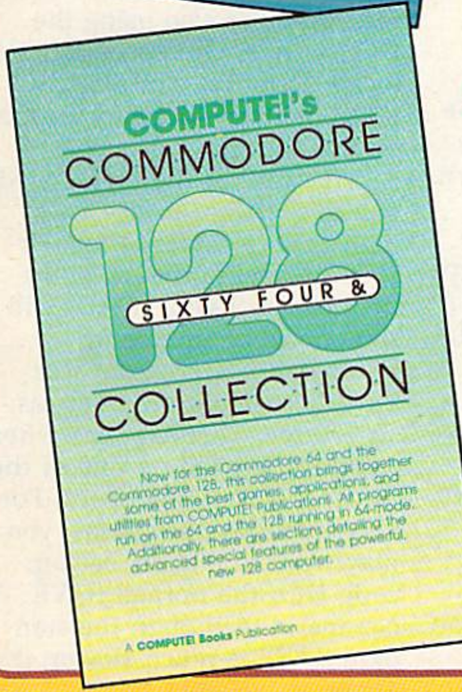

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you wish, except for the RAM hidden beneath the Kernal ROM on the 64. The contents of RAM beneath the 64's BASIC ROM can even be saved.

• A normal LOAD command will load any Turbosaved program *at TurboTape speed.*

It's quite simple to use TurboTape. Reset your computer by turning it off, then on. If you want to use some additional utility like "MetaBASIC", load and run it first. Then type NEW.

Now load TurboTape and run it. In the 64 version, a menu will appear, offering you two optional memory locations for TurboTape:

1. In BASIC RAM. The ending address of the relocated TurboTape will be what's currently indicated as the limit of memory in the pointer in addresses 55 and 56. You may have to select this option if you want some utilities to coexist with TurboTape. *Simons' BASIC,* for example, is one. Any utility which makes use of the RAM between addresses 52606 and 53247 (for example, the "64 DOS Wedge") will require this option. (This is the only option possible on the VIC. The VIC version will always relocate to the top of memory.)

2. In the 4K RAM buffer starting at 49152. Using this option, you can Turbosave all RAM from 0 to 52606 in one huge block.

To get accustomed to using TurboTape, however, let's avoid combining it with other utilities for now. Simply turn on the computer, load TurboTape, and type RUN (don't attempt to edit the BASIC portion of TurboTape). For the 64, select option 2.

You'll now see on screen where TurboTape has been located and the commands you use to activate TurboTape's features. Then type NEW to remove the TurboTape loader from memory. Write a program or load one into the computer. To Turbosave this program, type:

TURBOSAVE ***"filename"*** [press RETURN]

(Or you can abbreviate TURBOSAVE as TSAVE.) You'll then see the usual message:

PRESS RECORD & PLAY

Press those keys, then sit back and be amazed.

A header containing a special Turboload routine is written to tape. (On the 64, the screen will blank while the header is written.) Then rainbow-like colors will vibrate on screen as your program is flashed onto the tape. Finally, your screen will return to normal.

If you want to verify the TSAVEd program, rewind the tape and type:

TURBOVERIFY ***"filename"*** [press RETURN]

(TURBOVERIFY can be abbreviated TVERIFY.) You'll see the normal message:

PRESS PLAY

Press the PLAY key on the cassette drive. (On the 64, the screen will blank while the verification takes place.) If you should get an OUT OF MEMORY error message, simply type TVERIFY without a filename. As soon as the tape has passed the header, you get the FOUND message on screen. (For the 64, press the Commodore logo key.) If an error is found during TVERIFY, the screen will return to normal and you'll see the VERIFY ERROR message. If you're interested in knowing precisely where a mismatch was found, type:

?PEEK(172)+256*PEEK(173)

If there was no problem during the TVERIFY, you'll see the message VERIFY OK.

Lightning LOADs

You won't need the TurboTape utility to load programs which have been Turbosaved. Just type LOAD normally and everything will happen as it always does, except the program will zoom into your computer.

Here are a few additional notes about TurboTape. To save machine language programs, you'll need to specify the starting and ending addresses. For example, if your machine language program resides in memory from 864 to 890, save it in the following fashion:

TSAVE"MACHINE PROGRAM" ,864,891

Notice that you must use the ending address *plus one*. To save the entire contents of RAM on a 64, including the RAM hidden behind BASIC ROM, type:

TSAVE"ALL RAM",2049,52606

Most other programming utilities work well with TurboTape. If you use *Simons' BASIC,* however, you should not use RUN/STOP–RESTORE, and the COLD command has no effect. If you're also using the DOS wedge, choose option 1 to locate TurboTape into BASIC RAM memory to avoid conflicts on the 64.

Because of the high speeds, you might want to use only high-quality cassettes for reliable storage. TurboTape, like the normal SAVE/LOAD, will sometimes be unable to Turboload if a program was TSAVEd using a different cassette drive. This happens when a recording head on one of the drives is out of alignment. For very important programs, you may want to make a backup copy with the normal SAVE command. Although the standard SAVE is much slower, it's extremely reliable.

Another reason for making backup copies with the normal SAVE is that 64s cannot read tapes created by VIC TurboTape, and vice versa. This is a result of differences in the Turboload machine language routine.

You should use LOAD and the TurboTape commands only in direct mode, not from within a running program. Also, TurboTape cannot search through several files on a cassette in search of a certain filename. If you have several Turbosaved programs on a tape, you should fast-forward past any Turbosaved programs you don't wish to load. Use the cassette drive's counter for this purpose.

No Turbosaved program will relocate itself upon loading. The address in RAM memory from which you Turbosaved will be the address where the program will later load. In effect, all Turbosaved programs act as if you're using the nonrelocating command: LOAD "*filename*",1,1. This is especially important if you're a VIC owner who uses several different memory configurations. For example, a BASIC program Turbosaved on an expanded VIC will not load normally into an unexpanded VIC.

How Fast Is It?

Tests revealed that a 12K program took 34 seconds to load with a 1541 disk drive and 44 seconds to load with TurboTape. However, the TurboTape load time was actually only 28 seconds once the program header was located on the tape. We timed TurboTape with a completely rewound cassette, presuming that most people do not position the tape so that a program header is right in front of the tape head. If you do position your tapes exactly with the tape counter, TurboTape will indeed load programs faster than a 1541 disk drive.

Turbosaving the 12K program took 42 seconds; the 1541 disk drive took 40 seconds. Turboverify and disk verify took the same amount of time as loading a program.

(See listings on page 102.)

TurboDisk

Don Lewis

If you've ever used a really fast disk drive, you know that the Commodore 1541 drive leaves something to be desired—namely, speed. True, it's much faster than a Datassette—at least, a Datassette without "TurboTape"—but it's still annoyingly slow compared to other floppy disk drives with high-speed parallel interfaces. Now there's a solution: "TurboDisk."

Once you start using TurboDisk, you'll wonder how you got along without it. TurboDisk turbocharges the loading process by a factor of three times or more. In fact, the longer the program, the more improvement you'll see.

TurboDisk requires no modifications to your disk drive or computer. It loads programs saved in the usual manner; no special Turbosave is required. It works with most BASIC and machine language programs, including the DOS Wedge. It does not compromise reliability. And you can switch it on or off at any time by typing a single command.

If you're still skeptical, give TurboDisk a trial—it delivers what it promises.

Preparing TurboDisk

For the Commodore 64, you'll need to type in two programs to prepare TurboDisk: a BASIC program that creates a machine language file on disk (the actual TurboDisk utility); and a short two-line BASIC loader that calls up and activates TurboDisk. For the VIC, a single BASIC program is used to read the TurboDisk machine language from DATA statements and relocate it to the top of available memory.

Program 1 is the BASIC program that creates the 64 version of TurboDisk. Notice all the numbers in DATA statements; these represent the machine language portion of the utility. Be extra careful when typing these lines. We recommend using the "Automatic Proofreader" (published frequently in the GAZETTE) to prevent typing errors.

Save Program 1 on disk before running it for the first time. That way, if an error causes your computer to lock up, you can switch it off to clear the memory, reload the program, and search for the typing mistake. Otherwise you could lose all of your typing effort.

When Program 1 runs, it prints the message INSERT DISK AND HIT RETURN WHEN READY. Insert a formatted program disk and press RETURN. Program 1 creates a file on the disk with the name TURBODISK.OBJ and then prints the message TURBODISK.OBJ CREATED. You'll probably want copies of TurboDisk on all of your program disks, so rerun the program as many times as necessary.

Program 1 will print an error message if it detects a disk error or a typing mistake in the DATA statements. In addition, the partially written TURBODISK.OBJ file will be scratched from the disk if an error is detected in the DATA.

Finally, if you're using a Commodore 64, you must type

in Program 2 and save it on all your program disks with the filename TURBODISK. To load and run TurboDisk, all you have to do is enter **LOAD TURBODISK,8** and **RUN**. The short loader will call TURBODISK.OBJ off the disk, place it safely in high memory, and activate it automatically.

VIC TurboDisk

Program 3, for the VIC-20, reads the TurboDisk machine language from DATA statements and POKEs it into the top of available memory, adjusting addresses within the machine language as necessary. This is slower than the scheme used for the 64, but necessary because TurboDisk's position in the VIC depends on the amount of memory installed and whether any other utilities—such as the DOS Wedge—are already in memory. Memory expansion is required to use VIC TurboDisk, but any amount—even 3K—is sufficient. However, TurboDisk will reduce the amount of free memory by about 1300 bytes.

As always when entering DATA statements containing machine language, check carefully for typing mistakes, since a single wrong number can cause the program to crash. The Automatic Proofreader should help you avoid errors. Program 3 also includes internal checks on the DATA statements, and will report an error if the sum of all the DATA items doesn't match its predetermined total.

To install TurboDisk, simply load and run Program 3. If all DATA is correct, the program will tell you the SYS values that will turn TurboDisk on and off (these numbers vary according to the amount of memory expansion). Be sure to make a note of the numbers for later reference. Program 3 will also automatically activate TurboDisk, so you don't need the SYS to start it the first time.

Turbocharged LOADs

Once TurboDisk is activated, no special commands are necessary. Just type **LOAD "*filename*",8** or **LOAD"*filename*",8,1** as usual. You'll be amazed at the difference.

One thing you'll notice immediately is that the red light on the disk drive doesn't come on at all during a Turboload. Don't panic; this is normal. It's also normal for the 64's screen to blank out as TurboDisk works. When the program is loaded, the screen reappears unaltered. The VIC's screen doesn't blank; instead, you'll see the message TURBOLOADING to let you know that the high-speed loading is in progress.

You may occasionally find it necessary to deactivate TurboDisk and use a normal LOAD instead. For example, 1541 disk drives are prone to head alignment problems, so if you have a disk formatted on a drive other than your own, you may find that your drive has difficulty loading programs from it. Since the Turboload routine gives up more easily on difficult LOADs, you may have to switch to the more forgiving standard LOAD to get the program into your computer. You can switch off 64 TurboDisk at any time without erasing it from memory by entering **SYS 49155**. To reactivate 64 TurboDisk, enter **SYS 49152**. For the VIC, use the SYS values reported by the loader program.

You'll also find it necessary to use the SYS to reactivate TurboDisk after pressing RUN/STOP–RESTORE, which effectively disconnects TurboDisk.

The versions of TurboDisk presented here have one major improvement and several minor enhancements over the original versions from COMPUTE!. In the originals, the disk drive had to be the only active device on the serial bus; all other peripherals on the bus had to be turned off for the program to function properly. This meant, for example, that it was necessary to turn off your printer before Turboloading a program. These new versions eliminate that restriction: you can Turboload programs from the drive regardless of whether the printer or other serial bus peripherals are active.

On the Commodore 64, TurboDisk resides in the 4K block of free memory starting at address 49152 (hex $C000), so it's completely safe from BASIC. However, many machine language programs or subroutines also use this memory space and may overwrite TurboDisk. Don't attempt to use TurboDisk to load any program which occupies locations 49152–50431 ($C000–$C4FF).

Since VIC TurboDisk resides at the top of memory, care must be taken to avoid loading a program that is long enough to overwrite the Turbodisk machine language. After running Program 3, type **PRINT INT(FRE (0)/256)**. The value you get is roughly the maximum length in disk blocks for a program to load without disturbing TurboDisk. For example, on a VIC with 8K expansion and both TurboDisk and the VIC-20 Wedge installed, the PRINT above should yield a 38. Thus, for that memory configuration, you should not attempt to Turboload a program that the disk directory shows to be more than 38 blocks long.

TurboDisk speeds up LOADs—even LOADs from within programs, as are common in multipart VIC programs—but it can't speed up SAVEs or VERIFYs. It also doesn't affect the speed of disk file handling with OPEN, PRINT#, GET#, etc. It's not compatible with certain features of some programs, such as saving text files with *SpeedScript*, although you can use TurboDisk

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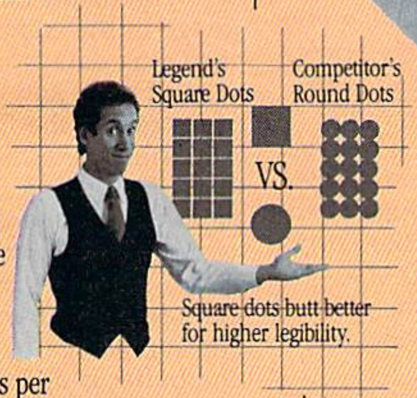

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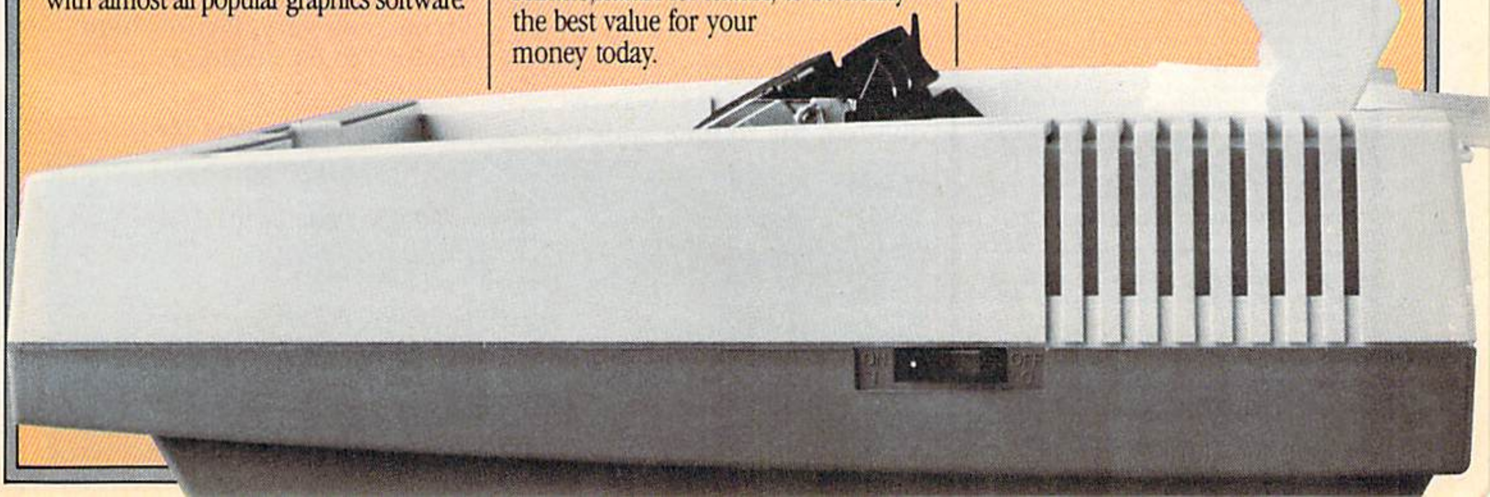

to load *SpeedScript* in the first place. It also may not work with some commercial software.

How TurboDisk Works

The machine language for TurboDisk is unusual in that only half of it works within your computer—the rest is actually executed within the 1541 drive itself. Commodore disk drives are *intelligent* units, containing their own microprocessors, RAM, and ROM. This means that they can be programmed for special effects, like Turboloading.

During the brief delay you notice between the time you enter the LOAD command with TurboDisk and the time the drive starts spinning, 444 bytes of machine language are transferred from the computer to the drive's RAM. This is the portion in the second set of DATA statements in Programs 1 and 3. In the 64, it is stored in locations 49664–50107 ($C200–$C3BB). This required transfer of data before each Turboload adds a certain amount of overhead time, which explains why TurboDisk gives less speed improvement for short programs.

TurboDisk operates by changing the ILOAD vector at locations 816–817 ($330–$331) to point to itself, bypassing the normal LOAD routines in ROM. TurboDisk first checks to see whether a disk directory (LOAD "$",8) or a VERIFY was requested. In either of these cases, control is returned to the ROM routines for normal processing. If a program LOAD was requested, the routine adds the filename to the code for the disk drive portion, then transfers that data to the drive's memory.

The portion of TurboDisk in the disk drive uses routines in the drive's ROM to locate the desired program and read it from the disk sector by sector. To improve speed, routines like the one that turns on the red light are omitted, and only the essential ones are used. The 256 bytes of data from each disk sector are transferred two bits at time to a 256-byte buffer within the computer. In the 64, this buffer is at locations 50176–50431 ($C400–$C4FF).

TurboDisk machine language in the computer reads the incoming data from the serial port's DATA and CLK lines, instead of just the DATA line as in normal serial data transfers. Thus, TurboDisk temporarily converts your serial drive into a two-bit parallel drive. When the entire 256 bytes from a disk sector have been transferred into the computer's buffer, data from the buffer is added to the program in memory while the drive is reading the next sector from the disk.

Just How Fast Is It?

Despite a few limitations, TurboDisk is one of the most valuable general-purpose utilities a disk user can own. To discover exactly how fast it is, we ran some tests. The results, below, demonstrate how TurboDisk yields the most improvement with medium to long programs. (Results with different disk drives may vary. Figures here are for the 64 version.)

(See listings on page 106.)

Program	Blocks	Normal LOAD	Turboload	Factor
Program 1	31	21 sec	7 sec	3.0
Program 2	17	13 sec	5 sec	2.6
Program 3	45	31 sec	9 sec	3.4
Program 4	8	7 sec	5 sec	1.4
Program 5	25	18 sec	6 sec	3.0
Program 6	122	75 sec	17 sec	4.4

Sleuth

Paul D. Farquhar

This intriguing game for the 64 and unexpanded VIC challenges your problem-solving abilities. A crime has been committed, and you must question suspects to discover who's responsible. What makes things difficult is that one of the suspects has problems telling the truth. And what gives the game added appeal is that it's different every time you play.

When you were invited to a small dinner party at Lord Crumbly's secluded mansion, you never thought you'd be accused of murder. In addition to yourself, there were three other guests and two servants. You knew his lordship was not a well-liked man, but you were certainly not expecting murder!

Late that evening, while you were alone in the library, a shot broke the silence. You rushed to the room of Lord Crumbly and discovered his lifeless body. A moment later, the others arrived to see you bending over the dead man. The police were summoned, but have not yet arrived. As the prime suspect, you must quickly discover the murderer or risk being accused of the crime.

The murder can be solved by questioning the suspects and keeping track of who said what about whom. But, to complicate matters, you know that one of them is a compulsive liar.

Sifting Through The Evidence

Three questions must be answered affirmatively before you make an accusation. First, did the suspect have a motive—a reason to dislike Lord Crumbly? Second, did the suspect have access to a gun? Third, where was he or she when the shot was fired—with someone else, near Crumbly's room, or somewhere unknown?

Your task is to narrow down the list of suspects until you find someone who had a motive, a weapon, and an opportunity. Obviously, if Professor Bard had no gun, he must be innocent. You may find more than one person who had motive or opportunity, but only one will fit all three categories.

Four of the five will always tell the truth, while one will always fib. The liar is not necessarily the murderer, although it is possible. How do you distinguish between the true and false statements?

At first, you don't know who's trustworthy, so don't believe anyone. Just write down what they say. It may help to use four sheets of paper. (If you're playing the 64 version, a four-page notebook is included in the program—see below for details.) Write *Motive* at the top of one sheet, *Weapon* on the second, and *Opportunity* on the third. On the fourth, draw a graph with *Motive, Weapon,* and *Opportunity* across the top and the names of the five suspects down the side: *Maid Whiggins, Sir Chauncy, Madam Larue, Butler Snipe,* and *Professor Bard.*

When someone says something, write it down on one of the first three sheets. For example, if Snipe says Larue was being blackmailed by Lord Crumbly, write it under Motive. If Bard says Chauncy was with someone when the shots were fired, write it under Opportunity (Bard says Chauncy had no opportunity). At the beginning, you don't know who's telling the truth, so keep track of who made the statement but don't fill in the graph yet.

There are two ways of finding who is lying or telling the truth.

Paring Down The List Of Suspects

If Snipe tells you that Whiggins did not have a gun, and Larue says the same thing, you can

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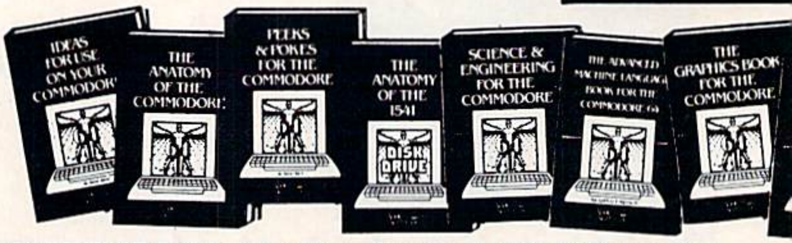

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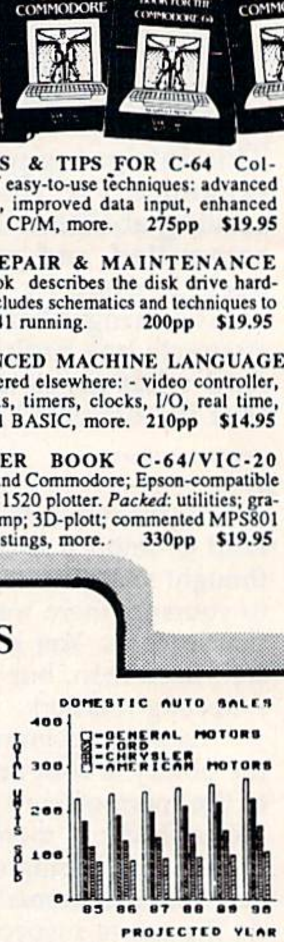

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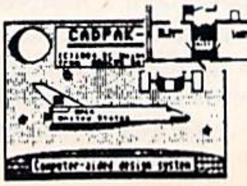

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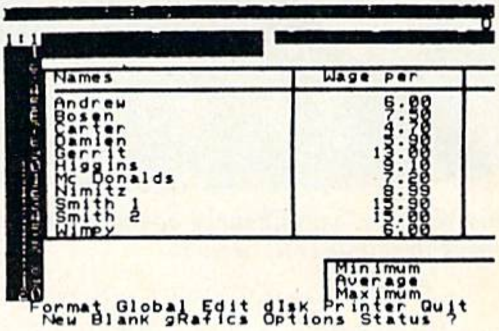

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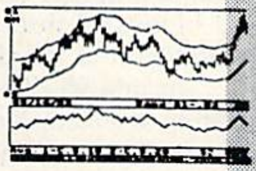

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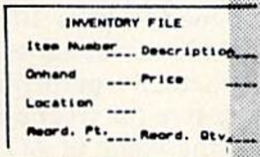

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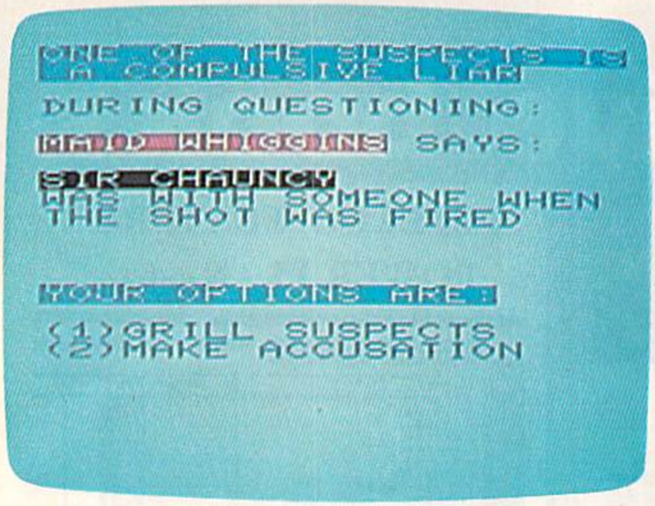
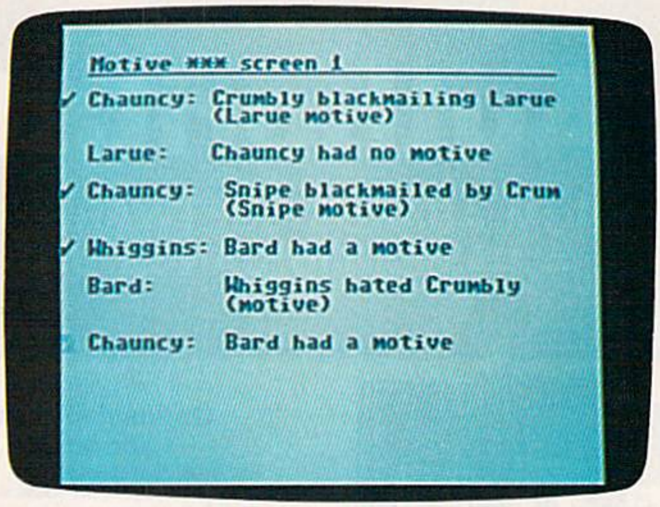


Maid Whiggins says Chauncy had no opportunity to commit the crime (VIC version).



Your notes on page one indicate that Whiggins and Chauncy agree, so they must be telling the truth (64 version).

conclude that both Snipe and Larue are truth tellers. Since there's only one liar, if Snipe or Larue was a liar, the other would have to be telling the truth, and they would say opposite things. But they said the same thing, so they must both be telling the truth. Once you know they're OK, you know everything they have said (and everything they may say in the future) will be correct. Now you can fill in part of the grid. In this case, you could write NO in the Whiggins/Weapon part of the graph.

By similar logic, if two suspects say contradictory things, you know one of them is lying. Bard says Snipe hated Lord Crumbly (a motive), but Chauncy says Snipe had no motive. Either Chauncy or Bard is not telling the truth, and since there's only one liar, Whiggins, Larue, and Snipe must all be truth tellers. Now you can fill in the graph with statements made by those three.

As you enter data into the graph, look for someone who had motive, weapon, and opportunity. As soon as you find a suspect with all three, you can solve the case. Another way to nail the murderer is to find four people who have at least one "no" across from their name. If Whiggins had no gun, Snipe no motive, Chauncy no motive, and Bard no opportunity, then that leaves a single possibility: Larue.

After uncovering the answer to the mystery, you'll see how many clues you were given (you can usually finish with about ten clues). You'll then be asked if you want to play again.

Typing In The Program

The VIC version of "Sleuth" can be typed in, saved to tape or disk, and then run. It will work on an unexpanded or expanded VIC.

The 64 version is nearly the same as the VIC version. If you own a 64, type in the Program 1 and then add the lines in Program 2. Some are replacement lines, others are additions. The 64 version's special notebook feature is discussed in "Notes On 64 Sleuth."

Basic Program Operation

This program should fascinate fans of logic puzzles as well as devotees of murder mysteries. It is written for the unexpanded VIC, although it will also work with expansion, and offers an endless series of computer generated brain teasers.

Immediately after dimensioning the "truth" matrix (a table) and defining some strings, the program enters an introductory subroutine beginning in line 415. This subroutine involves some simple graphics and sound.

Lines 40 through 75 provide a brief introduction to the dilemma.

In line 95, the liar and the murderer are randomly selected. Note that they may or may not be the same individual.

The elements of the truth matrix are assigned in lines 100 through 150. Each element is randomly assigned a value of 0 or 1, indicating whether a particular suspect did or did not have motive (or weapon or opportunity). For example, if the value of A(1,1) equals one, then Sir Chauncy had a motive to commit the murder.

The main body of the program consists of lines 155 through 315. Here witnesses are randomly chosen to offer random testimony based on the truth matrix. After each clue, one has the option of making an accusation or receiving another clue.

After an accusation is made, the results of the investigation are determined and printed. Finally, the option of another case is offered. All this involves lines 330 through 405.

Notes On 64 Sleuth

Kevin Mykytyn, Editorial Programmer

Since the VIC version of Sleuth is written in straightforward BASIC, very few changes (about 6 lines) were needed to make it compatible with the 64. First type in the VIC version (Program 1). Then, with the program still in memory, enter Program 2. Some lines of the VIC version will be replaced.

The game plays the same as the VIC version with one additional feature. The 64 version provides a four-page notepad to keep track of the clues.

When the choice to grill suspects or make an accusation appears, you can look at your notebook by pressing one of the function keys. The f1 key is the first page, f3 is the second, f5 is page 3, and f7 page 4. You may find it convenient to split up motive, weapon, and opportunity between three pages and use the fourth for your conclusions. After selecting a page, type in the message you want. "Larue says Bard just bought a gun," for example. You can also flip between the pages of the notebook by pressing the other function keys. To get back to the game, press the back arrow (the upper-left character on the keyboard).

Page Flipping

The electronic notebook is created using page flipping, which means relocating the screen display to a different section of memory. This technique is often used for animation on the Apple and Atari. While one screen is displayed, the computer draws the next picture on an alternate (invisible) screen. Then, a few POKEs cause the screen to change to the next frame. You don't need to know how it works to play Sleuth, but if you'd like to use page flipping in your own programs, here's a brief explanation.

Location 53272 controls several things, including the video matrix base address (where the screen starts, in plain English). The upper four bits of this location point to the start of the screen. Normally the bit pattern is 0001, meaning that the screen starts at 1*1024. If we want to change the location of the screen, we must be careful not to disturb the remainder of this byte. This can be done using the following statement:

POKE 53272,PEEK(53272)AND15 OR S*16

The variable S holds the number of the 1K block where the screen starts. It must be a number from 0 to 15 because the video chip can access information such as screen memory, sprite definitions, and character definitions from only one of four 16K blocks. So to change the start of screen memory to 12288 (12*1024), type **POKE 53272,PEEK(53272) AND15 OR 12*16**.

But POKEing to 53272 is not enough. There are a couple of problems to overcome. Even though the computer is now displaying screen memory from a new location, the BASIC editor is still printing to the old screen.

Location 648 tells the operating system where to find the screen if it needs to print something. It contains the start of screen memory divided by 256. Since the screen normally starts at 1024 this location is normally 4 (4*256 is 1024). To change the start of screen memory to 12288 enter **POKE 648,48**.

Even after telling the computer where to start its screen display memory and telling the editor where to print, there is still a problem. Locations 217 to 242 hold a screen line link table necessary for proper formatting of anything printed to the screen. If you type more than 40 characters on a line, the computer uses the line links to find out where to start the next line. After flipping pages, this table will still be set to work with the old screen. The line link table must be rebuilt to work with the new screen. BASIC has a routine that will do all this for us; the clear screen routine. Once the screen is cleared, all the line links are set for the new screen. But in Sleuth, it's necessary that the screen not clear when the pages are flipped. The machine language routine at the start of the program does the relinking without clearing the screen and sets the color RAM to blue.

It's possible to flip screen memory pages, but there is only one location for color memory (starting at 55296). This makes it necessary to set the color memory when a page is flipped. Otherwise, the characters could be on the new screen, but might be the same color as the screen and would not be visible. A second method is to save the color RAM in another portion of memory and move it back when the page is displayed.

Finally, the new screens that you create should be protected from BASIC by POKEing location 56 and doing a CLR. Also, when you're typing on an alternate screen and press RUN/STOP–RESTORE, location 53272 is reset but location 648 is not. Display memory is now at 1024, but your typing is still being printed on the other screen. This can be fixed by typing **POKE 648,4** and pressing RETURN (even though you can't see what's being typed).

If you don't want to write your own page flipping routine, you can use the one in the 64 version of Sleuth. Include lines 1–9,36,320,and 485–540 in your program (you can renumber them, of course). Line 1 protects the new screens from BASIC and reads the machine language routine, from lines 2 to 9, into memory. This should be done at the start of the program.

Line 36 calls line 540, which clears all the alternate screens. Then the position array is set to 0. This array, labeled C, keeps track of which row the cursor is on when a page is flipped and returns the cursor to that row when the page is restored. This routine should also go at the beginning of the program. Line 320 checks for the press of the function keys. It should be included as part of your key input routine. Lines 485–535 are the main page flipping routine and can be placed anywhere in the program.

Some Ideas For Modifications

Sleuth fits an unexpanded VIC, but occupies almost all the memory. The program will work with memory expansion, though. If you don't have an expander and find yourself running out of memory, you can eliminate the introductory graphics by modifying lines 415 and on.

If you have additional memory and the inclination to tinker with the program, you could make some additions and modifications. Different scenarios would not affect the difficulty of the puzzle, but some modifications could. A simple way to increase the difficulty would be to add more suspects, but this would lessen the impact of the liar. A countermeasure, which would drastically increase the challenge of the puzzle, would be to add more liars. If two suspects said the same thing, you wouldn't know if they're both truth tellers or both liars.

If you'd rather not type this program listing (VIC version only), send $3 and a stamped, self-addressed mailer with a blank tape to:

Paul Farquhar
Rt. 1, Box 414
Ponder, TX 76259

(See listings on page 97.)

Space Gallery

Jeff A. Lapkoff

Swirling frisboids, pellets, and heat seekers are headed your way. Can you fend them off with your cannon? A colorful arcade-style game written entirely in machine language for the Commodore 64. Joystick required.

The year is 2023, and you're a solo space gunner on an earth-orbiting colony. You must try to defend against hostile forces, and as the colony's sharpshooter, you must remain stationed at the video control center. For days, the radar has shown an approaching force, and based on the direction and speed at which they're coming, you know what to expect: the dreaded frisboids, curious but deadly creatures. They come in waves of four, but you have only one cannon. And they shower you with lethal pellets, which can destroy your cannon.

The object of "Space Gallery" is to shoot as many frisboids as you can while dodging the falling pellets. To fire at a frisboid, press the fire button on your joystick (plugged into port 2). For each one you hit, you earn five points. Your cannon has unlimited ammo; however, the fewer shots you take, the higher your shot bonus at the end of each level of play.

To dodge the pellets, move your cannon left or right with the joystick. If your cannon is hit by a pellet, it will explode. The game ends when you've used up five cannons.

A Bonus And An Option

Shooting down five waves of frisboids advances you to a higher level and, if you didn't use too many shots, rewards you with a shot bonus. Once you get to level five, you receive an extra cannon.

Space Gallery also features a heat seeker option, but beware—it makes the game much more difficult. The heat seeker is a normal-looking frisboid that drops blue pellets, which home in on your cannon. At the beginning of the game, you can activate the heat seeker by toggling on the gray square at the bottom of the screen.

Typing It In

You must use MLX, the machine language entry program which appears regularly in the GAZETTE, to enter Space Gallery. If you don't have a copy, type it in and save a copy to tape or disk. Before running MLX, you must enter this line in immediate mode (without a line number):

POKE642,20:SYS58260

This relocates the start of BASIC from 2049 to 5121, so the program will not interfere with MLX. Next, load MLX and run it. Answer the initial prompts:

Starting Address: 2049
Ending Address: 4724

When you've finished, save to tape or disk. Before running it, turn your computer off and on, and then reload Space Gallery. The enabling SYS is built into the program; type RUN to begin playing.

(See listing on page 98.)

The frisboids travel in groups of four, showering you with deadly pellets in "Space Gallery."

REVIEWS

Weather Tamers

Many people watch the weather forecast on television each evening. *Weather Tamers,* although a game, can help you learn exactly what all those highs and lows mean. It also prognosticates: You can press a key and see what the weather map today will turn into the next day and the next. You can choose a date and see a typical weather map, then see a simulation of the weather patterns. The information is from actual weather sources.

The idea of *Weather Tamers,* though, is that *you* must control the weather. You have clients that require certain weather conditions, such as "The rocket launchers demand clouds at Cape Canaveral." After checking the current conditions (using satellite reports) you can actually move the highs and lows or change the temperature, humidity, and pressure to get the desired weather. You have to remember, however, that the weather also depends on the prevailing winds.

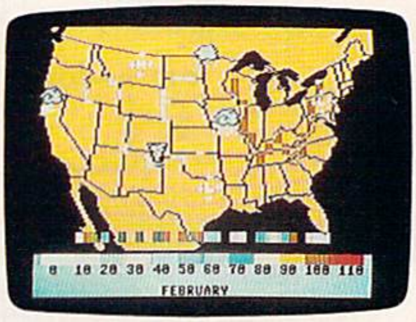
Part of the game is making predictions. After all the changes have been made, the current weather map is shown. You then make a weather prediction for the next day. Your score depends on your prediction and the result. For example, if you had predicted a 25 percent chance for snow and the weather was snowy, your score would be 25 percent of the "credits."

This game is designed for ages ten and up and can be played by one to four people (or in teams for larger groups or families). There are three game levels, Introductory, Standard, and Advanced. In the latter two categories, you have to pay credits to make changes, but in the Introductory level you can change anything without penalty. The Advanced level adds more difficult weather conditions like fog, sleet, and thunderstorms, and even tornadoes and hurricanes.

You choose the length of the game—8, 16, or 30 days. Each round is two days—you tame the weather, predict, then see the next day's results. Clients hire the weather tamers and pay the credits for good results. You may choose one, two, or three clients per round. Finally, you may choose a starting month or date.

In all options you use a joystick, and the instructions on the screen are easy to follow. High-resolution graphics produce the weather map—the United States is outlined with colors indicating temperatures and various symbols for highs, lows, clouds, rain, and snow. You may even see a tornado. Although this educational program is designed to teach about weather, it's also a good geography review.

The *Weather Tamers* manual is clear and helpful. There are



several screen photographs of weather maps with explanations of various symbols. The game is explained very well, step by step. The manual shows the game screens and describes exactly what you need to do to respond. Every section of the game and every procedure is described.

The manual also includes two pages of "Weather Tamers Principles," which describe the nature of weather and how weather patterns work. There is also a glossary of weather terms.

Developed by the Children's Television Workshop for CBS Software, *Weather Tamers* has sound educational value and would be useful in a classroom setting. You can see patterns throughout the United States at any time of the year—and see a daily change because of those conditions. Or you can set up conditions and see what the resulting weather is.

C. Regena

CBS Software
One Fawcett Place
Greenwich, CT 06836
$19.95 (disk)

The MPS-802 And MPS-803 Printers

These two "new" printers from Commodore are not so new after all. The MPS-802 is essentially a revised 1526; it looks almost exactly like its predecessor. The MPS-803, a small printer in a charcoal gray case (the same color and styling as the Plus/4 and 16), does not resemble the MPS-801 or 1525, but it operates almost identically. The advantage of this compatibility is plain: Software written for the 1525 and MPS-801 will run on the 803, and software for the 1526 will work on the 802. While listing a program or printing text from a word processor should work on any of these Commodore printers, hi-res graphics programs for the odd-numbered printers (1525, 801, and 803) are generally not compatible with the even-numbered printers (1526 and 802) and vice versa.

The MPS-802 characters seem to be the same as the 1526, but the 802 uses squarer dots, which makes the letters look more filled in, more solid. Commodore also reprinted the 1526 user's manual, replacing *1526* with *MPS-802* where necessary, but keeping the typographical errors from the original.

You can print up to 80 columns horizontally. Paper is either friction-fed, for individual sheets of bond or letterhead, or tractor-fed, for continuous fanfold (computer) paper. The printhead can be positioned to accept one to three sheets in case you wish to make carbon copies. Characters are made up of 64 pixels in an eight by eight matrix. The descenders (tails on letters like q, g, and y) are reasonably realistic and extend below the line.

ABCDEFGHIJKLMNOPQRSTUVWXYZ

abcdefghijklmnopqrstuvwxyz

The upper/lowercase character set of the MPS-802.

There are two character sets, corresponding to the Commodore uppercase/graphics mode and the upper/lowercase mode. In addition, characters can be printed in reverse, white on black, or in enhanced mode, twice as wide as normal. The manual lists the speed in lines per minute; it translates to 40–60 characters per second, depending on the number of columns being printed. (See below for the actual speed.) There is a single programmable custom character, and no provision for hi-res graphics, although you can print in hi-res if you have enough diligence and patience.

The 802 is not especially good for hi-res graphics, although the standard Commodore graphics characters are available. It has a number of features, however, that make it well worth considering, especially if you plan to use your printer for more serious applications like business or word processing.

Printing a CHR$(147) makes the 802 skip over perforations. This is handy when you're making program listings. The listing stops printing three lines short of the bottom of the page and starts again a few lines down on the next. You can also program the page length, which would be useful for printing on nonstandard paper like invoices. Printing a CHR$(12) to the printer advances the paper to the top of the next page.

Another helpful function for a business application is print formatting, which is similar to the PRINT-USING command found on some computers.

The MPS-803 is less suitable for business applications, but handles hi-res graphics better than the 802. It's smaller than previous Commodore printers, about as high as the keyboard of the 64, but not as wide.

The manual is similar to the manual of the MPS-801, with some paragraphs lifted directly from the earlier edition. The commands used by the 801 and 803 are almost identical, and the character set seems to be the same. The characters do *not* have proper descenders, so the lowercase q, g, p, y, and j seem out of place, hovering above the line.

ABCDEFGHIJKLMNOPQRSTUVWXYZ

abcdefghijklmnopqrstuvwxyz

The upper/lowercase character set of the MPS-803.

Unlike the 801, which accepts pin-feed paper, the 803 is friction-fed. You can print on single sheets of paper or use continuous (computer) paper.

Like all other Commodore printers, there are two character sets, graphics mode and business (upper/lowercase) mode. The 803 also features reverse field printing and enhanced (double width) mode.

We tested a *SpeedScript* file on both the 802 and 803. The file took up 32 disk blocks, approximately 8K. Both printers finished eight double-spaced pages in less than five minutes (for an effective speed of about 30 characters per second, about half of the 60 cps mentioned in the manual). The 802 was slightly faster than the 803.

Next, we used *Koalaprint* to print a hi-res picture. The MPS-803 finished in less than three minutes. The 802 (with its limited hi-res capabilities) chugged away for nearly 21 minutes before the picture was complete.

If you plan to do a lot of word processing and business applications, the 802 may be a better choice. The print is darker, its character set is more legible, and it has some good formatting commands. If you're willing to sacrifice some readability and want a printer mainly for program listings and graphics, the 803 may be preferable.

—Todd Heimarck

Commodore Business Machines
1200 Wilson Drive
West Chester, PA 19380
MPS-802, $239 (suggested retail)
MPS-803, $199 (suggested retail)

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The chart-leading Ghostbusters,™ the incredible living novel, Mindshadow,™ and the fast-paced challenge of Master of the Lamps™... we're not about to make "experiencing" any of our software less challenging... but here's a list designed to make "finding" it very, very easy.

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Video Basic-64

You've just written a great program—with lots of sound and graphics embellishments—using the BASIC enhancement utility you bought a while ago. Your program is so good that you'd like to give it away, maybe even sell it. But of course, you can't. It will run only on machines equipped with the same enhancement you used.

Now there's a way to sidestep this problem. *Video Basic-64*, a software development package from Abacus, provides the usual extended BASIC sound and graphics commands (with extras), plus a runtime version of itself that you can add to disks you make. Your program will then run on any 64 with a disk drive. And there are no royalties involved. You're even free to use this product commercially.

This thoughtful approach is reflected throughout the package. Without going into detail, there are commands giving easy control of hi-res and multicolor bitmap plotting, sprite definition and movement, music and sound effects, and joystick and paddle input.

While that's it for many BASIC enhancements, it's only the starting point for *Video Basic-64*. To ensure that you realize the potential of this system, an impressive demonstration is included on the disk. There is also a comprehensive, three-part, self-paced tutorial that should help iron out any difficulties you may have. If that's not enough, there's a 73-page manual.

Another bonus: The program includes Turtle graphics features. While these are a powerful tool in their own right, such commands are also widely recognized as an excellent resource in teaching logic and programming skills. With the overall educational tenor of this package, it's not difficult to imagine the graphics-oriented novice actually beginning programming studies with these commands.

However, *Video Basic-64* is a full-fledged software development system, and accordingly offers features to delight the advanced programmer. Here's a sample of some of the major ones.

- Save to tape or disk all or part of your graphics display, including color memory and sprite patterns if you want them.
- Copy your graphics display to a printer. Commodore, Epson, Gemini, and Okidata are supported.
- Transfer chunks of memory around your machine. This enables you to keep two complete graphics screens in memory at the same time, and switch rapidly between them.
- Fill graphics with your own pattern by simply adding eight numbers, much like a character definition, to the Fill command.
- Copy portions of your graphics screens and move them from place to place, or even to another screen.

Impressive as these features may sound, only when you see them actually working in a program will you gain an appreciation of how powerful they really are. And that's typical of this package, where every effort seems to have been made to keep the user of the system happy.

On the other hand, there are a few aspects that might be considered shortcomings by some. The program uses a nonstandard form of the multicolor bitmap. In it, vertical and horizontal resolution are halved. The documentation, while generally very good, is not as clear as it might be when discussing the advanced features of the program. Additionally, the system reduces the amount of memory for BASIC to 27K, although it would be rare for this to be a handicap, due to the compact and powerful nature of *Video Basic-64* coding.

This is, in essence, an exceptionally fine product, even at its somewhat high cost. Unless you want to delve into machine language programming, there is probably no more flexible or potent way of creating sound and graphics on the 64. And the friendly, educational stance of the package, extending even to providing a free runtime distribution system, is a rare and pleasant thing in today's uncertain software environment.

—Lee Noel, Jr.

Abacus Software
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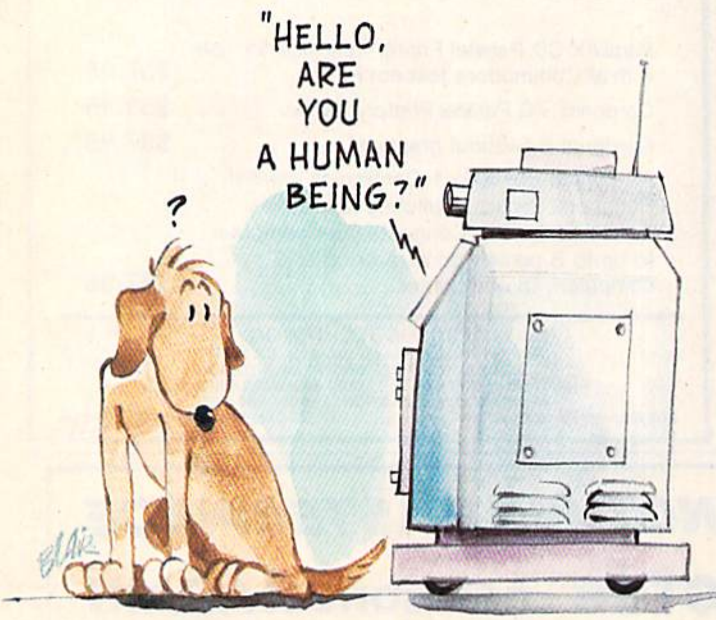
Our Robot Hotel

Fred D'Ignazio, Associate Editor



The Mad Scientist

When I was a kid, I had a huge, walk-in closet in my bedroom. When I entered the closet, I became a mad scientist and the closet became my lab. In the lab were all sorts of old, broken-down machines, including a copier, a bed pan, and a motorcycle motor. I spent dozens of hours tucked away in my lab—hammering, soldering, and bolting the machine parts together trying to build a walking, talking robot.

My blueprints were the pictures in comic books, fantasy tales, and science fiction movies I saw late at night when my parents thought I was sleeping.

Despite my high hopes and hard work, I never built my robot. That was 25 years ago, but the fascination for bringing a machine to life still lingers. And judging from the interest in the real robots on the market, there are millions of you out there who love robots as much as I do.

To get ready for this article, I invited all the robots I knew to visit my house. There are so many robots here, now, that they have turned the house into a hotel—a robot hotel.

Robot King Of The Mountain

A real contender for robot king of the mountain is Hubot from Hubotics. Hubot costs between \$3,600 to \$4,000 and is a big guy—almost five feet tall and weighing 150 pounds. To keep him from running over your family cat, there are two sets of ultrasonic sensors—on his chest and at the base, just above the floor—that help him "see" where he is going.

Hubot is really a mobile, talking, playful appliance. He has a built-in computer with 64K of memory and a disk drive. He has a built-in video game, a radio/cassette player, and his screen doubles as a monitor and a TV. Hubot's makers see him as a "Man Friday"—a programmable vacuum cleaner, playmate and tutor for the children, watchdog when you're not at home, and personal secretary for mom and dad.

Robot Pets

Next, we come to another group of guests in our robot hotel—the robot *pets*: HEROjr from Heath Company for \$600 (as a kit) and \$1000 (assembled); Maxx Steele from CBS Toys for \$400; and Omnibot from Tomy for \$300.

All three are programmable, and HEROjr comes with sound, light, infrared and ultrasonic sensors that give him the ability to react to the outside world.

These robots *can* make themselves useful—for example, you could program them to carry a soda to you from the kitchen (if someone got it out of the refrigerator first). And HEROjr has a security feature that turns him into a burglar alarm. But these are not serious servants. They are robot playmates, companions, and tutors.

Maxx Steele and HEROjr play games like Moon Ball, and Cowboys and Robots. Omnibot has a cassette player, and HEROjr and Maxx have voices; to make Omnibot talk you speak through his remote controller and your voice comes out of his chest. My kids love this feature

1) Hubot—"king of the mountain" (Hubotics); 2) Maxx Steele (CBS Toys, Ideal); 3) Dingbot, Verbot, and Omnibot (Tomy); 4) HEROjr (Heath)

for games of hide 'n seek and tag. HEROjr sings and recites poetry. And all three robots have clocks and calendars so they can remember birthdays and sound an alarm when your favorite TV show is about to come on.

The Educational Robots

The next class, the *educational robots*, includes the Nomad from Genesis for $180; the Turtle Tot from Harvard Associates for $400; F.R.E.D. from Androbot for $500; TOPO from Androbot for $1500; and HERO from Heath for $2000.

All of these are programmable. The Nomad, the Turtle Tot, and F.R.E.D. can be programmed in Logo. The Turtle Tot and F.R.E.D. hold a pen so they can draw designs on paper.

Also, each of these can be attached to the Commodore 64. This is an important feature since you can create a whole library of programs on the computer, then send them one at a time over a cable to your robot.

And remember, *software* is as important to robots as it is to computers. However, unlike home computers, most of the home robots on the market have little or no ready-made software—the programs and commands that make the robot perform even the simplest activity like turning in a circle. That means you have to write your own or wait for robot software companies like Computer Magic, which makes software for the Hubot and the Tomy robots, to create programs you can buy. (Computer Magic plans to make Commodore 64 software for all the popular, low-cost robots. In many cases, the robot companies will distribute Computer Magic's software under their own label.)

The high-end educational robot, HERO, is a complete robot laboratory. It makes a great project for a family or school class. It may take you up to 90 hours to put it together, but you'll learn all about robots, including robot sensors, arms, motors, mobility, microchips and electronics, and how to program them.

Robot Toys

Next come the *robot toys*. At the very low end are the Robo Force Action Figures from CBS Toys for $5 to $6, the Dingbot and Flipbot robots from Tomy for $10, and the robot transformer watches from Takara for $14.

The Robo Force robots are for very young children—seven and under. They come with comic books, good guys and bad guys, and a dramatic, imaginary scenario that sweeps over an alien planet. They are safe, easy for young children to manipulate, and are great food for the imagination.

While Dingbot and Flipbot are nothing more than a motor on wheels, they are undeniably cute. And the robot watches motivate kids to learn to tell time.

Probably the best buy, for the money, are the Transformer robots from Hasbro and the GoBots from Tonka. For $2 to $10 your children get hours of play while improving hand-eye coordination and fine motor skills, and exercising their imagination. And if you think transforming one of these little creatures from car to robot is trivial, you should try it yourself.

I couldn't do it. Even my mechanic at the filling station couldn't do it. But my five-year-old could.

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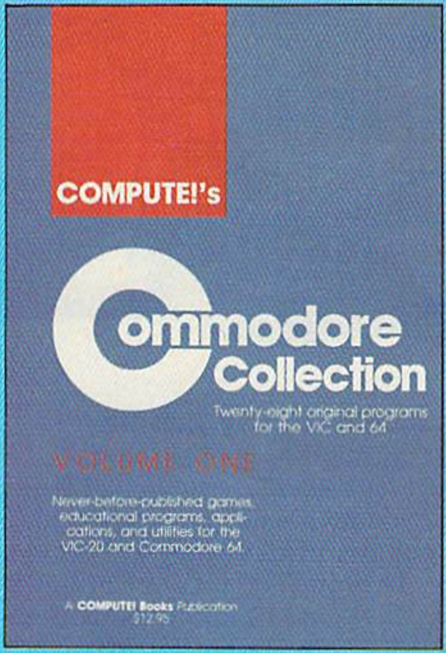

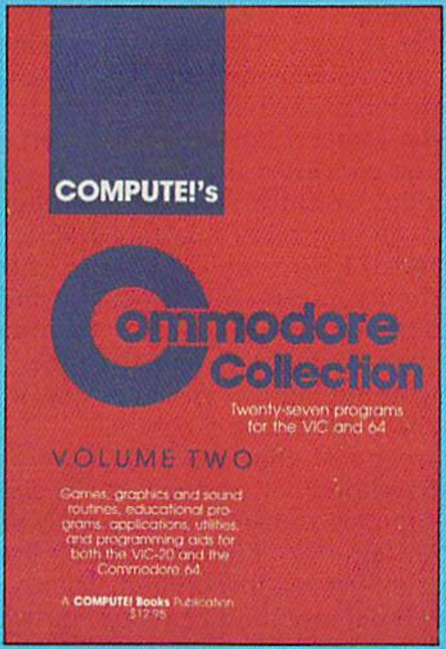

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1) Elami and Elami Jr. (North American Robotics); 2) GoBots (Tonka); 3) Transformers (Hasbro); 4) Robo Force Action Figures (CBS Toys, Ideal); 5) Memocon Crawler (OWI)

Educational Toy Robots

Last on the list come my favorites—the *educational toy robots*. These are authentic enough to give you an idea of how robots are made and how they work, yet they are extremely inexpensive. They include the Erector Set Maxx Steele from CBS for $12; the Robotix Robot Construction Kits from Hasbro for $20 to $30; the Armatron from Radio Shack for $25; the remote-controlled Erector Set Maxx Steele from CBS for $40; the voice-controlled Verbot robot from Tomy for $65; the Movit family of robots from OWI that range from $25 to $75; and the Elami (pronounced EL-ah-mee) robot family from North American Robotics for $130 and up.

The only Elami robot currently available is the 12-inch high steel and plastic Elami Jr. that runs at two speeds and moves equally well on tabletops and floors. It comes assembled, for $130, and has several attractive features, including easy programmability (with 4K of memory for programs); an animated LCD face with four expressions; a flat, membrane command panel on its chest for programming; a 194-word vocabulary spoken in a humanlike voice; and two sensors: an infrared sensor above the command panel, and a bumper sensor at its base. The robot's developer appears committed to making the product safe and reliable, and supporting it with educational materials, activities, and software.

One of the Movit robots, the Memocon Crawler, can be converted into a real, programmable robot, at much less cost than the Elami Jr. You can buy a $40 interface (cable, disk, and manual) kit for the Crawler and hook it up to a 64. Then you can write programs and send them to the robot. As you write the programs, the robot obeys them, one at a time. Then, when you unplug the robot and put it on the floor, it obeys the entire program.

Robot "creatures" that you build from a Hasbro/Bradley Robotix Construction Kit can become real computer-controlled robots with the aid of the $90 Kelp (for "Kinetic Helper") Board from Crabapple Systems in Portland, Maine. This allows you to build any kind of robot you want out of Robotix components, then connect up to eight Robotix three-volt motors to your 64, and program your robot in BASIC. The 64 version of

Robots And Robot Companies:

GoBots ($2–$3)—Tonka Toys, 4144 Shoreline Blvd., Spring Park, MN 55384, (612) 475-9500

Transformers ($3–$10), Robotix ($20–$30)—Hasbro, 1027 Newport Ave., Pawtucket, RI 02861, (401) 726-4100

Robo Force Action Figures ($5–$6), Maxx Steele Erector Set ($12), Maxx Steele Remote-Controlled Erector Set ($40), Maxx Steele Programmable Robot ($400)—CBS Toys (Ideal), 1107 Broadway, New York, NY 10010, (212) 675-6100

Dingbot ($10), Flipbot ($10), Verbot ($65), Omnibot ($300)—Tomy Corporation, 901 E. 233rd St., P.O. Box 6252, Carson, CA 90749, (213) 549-2721

Robot Watch ($14)—Takara Toy Company, 200 Fifth Ave., Rm. 660, New York, NY 10010, (212) 989-0400

Armatron ($25)—Radio Shack (3500 stores around the U.S.)

Movit Family of Robots ($25–$75)—OWI Incorporated, 1160 Mahalo Place, Compton, CA 90220, (213) 638-4732

Elami Jr ($130)—North American Robotics, 4251 N. Federal Highway, Boca Raton, FL 33431, (305) 368-8118

Nomad ($180)—Genesis Corporation, P.O. Box 152, Hellertown, PA 18055, (215) 861-0850

Turtle Tot ($400)—Harvard Associates, 260 Beacon St., Somerville, MA 02143, (617) 492-0660

F.R.E.D. ($500), TOPO ($1500)—Androbot Inc., 550 Charcot Ave., San Jose, CA 95131, (408) 262-8676

HEROjr ($600 kit/$1000 assembled), HERO ($1000 kit/$2000 assembled)—Heath Company, Benton Harbor, MI 49022, (616) 982-3678

Hubot ($3600–$4000)—Hubotics Corporation, 6352 Corte del Abato, Carlsbad, CA 92008, (619) 438-9028

Interface Boards/Cables:

Kelp C64/Robotix Interface Board and Software ($90)—Crabapple Systems, 118 Commercial St., Portland, ME 04101, (207) 772-8610

C64/Movit Interface Cable and Software ($40)—OWI Incorporated, 1160 Mahalo Place, Compton, CA 90220, (213) 638-4732

Robot Software:

Computer Magic Ltd., 18 East Mall, Plainview, NY 11803, (516) 694-8960

Robot Books:

The Everyone Can Build A Robot Book by Kendra Bonnett, Gene Oldfield, and the editors of DIGIT Magazine (Simon & Schuster, $8.95, 1984)

The State-Of-The-Art Robot Catalog by Phil Berger (Dodd, Mead, $12.95, 1984)

If I Had A Robot: What To Expect From The Personal Robot by Nelson B. Winkless III, (Dilithium Press, $9.95, 1984)

Working Robots by Fred D'Ignazio (Hayden, $7.95, 1984) the Kelp board should be available as you read this. Call Crabapple Systems directly (see below) for inquiries or orders.

The voice-activated Verbot robot is also special because, with software from Computer Magic, it can be programmed from a 64; and can be used for children with speech disabilities and by children who don't speak English. As long as children can make a sound, they can train Verbot to obey them.

How To Build A Robot Of Your Own

Many of you kids out there probably want to build a robot, just as I did. Now you have the chance to learn how to build robots the smart way—with robot kits. You can begin with little robot toys like the Transformers and GoBots. You can graduate to the erector set robots and the Robotix construction kits. Then you'll be ready for the Movit robots. The Movit kits have dozens of pieces and take hours to build, but they teach you a lot about robot mechanics and electronics. With any of the more complicated kits, it's best to get help from parents and teachers. It's easier and quicker to build a robot as a team and much more fun.

After the Movits, you may be ready to tackle a full-scale robot like the HERO or HEROjr. Or you may wish to build a robot of your own design. But before you do, stop and do a little research with books like the *Everyone Can Build A Robot Book* from Simon & Schuster; *The Robot Catalog* from Dodd, Mead; *If I Had A Robot: What To Expect From The Personal Robot* from Dilithium; or my book, *Working Robots*, from Hayden.

Robots Are Special

For you parents and teachers, don't be disappointed that I didn't show any robot maids or butlers. These machines will arrive, not as robots, but as *intelligent appliances*—dishwashers with arms, ovens with voices, and smart vacuum cleaners that wander around the house unattended while they suck up dust and crumbs.

We could all use more help around the house, but it will come from these intelligent appliances, not from robots. Robots are special. We humans find robots more fascinating than any other machine because, unlike other machines, robots appear lifelike. And there is a danger that robots will lose this special charm if we strip them of their lifelike qualities and turn them into common, dull machines like can openers or toasters.

Who loves robots the most? Kids. As parents and teachers, our job is to recognize the fantastic appeal that robots have for kids and use it constructively to help them learn important skills, and to spark their imagination. This can be accomplished with a $2 robot toy as easily as with a full-blown $4000 robot appliance.

How To Type In *COMPUTE!'s GAZETTE* Programs

Each month, COMPUTE!'s GAZETTE publishes programs for the VIC-20, Commodore 64, Plus 4, and 16. Each program is clearly marked by title and version. Be sure to type in the correct version for your machine. Also, carefully read the instructions in the corresponding article. This can save time and eliminate any questions which might arise after you begin typing.

We publish two programs, which appear periodically, designed to make your typing effort easier: The Automatic Proofreader, and MLX, designed for entering machine language programs.

When entering a BASIC program, be especially careful with DATA statements as they are extremely sensitive to errors. A mistyped number in a DATA statement can cause your machine to "lock up" (you'll have no control over the computer). If this happens, the only recourse is to turn your computer off then back on, erasing whatever was in memory. So be sure to *save a copy of your program before you run it*. If your computer crashes, you can always reload the program and look for the error.

Special Characters

Most of the programs listed in each issue contain special control characters. To facilitate typing in any programs from the GAZETTE, use the following listing conventions.

The most common type of control characters in our listings appear as words within braces: {DOWN} means to press the cursor down key; {5 spaces} means to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing another key), the character is underlined. For example, A means hold down the the SHIFT key and press A. You may see strange characters on your screen, but that's to be expected. If you find a number followed by an underlined key enclosed in braces (for example, {8 A}), type the key as many times as indicated (in our example; enter eight SHIFTed A's). To type {SHIFT-SPACE}, hold down the SHIFT key and press the space bar.

If a key is enclosed in special brackets, Ɛ Ǝ, hold down the Commodore key (at the lower left corner of the keyboard) and press the indicated character.

Rarely, you'll see a single letter of the alphabet enclosed in braces. This can be entered on the Commodore 64 by pressing the CTRL key while typing the letter in braces. For example, {A} means to press CTRL-A.

The Quote Mode

Although you can move the cursor around the screen with the CRSR keys, often a programmer will want to move the cursor under program control. This is seen in examples such as {LEFT}, and {HOME} in the program listings. The only way the computer can tell the difference between direct and programmed cursor control is *the quote mode*.

Once you press the quote key, you're in quote mode. This mode can be confusing if you mistype a character and cursor left to change it. You'll see a reverse video character (a graphics symbol for cursor left). In this case, you can use the DELete key to back up and edit the line. Type another quote and you're out of quote mode. If things really get confusing, you can exit quote mode simply by pressing RETURN. Then just cursor up to the mistyped line and fix it.

When You Read:	Press:	See:
{CLR}	SHIFT CLR/HOME	
{HOME}	CLR/HOME	
{UP}	SHIFT ↑CRSR↓	
{DOWN}	↑CRSR↓	
{LEFT}	SHIFT ←CRSR→	
{RIGHT}	←CRSR→	
{RVS}	CTRL 9	
{OFF}	CTRL 0	
{BLK}	CTRL 1	
{WHT}	CTRL 2	
{RED}	CTRL 3	
{CYN}	CTRL 4	

When You Read:	Press:	See:
{PUR}	CTRL 5	
{GRN}	CTRL 6	
{BLU}	CTRL 7	
{YEL}	CTRL 8	
{F1}	f1	
{F2}	SHIFT f1	
{F3}	f3	
{F4}	SHIFT f3	
{F5}	f5	
{F6}	SHIFT f5	
{F7}	f7	
{F8}	SHIFT f7	

When You Read:	Press:	See:
←	←	
↑	SHIFT ↑	

For Commodore 64 Only

When You Read:	Press:	See:
Ɛ1Ǝ	C= 1	
Ɛ2Ǝ	C= 2	
Ɛ3Ǝ	C= 3	
Ɛ4Ǝ	C= 4	
Ɛ5Ǝ	C= 5	
Ɛ6Ǝ	C= 6	
Ɛ7Ǝ	C= 7	
Ɛ8Ǝ	C= 8	

MLX Machine Language Entry Program

For Commodore 64 And VIC-20

Charles Brannon, Program Editor

MLX is a labor-saving utility that allows almost fail-safe entry of machine language programs published in GAZETTE. You need to know nothing about machine language to use MLX—it was designed for everyone. There are separate versions for the Commodore 64 and expanded VIC-20 (at least 8K).

MLX is a new way to enter long machine language (ML) programs with a minimum of fuss. MLX lets you enter the numbers from a special list that looks similar to BASIC DATA statements. It checks your typing on a line-by-line basis. It won't let you enter illegal characters when you should be typing numbers. It won't let you enter numbers greater than 255 (forbidden in ML). It won't let you enter the wrong numbers on the wrong line. In addition, MLX creates a ready-to-use tape or disk file. You can then use the LOAD command to read the program into the computer, as with any program:

LOAD "filename",1,1 (for tape)
LOAD "filename",8,1 (for disk)

To start the program, you enter a SYS command that transfers control from BASIC to machine language. The starting SYS number always appears in the appropriate article.

Using MLX

Type in and save MLX (you'll want to use it in the future). When you're ready to type in an ML program, run MLX. MLX asks you for two numbers: the starting address and the ending address. These numbers are given in the article accompanying the ML program.

You'll see a prompt corresponding to the starting address. The prompt is the current line you are entering from the listing. It increases by six each time you enter a line. That's because each line has seven numbers—six actual data numbers plus a *checksum number*. The checksum verifies that you typed the previous six numbers correctly. If you enter any of the six numbers wrong, or enter the checksum wrong, the computer rings a buzzer and prompts you to reenter the line. If you enter it correctly, a bell tone sounds and you continue to the next line.

MLX accepts only numbers as input. If you make a typing error, press the INST/DEL key; the entire number is deleted. You can press it as many times as necessary back to the start of the line. If you enter three-digit numbers as listed, the computer automatically prints the comma and goes on to accept the next number. If you enter less than three digits, you can press either the SPACE bar or RETURN key to advance to the next number. The checksum automatically appears in inverse video for emphasis.

To simplify your typing, MLX redefines part of the keyboard as a numeric keypad:

	U	I	O			7	8	9
H	J	K	L	become	0	4	5	6
	M	,	.			1	2	3

MLX Commands

When you finish typing an ML listing (assuming you type it all in one session) you can then save the completed program on tape or disk. Follow the screen instructions. If you get any errors while saving, you probably have a bad disk, or the disk is full, or you've made a typo when entering the MLX program itself.

You don't have to enter the whole ML program in one sitting. MLX lets you enter as much as you want, save it, and then reload the file from tape or disk later.

MLX recognizes these commands:

SHIFT-S: Save	**SHIFT-N: New Address**
SHIFT-L: Load	**SHIFT-D: Display**

When you enter a command, MLX jumps out of the line you've been typing, so we recommend you do it at a new prompt. Use the Save command to save what you've been working on. It will save on tape or disk, as if you've finished, but the tape or disk won't work, of course, until you finish the typing. Remember what address you stop at. The next time you run MLX, answer all the prompts as you did before, then insert the disk or tape. When you get to the entry prompt, press SHIFT-L to reload the partly completed file into memory. Then use the New Address command to resume typing.

To use the New Address command, press SHIFT-N and enter the address where you previously stopped. The prompt will change, and you can then continue typing. Always enter a New Address that matches up with one of the line numbers in the special listing, or else the checksum won't work. The Display command lets you display a section of your typing. After you press SHIFT-D, enter two addresses within the line number range of the listing. You can abort the listing by pressing any key.

What if you forgot where you stopped typing? Use the Display command to scan memory from the beginning to the end of the program. When you reach the end of your typing, the lines will contain a random pattern of numbers. When you see the end of your typing, press any key to stop the listing. Use the New Address command to continue typing from the proper location.

(See listings on page 109.)

BASIC Magic

Michael S. Tomczyk

A Matter Of Time

All Commodore computers have built-in clocks that "keep on ticking" even while a program is running. The only time they may miss a few ticks is when your computer interfaces with an outside peripheral such as a printer or disk drive. Then the clock may be interrupted or slowed down.

You can use your computer's clock for all sorts of things, from stopwatches (Commodore computers have been connected to special sensors to measure performance times in water ski competitions) to game programs and homework helpers.

TI$ is an abbreviation for the variable TIME$. Unlike most variables, TI$ is built into the computer. You don't have to define it or give it a value. The "clock" is automatically turned on and set to "000000" when you turn on your computer. It keeps time in hours, minutes, and seconds. You can redefine TI$ and set the clock to any time you like. To display the time on the screen, type this command:

PRINT TI$

The computer displays the time in six digits and runs through a 24-hour cycle from "000000" (midnight) to "235959" (11:59:59 p.m.). The first two digits represent the hour, the second two are minutes, and the last two are seconds.

If you just turned on your computer, TI$ might read 000005, which means the computer has been on for five seconds. If you've been working for a while, the time might read 014530, which means you've been working on the computer 1 hour, 45 minutes, and 30 seconds, if you haven't reset the clock.

Type the PRINT TI$ command again and see how far the time has advanced while you were reading this.

Military services, airline pilots, and many foreign countries use a 24-hour time standard instead of the 12-hour a.m./p.m. standard we use in the U.S. Computer time is based on a 24-hour clock. A 24-hour time clock reading of "184530" is the same as 45 and a half minutes after 6 p.m., or 6:45 p.m., and 30 seconds. Remember that any a.m. time from 12:00 midnight to 11:59 a.m. is the same in both time standards. Thus, 2 a.m. in 12-hour time is 020000 in 24 hour-time.

To convert a p.m. number from 12-hour time to 24-hour time, *add* 12 to the hour: 2 p.m. is 2+12 or 140000. To convert 24-hour time to 12-hour time, *subtract* 12 from the hour: 203000 is 8:30 p.m. because 20 − 12 = 8.

REM: *To check any programs using time, check the following time settings to make sure they "roll over" properly to the next time: 005957, 095957, 115957, 125957, 215957, and 235957. When you set these examples, the clock displays the time, counts 3 seconds and rolls over to the next hour. You may find that spacing solutions are needed to adjust your time displays so they come out properly.*

Setting The Built-In Clock

Setting the clock is easy—in direct mode or in a program. Type the following and press RETURN:

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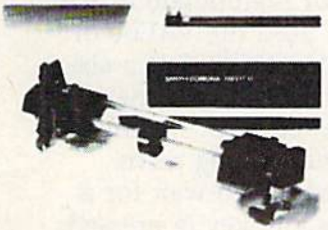

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No. of Char. in Char. Set: 96 ASCII International

Graphics Capability: Standard 60, 72 Dots Per Inch Horizontal, 72 Dots Per Inch Vertical

Pitch: 10, 12, 16.7, 5, 6, 8.3

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Char. Matrix Size: (Standard) 9H x 8V, (Elongate) 10H x 8V

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TI$="000000"

This starts the clock running at zero. Note that you put the time inside quotation marks. If you've been following this column, you'll remember that a dollar sign marks a *string variable*, which must be enclosed in quotes when you define it. You can read the time in a program, or directly, by using the command PRINT TI$.

You can also set the clock to a specific time. For example, to start the clock at 11:30 a.m., type TI$="113000." To set the clock at 11:30 p.m., type "233000." Midnight is "000000" and 12 noon is "120000."

A Computer "Stopwatch"

This program creates a "loop" which shows how much time has elapsed, like a stopwatch. We start at "000000" because we're just measuring *elapsed time*:

```
5 PRINT "{CLR}"
10 TI$= "000000"
20 PRINT "{HOME}"TI$: GOTO 20
```

Type RUN and press RETURN to start the clock. Press the RUN/STOP key to stop the stopwatch.

Line 5 clears the screen. Line 10 defines TI$ as 0 (don't forget to type all six zeros).

Line 20 uses the PRINT command to put the cursor in the home position at the top left corner of the screen, and to display the time. Home means press the HOME key without shifting. We use HOME instead of CLR because if we cleared the screen here the display would "flutter." Finally, the GOTO command sends the computer back to line 20, over and over, to update the time.

To stop the program, press RUN/STOP. The computer clock will keep running even after the program is stopped. To test this, type: PRINT TI$.

The "Any Key" Stopwatch

Our next example lets you turn the stopwatch on and off by pressing any key.

```
20 TI$= "000000": PRINT "{CLR}"
30 PRINT "{HOME}{RVS}COMPUTER STOPWATCH":
   PRINT: PRINT "TIME:" TI$
40 GET K$: IF K$="" THEN GOTO 30
50 PRINT: PRINT "YOU STOPPED THE TIME AT
   {SPACE}"VAL(TI$)" SECONDS."
60 PRINT "PRESS ANY KEY"
70 GETK$: IF K$="" THEN GOTO 70
80 GOTO20
```

Line 20 sets the computer's internal clock to zero and clears the screen.

Line 30 sends the cursor to the home position and prints the screen title in reverse characters ({RVS} means hold down CONTROL and press RVS ON). The PRINT command used by itself inserts a blank line on the screen. Next, we print the word "TIME:" followed by TI$, which is the current time on your computer's clock. Remember, variables are always put outside quotation marks.

Line 40 uses the GET command to tell the computer to check the keyboard to see if a key (K$) is pressed. If no key is pressed (quotation marks "" with nothing inside represent no key), then the computer goes back to line 30 to constantly update the time. As soon as any key is pressed, the program drops down to line 50.

Line 50 uses a PRINT command to insert a blank line on the screen, then prints the first part of the message, followed by VAL(TI$) outside of quotation marks and the rest of the message inside. VAL is a very useful command which isn't explained too often. It allows you to convert a string variable to a numeric variable, which means you can then display or manipulate it like any number. In this case, we used the VALue of TI$ so we can display a number instead of a six-digit time display. If we used TI$ by itself here, we would get something like "000005." Using the VALue of TI$ drops off the leading zeros.

Line 70 uses a GET command to wait for a key to be pressed. As soon as any key is pressed, the computer drops down to line 80.

Line 80 uses GOTO to send the program back to line 20 to repeat.

A Bug In The Program

If you use the stopwatch program to time a short event (less than a minute), it works fine. But what happens if you time something a little longer, like a three minute song on the radio? The variable TI$ counts in hours, minutes, and seconds, so three minutes would translate to 000300. The VALue of that string is 300, so the program prints 300 seconds, which is not the same thing as three minutes.

We've discovered a *bug*, a situation where the program doesn't work right. Even the best programmers will sometimes accidentally write a bug into a program.

At this point we can do three things. We can leave the bug in the program and use it only to time events less than a minute. Or we can modify it by dividing the 300 by 100 and multiplying times 60; although this would introduce another bug (can you figure out what would be wrong?). Or we could rewrite the section that contains the bug:

```
50 PRINT: PRINT "YOU STOPPED THE TIME AT
   {SPACE}"TI/60" SECONDS."
```

Note that this new line has a variable TI without a dollar sign, meaning it's a numeric variable, a number. Like TI$, TI is built into the computer. It takes its value from the *jiffy clock*, which measures time in sixtieths of a second. TI doesn't count in hours, minutes, or even seconds—it keeps track of how many sixtieths of a second have gone by since the clock was set to midnight. If TI$ tells you the time is 1:30 a.m. (013000), TI will hold 324000. To translate TI to seconds, divide by 60.

Setting And Displaying 24-Hour Time

This next program sets and displays time in a 24-hour time format:

```
10 PRINT "{CLR}TYPE THE CURRENT TIME IN 6
   DIGITS AND PRESS RETURN": INPUT TI$
20 PRINT "{CLR}"
30 H$=LEFT$(TI$,2): M$=MID$(TI$,3,2): S$=
   RIGHT$(TI$,2)
40 PRINT "{HOME}{RVS}TIME " H$ ":" M$ ":"
   S$
50 GOTO 30
```

Line 10 is similar to our previous examples. To set the clock to 9:45 a.m., type "094500." To set the clock to 9:45 p.m., type "214500." The last two digits are seconds, and are usually set at zero. Line 20 clears the screen.

Line 30 creates three variables—H$, M$, and S$—which allow us to work with each "part" of the time reading. The time represented by TI$ has six digits. We use LEFT$, MID$, and RIGHT$ to define H$ as the first two digits (hours); M$ as the middle two digits (minutes); and S$ as the last two digits (seconds). From now on we can use these variables to print the hours, minutes, or seconds together or separately, and we can even tell the computer to do certain things if a specific time is reached or a certain amount of time has elapsed.

Line 40 homes the cursor and creates a reverse display. Then we print the three time variables—hours, minutes, and seconds—separated by colons. Note the time variables go outside the quotation marks, but the colons go inside quotation marks.

Line 50 sends the computer back to line 30 to update the variables and repeat the time display.

The 12-Hour "Easy Clock"

Our 24-hour clock is handy, but it's a little awkward to read. For example, one minute past midnight is displayed as: "00:01:00." The following program displays hours and minutes in standard 12-hour time.

You can build on this program to create a clock made with graphics characters and even add sound effects. Or you can make an alarm clock by inserting a line 15 asking for an alarm time, then add an IF-THEN statement which GOSUBs to a sound routine if TI$ corresponds to the time the alarm was set.

```
10 PRINT "{CLR}TYPE THE CURRENT TIME IN 6
   DIGITS AND PRESS RETURN": INPUT TI$
20 PRINT "{CLR}"
30 H$=LEFT$(TI$,2): M$=MID$(TI$,3,2)
40 IF VAL(H$)>12 THEN H$=STR$(VAL(H$)-12)
50 IF VAL(H$)=0 THEN H$="12"
60 PRINT "{HOME}{RVS}TIME: " H$ ":" M$ "
   {3 SPACES}"
70 GOTO 30
```

Lines 10 and 20 are the same lines we used earlier. Line 40 checks to see IF the VALue of H$ is greater than 12, and, if it is, THEN it subtracts 12 from H$. This is what makes the numbers 1300 to 2300 appear as 1:00 to 11:00 when the clock gets into p.m. territory.

The end of line 40 is tricky. Here, we define the string variable H$ as a number value, use that value to perform a calculation (subtract 12 from it), then use the STR$ command to make H$ a string variable again. We'll come back to that in a moment.

Line 50 converts the "00" hour reading to a 12 so 12 a.m. reads correctly. We could have also used: IF LEFT(TI$,2)="00" THEN H$="12" as an alternative.

Line 60 prints the time. The three spaces are cosmetically important. Line 70 goes back to line 30 to update the time again.

REM: *The VAL command turns a string variable—a word—into a number value which we can use in calculations. We then subtract from that VALue. Finally, we have to put that VALue back into string variable form, and this requires a new command called STR$, which is the opposite of the VAL command. STR$ converts a number value into a string variable. Here are some quick one line examples to practice with:*

```
N$=STR$(4000): PRINT N$
F$="5": N$=STR$(VAL(F$)*10): PRINT N$
T$="200 DEGREES FAHRENHEIT": PRINT VAL(T$)
A$="200 DEGREES": B$=STR$(INT(VAL(A$)-
   32)*5/9): PRINT B$" DEGREES CELSIUS"
```

Using TI$ As A Time Delay

Another way to use TI$ is to insert a time delay loop. If you've been following this column, you know you can put a FOR-NEXT loop almost anywhere in your program to slow it down, like this:

```
10 PRINT "{CLR}HOME COMPUTER WARS"
20 FOR T=1 TO 500: NEXT
30 PRINT "{CLR}PUBLISHED BY COMPUTE!"
40 FOR T=1 TO 500: NEXT
50 GOTO 10
```

Line 10 clears the screen and prints the first message. Line 20 contains the time delay loop which "counts" to 500 so we have time to read the message. Line 30 is the same as line 10 but with a different message (we clear the screen again so the second message replaces the first in the same position). Line 40 contains another time delay which pauses to leave the second message on the screen. Line 50 tells the computer to go back to line 10 and repeat the entire program. The result is a message which appears to flash.

TI$ And "Jiffy-Timer" Delay Loops

You can use both TI$ and its sister command, TI, to create time delays. Here's the same program we just looked at, using TI$ instead of FOR-NEXT to create a time delay of approximately one second:

```
10 PRINT "{CLR}HOME COMPUTER WARS"
20 GOSUB 1000
30 PRINT "{CLR}PUBLISHED BY COMPUTE!"
40 GOSUB 1000
50 GOTO 10
60 END
1000 C$=TI$
1010 IF C$=TI$ THEN 1010
1020 RETURN
```

Line 1000 defines C$ as TI$, so now both C$ and TI$ equal the current value of TI$. Line 1010 causes the computer to keep going back to line 1010 (to pause as long as C$ equals the current time of TI$). As soon as TI$ changes to the next second, C$ no longer equals TI$ because TI$ has changed, and this lets the computer drop through to line 1020, which returns it to the main program.

Here's where TI comes in handy. A string such as TI$ can be compared to other strings with the equals sign (as in line 1010 above). Because TI is a numeric variable, it's easier to use for calculations if you have to add, divide, or otherwise manipulate time. You can use TI in the delay subroutine above by substituting the following lines:

```
1000 J=TI
1010 IF TI=(J+60) THEN RETURN
1020 GOTO 1010
```

Einstein's Time: Fast Is Slow

Someday, you may be able to change time in real life—not just in your computer. One of Einstein's major discoveries is that time moves at different rates in different places at different speeds.

To understand what this means, let's say we have two computers which each keep *exactly* the same time. Put one computer in a jet and keep it flying continuously around the world at a very high speed. Leave the second computer on the ground. The computerized clock on the plane will run more slowly than the clock on the ground, although you have to fly exceptionally fast for a very long time before you get even a very tiny change you can measure.

Sound like science fiction? It's not. This experiment was actually performed, using ultra-precise atomic clocks.

Someday, parents may travel into deep space at tremendously fast speeds. Aboard their spacecraft, they won't notice any change in the rate at which time passes. For them, time will appear to move normally—but when they return to Earth, they may be shocked to find that they're "younger" than their children. Time "slowed down" when they traveled at such high speeds.

Speed influences time, which means time moves more slowly for objects moving fast, and time moves more quickly for objects moving slow—at least in terms of how those objects relate to each other.

There are many such undiscovered, untested, or unrefined relationships in the universe, some of which are only observable on an atomic or subatomic level, or on a planetary, stellar, or galactic scale.

It's inevitable that many discoveries now in progress will continue to change our entire concept of time, and perhaps time itself.

Line 1000 defines J as TI, just like C$ was defined as TI$ in the previous example. Line 1010 returns the computer to the program if 60 jiffies (1 second) are counted. Line 1020 keeps sending the subroutine back to line 1010 to see if 60 jiffies have passed yet. With this technique, you can "fine tune" your time delay. By changing 60 to a higher or lower number, you can vary the time delay. Two seconds would be 120 jiffies, three 180, and so on.

MACHINE LANGUAGE FOR BEGINNERS

Richard Mansfield, Senior Editor

Welcome To The Nightmare

Here's an interesting question we recently received:

What if I wanted to store (as an ML variable) a number like .5? I tried to POKE it in from BASIC by using POKE 49152,.5. However, when PEEKed, it was a 0. What gives?

Welcome to the nightmare: Numbers with decimal points in them (fractional numbers) are handled by the computer by a method called *floating point arithmetic*. Floating Point (FP) numbers are complicated because you have to take into account a whole range between minus zillions to plus zillions and, what's worse, each number within this range can have complicated fractions attached. This means that the result is a dizzyingly huge collection of possible numbers to work with. FP has caused computer engineers headaches ever since Alan Turing invented modern computing techniques in the '40s. He wrestled with FP, now it's your turn.

By contrast, numbers without any decimal point are called *integers* and can be manipulated by the computer (and us programmers) much more quickly and easily. For example, 15 is an integer, but 15.75 is a floating point number. The thing is said to "float" because you could also enter numbers like 157.5 or 1.575. The point isn't fixed in one predictable location within the numbers, hence, the point floats.

FP is an advanced topic, so we're going to split this column down the middle this month and show you how to work with floating point in ML, but, for beginners, we'll show how to write a universal, customized INPUT routine for any ML program.

Two Approaches

Notice that, in BASIC, you can define three kinds of variables: X$, which is alphabetic; X, which is floating point; and X%, which is integer.

ML usually involves only integer arithmetic (ADC, SBC, and other ML commands work on integers). For beginners, this is generally sufficient. You can easily write database, game, and most other software in ML without ever worrying about FP. However, if you must manipulate floating point variables (for a spreadsheet program or something deeply scientific), there are two main approaches:

1. The easiest way is to just write the floating point input, output, and arithmetic routines in BASIC. Let it do the hard part. Then SYS to ML for other aspects of the program.

2. JSR to BASIC's built-in floating point routines. These routines require that you establish the correct preconditions and that you set up a little buffer to make changes between ASCII-type, alphanumeric numbers, and true numbers. (This distinction is important in much ML work where you need to INPUT or PRINT numbers. The *ASCII* (printable) number 7 is 55. The *true* number 7 is, of course, 7.)

Here's a demo program which will show you how to access the built-in floating point math routines and how to INPUT and PRINT them from within ML:

Floating Point ML Routines

```
100 *= 864
110 ; "SIMPLEMATH"
120 ;  HOW TO ENTER TWO ASCII NUMBERS, MULTIPLY (OR DIVIDE OR ADD OR
130 ;  SUBTRACT THEM) AND THEN PRINT OUT THE RESULTS
140 .O
150 .S
160 ;---------------------- EQUATES ----------------------------
170 ASCIITOFP = $BCF3  (DCF3 VIC)
180 ;      ..............................................................
190 ;            USE ANY OF THE FOLLOWING FOUR AS YOUR JSR TARGETS
200 ;            IN LINE 400 TO ACCOMPLISH MULTIPLICATION, ADDITION
210 ;            SUBTRACTION, OR DIVISION.
220 ONETIMESTWO = $BA28; (DA28 VIC) (A = LOWBYTE, Y = HIGHBYTE IN MEMORY)
```

```
230 ;                THIS ROUTINE MULTIPLIES FAC1 BY MEMORY VARIABLE
240 ;                HELD IN 5-BYTE FP FORMAT & POINTED TO BY A AND Y.
250 ONEPLUSTWO = $B867; (D867 VIC) (SAME AS ABOVE, BUT ADDS FAC1+FAC2)
260 TWOMINUSONE = $B850;(D850 VIC)(SAME AS ABOVE, BUT SUBTRACTS FAC1 FROM FAC2)
270 TWOBYONE = $BB0F; (DB0F VIC)(SAME AS ABOVE, BUT DIVIDES FAC2 BY FAC1)
280 ;      ..........................................................
290 ;
300 FACTOMEM = $BBD4;(DBD4 VIC) STORE FAC1 INTO RAM (X = LOWBYTE, Y = HIGHBYTE)
310 FPTOASCII = $BDDD (DDDD VIC); CONVERT FAC INTO ASCII STRING
320 CHRGET = 115; BASIC'S READ-EACH-CHARACTER ROUTINE
330 CURPOS = 211; POSITION OF CURSOR ON SCREEN LINE
340 ;-------------------- MAIN LOOP ------------------------------
350 JSR INPUTFP; GET FIRST NUMBER INTO FAC1
360 LDX #<FACHOLD:LDY #>FACHOLD:JSR FACTOMEM;  STORE FAC1 TO MEMORY
370 JSR PRINTCR
380 JSR INPUTFP; GET SECOND NUMBER INTO FAC1
390 JSR PRINTCR
400 LDA #<FACHOLD:LDY #>FACHOLD
410 JSR ONETIMESTWO; MULTIPLY THEM
420 JSR OUTPUTFP; PRINT RESULT
430 RTS;  RETURN TO BASIC
440 ;.......................  SUBROUTINES  ............................
450 ;----------------------  INPUT NUMBER  -------------------------
460 INPUTFP LDA #$3F:JSR $FFD2; PRINT QUESTION MARK
470 LDY #0:GB STY Y:GF JSR $FFE4:BEQ GF; GET A BYTE FROM KEYBOARD
480 CMP #13; IS IT CARRIAGE RETURN
490 BEQ DONE; IF SO, STORE ZERO DELIMITER INTO BUFFER
500 CMP #20; IS IT THE DELETE KEY
510 BNE STORE:DEC CURPOS:LDA #32:JSR $FFD2; (DELETE, SO PRINT BLANK)
520 DEC CURPOS:DEC Y:JMP GF; LOWER Y POINTER AND RETURN TO GET LOOP
530 STORE LDY Y:STA $0100,Y; OTHERWISE STORE NUMBER
540 JSR $FFD2:INY:JMP GB; PRINT NUMBER & LOOP FOR MORE
550 ;---------------------  TRANSFORM & STORE  ---------------------
560 DONE LDA #0:LDY Y:STA $0100,Y; STORE DELIMITING ZERO
570 LDA $7A:STA T7A:LDA $7B:STA T7B; SAVE CHRGET ADDRESSES
580 LDA #$FF:STA $7A:LDA #0:STA $7B; POINT CHRGET TO BUFFER
590 JSR CHRGET:JSR ASCIITOFP; PUT STRING INTO FAC1
600 LDA T7A:STA $7A:LDA T7B:STA $7B; RESTORE CHRGET
610 RTS
620 ;--------------------  OUTPUT NUMBER  --------------------------
630 OUTPUTFP JSR FPTOASCII;PUT FAC1 INTO STRING AT $0100
640 LDY #0;   PRINT OUT STRING
650 SHOWIT LDA $0100,Y:BEQ ALLDONE:JSR $FFD2:INY:JMP SHOWIT
660 ALLDONE RTS
670 ;--------------------  PRINT CARRIAGE RETURN  -----------------
680 PRINTCR LDA #13:JSR $FFD2:RTS
690 ;-----------------------  VARIABLES  --------------------------
700 T7A .BYTE 0
710 T7B .BYTE 0
720 Y .BYTE 0
730 FACHOLD .BYTE 0 0 0 0 0;  STORAGE FOR FAC IN MEMORY
```

All the other built-in BASIC math routines are similarly accessible. If you want to activate SIN, just look on a map of your BASIC ROM for its entrance point and preconditions.

Custom INPUT

Since anyone who's deeply enough into ML to work with floating point math is capable of reading the source code in this program for himself or herself, we'll limit ourselves to an explanation of the input subroutine between lines 460–540.

You might have wondered how programmers created custom cursors, excluded certain input, etc. The subroutine in this program, called INPUTFP, can be modified to allow you to accept inputs from the user for any kind of program. What's especially useful about this is that you can check and control what the user is allowed to type in, rejecting things if you wish. You can also allow commas, suppress video echo (for secret password entry), or whatever else you might need for a general purpose input subroutine for use in your ML programs.

As it stands, the routine only recognizes the carriage return and the delete key as special cases. You could add your own CMPs to create as many particular responses as your program requires. Here, we're simply getting a string of digits into a buffer at address $100. The Y Register will keep track of our position in the buffer so that each new digit will be in its proper place.

Let's go through the routine step-by-step to see what's happening. First, we print a question mark on the screen to let the user know that we expect input. You could create a prompt message here, draw a box limiting the size of the number to be input, make a special cursor, etc.

A Tight Little Loop

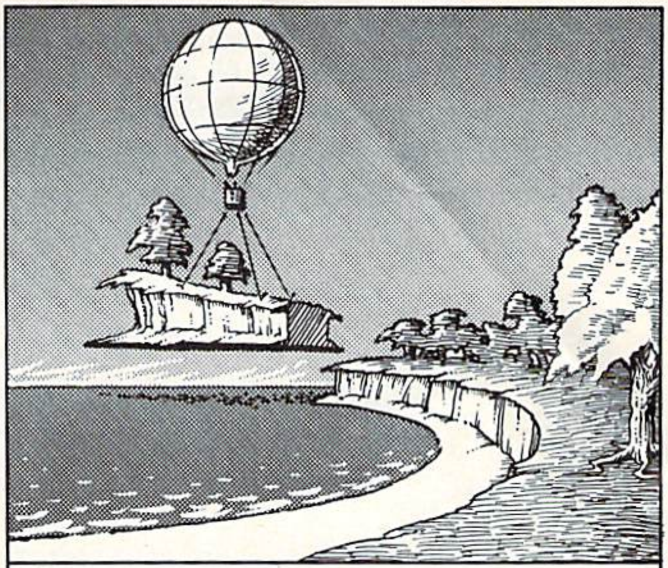
After printing ?, we set our position counter, Y, to zero so the first digit will be stored at $100. There are two loops in this routine: GB and GF. GB starts off by saving the position counter into a variable we've defined as "Y" and then we fall into the tight little loop that cycles until someone presses a key on the keyboard. GF...BEQ GF on line 470 is a pretty typical GET loop.

Then we test to see if the user has entered his entire number and, therefore, has pressed RETURN. If so, we BEQ out of the input routine and store a 0 at the end of our string of digits to show that the number ends there. However, if the user hasn't yet pressed RETURN, we next test to see if he's made an error and is trying to rub it out with the delete key (line 500).

If no delete is detected, we branch down to the STORE routine in line 530 where we recover the position pointer from its "Y" holding place, store the digit into the buffer address *plus the value of the Y register* (STA $0100,Y), print the number on the screen (JSR $FFD2) so the user can see what he's typed, raise the pointer with INY, and return to the start of the loop to fetch another digit.

Allowing Deletes

If, however, there was a delete keypress detected in line 510, we DEC CURPOS. CURPOS is the zero page variable maintained by the computer which always knows where the current cursor position is (see line 330 where this is defined for the assembler). We want to back up one character and LDA #32: JSR $FFD2 which will print a blank over the previous digit. However, printing that blank automatically moves the cursor one column to the right, so we need to DEC CURPOS once more to be ready to receive the next digit in the proper place on the line. Then we DEC Y, which lowers the pointer position variable by one, and jump back to the start of the loop to get another digit.



FLOATING POINT

This routine does not contain any range checking to prevent the user from entering, say, letters of the alphabet instead of digits. That's one thing you might want to add to your customized input routine. Any input lower than 48 (ASCII for 0) or higher than 57 (ASCII for 9) could be blocked. A simple jump back to GF would prevent such errors from being echoed to the screen or stored into the little input buffer.

Quick Search

W. A. Yarberry

If you've discovered a clever timesaving technique or a brief but effective programming shortcut, send it to "Hints & Tips," c/o COMPUTE!'s GAZETTE. If we use it, we'll pay you $35. Due to the volume of items submitted, we regret that we cannot always reply individually to submissions.

Do you have a collection of several thousand stamps, baseball cards, recipes, or something else you've always wanted to catalog on your computer? Perhaps you've already started writing a cataloguing program with ideas from the "Relative Files" article in the June GAZETTE and "Understanding Sorts" in the May issue.

So now you have an outline for a program that allows you to enter and alphabetize data for the catalog. Once the program is done, and you've typed in all of the information, how are you going to find a specific entry in the list? Let's investigate a simple telephone directory program.

Telephone List

At the beginning of the program, you reserve space in memory with the dimension statement: DIM NAME$(200): DIM TEL(200). People's names will go in the string array, their telephone numbers in the numeric array.

Next, you design a menu that offers several choices, like 1) enter new names, 2) make corrections, 3) alphabetize, 4) print entire list, and so on. You also need a file-handling routine to read and write names to disk or tape. Each menu item is tied to a subroutine.

One of the subroutines will look for a specific person's name and print his or her telephone number. So you sketch out a searching algorithm:

```
900 PRINT "WHOSE TELEPHONE NUMBER?"
910 N=0:INPUT N$
920 FOR J=1 TO 200:IF N$=NAME$(J) THEN
    N=J:J=200
930 NEXT J
940 IF N=0 THEN PRINT"NAME NOT
    FOUND":RETURN
950 PRINT TEL(N):RETURN
```

The basic idea is to search through the list, from beginning to end, comparing the names with the target name. If the name is found, J is set to 200 (the end of the list), so the FOR-NEXT loop ends.

At the root of this idea is brute force—trying things until you find something that works. If everything's in alphabetical order, and you're searching for a Youngblood at the end of the list, your computer will have to look laboriously through the Adams, Browns, Coopers, and so on. As the list gets longer, so does the tedious wait you'll have to endure.

A Binary Search

How do you find a name in the telephone book? It would be madness to start at AAA Realty and read through every single name until you find a match, right? If you want Joan Smith's number, you'd probably open the phone book halfway, compare the names on the page to Smith and flip pages back and forth until you reach the right name.

This method, jumping back and forth while narrowing down the choices, can be used in a program. It's called a binary search because the list is divided in two again and again. First you find the halfway point, and decide if the target name is in the first half or the second half. With one IF-THEN, you've eliminated half of the names on the list. Next, look at the halfway point of the remaining items.

Here's how the search works. In this case, the variable H starts out as the highest item on the list, and L is lowest. M is the midpoint and is used as a new H or L, depending on whether we're too low or too high in the list.

```
500 H=200:L=1:R=0
510 PRINT"WHOSE TELEPHONE NUMBER?"
520 INPUT N$
530 M=INT((H+1-L)/2)+L
540 IF H-L<5 THEN GOTO 580
550 IF N$=NAME$(M) THEN R=M:GOTO600
560 IF N$>NAME$(M) THEN L=M+1:GOTO530
570 IF N$<NAME$(M) THEN H=M-1:GOTO530
580 FOR J=L TO H:IF N$=NAME$(J) THEN R=J
590 NEXT
600 IF R=0 THEN PRINT"NOT FOUND":RETURN
610 PRINT TEL(R):RETURN
```

One essential condition for a binary search is that the names (the array NAME$, in this case) must be in alphabetical order. If you have a jumble of names, in no particular order, a binary search won't work. The same would be true of a phone book. If the phone company listed names haphazardly, you'd have to search through the entire book to find a specific person.

Note line 540, which jumps to 580 if the difference between H and L is less than five. Once you've got it narrowed down to a few names, you might as well loop through them.

This subroutine finds a certain item and puts its index number into the variable R. If no match is found, R will be zero.

Let's say your phone list includes Adelaide Van Buren and her name is number 162 on the list. Here's how the binary search would work:

L	H	M	(result)
1	200	101	too low
102	200	151	too low
152	200	176	too high
152	175	164	too high
152	163	158	too low
159	163	(start FOR-NEXT loop)	

After just five comparisons, we've narrowed the search to 159–163. Compare that to the brute force FOR-NEXT loop which would have to compare 161 items before finding the right one.

With long lists, the time saved multiplies. If you double the size of the list (from 200 to 400), only one more comparison would be needed, because each time the midpoint M is transferred to L or H, you eliminate half of the list from consideration.

In benchmark tests, the binary search took just 3.0 seconds to locate a telephone number from an array of 2000 names, compared to 13.7 seconds for the FOR-NEXT loop. Granted, 14 seconds doesn't seem like a long time, but it means that only about four names can be found per minute, compared to 20 names per minute with a binary search.

ZOUNDS! Part 1

Lawrence Cotton

Your 64 never sounded like this before. In this first of a three-part series, the author presents six short "zound" demos for use in your own programs—and for your listening pleasure.

Of all the impressive capabilities of the Commodore 64, the one that stands head and shoulders above the competition is sound. In this three-part series, we'll look at (and listen to) 18 short sound programs—six each month—which you can use in your own programs. While we won't guarantee you haven't heard similar sounds in a few commercial programs, we doubt it.

How can one computer make so many sounds? It has only three voices and four waveforms. But the chips and keys that are the Commodore 64 belie its real capabilities; even these sound programs are just the tip of the iceberg.

Most of these programs use the ring modulation and sync features of the SID chip. For those new to the Commodore 64, these rather arcane capabilities were designed into this chip to give it music-synthesizer characteristics. But music synthesizers are often used not to make music, but sounds.

Short And Sweet

Note that only a few lines are necessary to program these sounds. If you leave out the REMs, they can usually be compressed into four or five lines. Be sure to save each program to tape or disk before running, in case of a mistyped number.

You can easily change the sounds produced by these programs to suit your own tastes. But a few of these programs are very delicately balanced, so that even a seemingly innocent change in values can drastically alter the final output. If you change a sound, save it to disk or tape as soon as you get it where you like it. You may never find it again. (I lost some really good ones before I learned this lesson.)

All of these programs sound better when played through a good hi-fi system. If you haven't taken advantage of the hi-fi output of your computer, now's the time to do so. Just buy a DIN plug to fit your computer and a shielded RCA phono-plug cable long enough to reach your hi-fi. Connect the open end of the cable to the pins of the DIN plug corresponding to the audio out and ground pins of your computer. Check your User's Guide for which pins are which. Radio Shack carries both the plug and the cable.

Sound Anatomy

All programs clear the sound chip and set the maximum volume in line 10, then set up the envelope (how fast a sound starts and ends) in line 20. Most POKE waveform 23 to voice one

(54276) in line 20 also. Waveform 23? There's no such thing! While largely undocumented, it's possible to use sync and ring modulation together with the triangle waveform. Many of these sounds depend on this very combination for their uniqueness. The number 23 is the sum of 16 (triangle) + 4 (ring modulation) + 2 (sync) + 1 (gate or turn-on). For those programs which have a 21 POKEd to 54276, the sync feature is omitted.

Ring mod and sync are two ways to combine two notes of different frequencies to produce a totally different, and usually unpredictable, result. In the case of ring modulation, the result is notes with a wide range of nonharmonic overtones; syncing two voices logically ANDs them together to produce different overtones, which will be momentarily in phase (reinforcing) then out of phase (cancelling) each other.

Most of the programs also make extensive use of nested FOR-NEXT loops. To help identify beginnings and endings of loops (but at the loss of some speed), all the NEXTs include the name of the FORs. That is, FOR Z = 1 TO 3: . . . NEXT Z. Incidentally, the Z loop is always the number of times the sound is cycled.

Look for F1 and F2 in the program listings. These are the two values POKEd into frequency registers for voices one and three, respectively. (Note that the most significant byte of the two frequency registers per voice is used, except for "Decelerator," to come later in the series.) The sounding voice (one) must have its waveform, envelope, and frequency registers POKEd with values, but the controlling or synced voice (three) usually needs only its frequency register (54287) POKEd with a value.

Because of space limitations here, only one program—"Bent Laser"—will be analyzed as a typical example. For the rest we'll mention only unique characteristics.

This program contains four nested FOR-NEXT loops. Starting with the innermost loop (X): F2 (voice three's frequency) is incremented by multiplying it by 1.4 five times. The next loop out (Y) resets voice three's frequency to 8 and increments F1 (voice one's frequency) three times by a multiple of 1.5.

Control then moves to the W loop, which multiplies voice three's frequency by 1.05 ten times. This ends the first cycle, controlled by the outermost loop Z. The Z loop resets F1 to 2, and repeats the same basic sound three times.

Increase Z to cycle the sound more times, or play with other parameters to see what effect they have. The REMs should be of some help.

"Three-Toed Wheel" uses three nested loops and waveform 21 instead of 23.

"Minor Thriller" yields an elaborate arpeggio of a minor chord, using five loops (V loop is a short delay) and waveform 23.

"Sliding Forest" sounds just like its name. Note that it's based on waveform 21 and uses only two loops.

"Ring Thing" and "Gnir Gniht" are just alike except that the first uses waveform 23 and the second uses waveform 21.

The easiest way to use these sounds in your own programs is to make subroutines out of them. You must clear the sound chip and set the volume at least once, usually near the beginning of your program. Since none of the Zounds programs uses GOTOs, they can be renumbered with your own subroutine line numbers. When you want the sound to be heard, just GOSUB to your line number. Be *sure* to add a RETURN as the last statement in the subroutine (usually after POKE 54278,15). Because the FOR-NEXT loops are extraordinarily sensitive, adding any sprite movements or other time-consuming activities *inside* them will wreak havoc on the timing; the sound will most likely be totally different, although not necessarily bad.

Next month, we'll continue with more "Zounds" for the 64.

(See listings on page 102.)

User Group Update

When writing to a user group for information, please remember to enclose a self-addressed, stamped envelope.

Send additions, corrections, and deletions for this list to:

COMPUTE! Publications
P.O. Box 5406
Greensboro, NC 27403
Attn: Commodore User Groups

Changes

People wishing to contact Wisconsin's Coulee Country Commodore Club may do so at the following address: Coulee Country Commodore Club, W. 6581 Oak Park Dr., Onalaska, WI 54650. Previously, the club had only provided us with an address of its meeting place.

The new contact person and address for the Colorado Springs Computer Society (CSCS) is Alyn M. Jackson, 4058 Baytown Dr., Colorado Springs, CO 80916. The phone number is (303) 390-6289.

The Sphinx Commodore Users Group Inc. also has a new address: 22091 Young Ave., Castro Valley, CA 94546. The club's bulletin board can be reached at (415) 581-9452.

The Zymec Users Group in Lander, WY, has disbanded. Those interested in re-forming a group in this area should contact Tim Struna at 254 Canyon St., Lander, WY 82520; telephone (307) 332-6644.

The Pioneer Valley VIC/64 Club is now the Pioneer Valley Commodore Club. The new address and phone number are 6 Laurel Terrace, Westfield, MA 01085; (413) 562-1027.

The Southern Maine 20/64 is now Southern Maine Commodore. Information about the group can be obtained by contacting Steve Shoprio, chairman, P.O. Box 416, Scarborough, ME 04074-0416.

New Listings

ALABAMA

Valley Commodore Users Group (VCUG), David W. Nelson, 915 Way Thru the Woods SW, Decatur, AL 35603, (205) 355-4005

Montgomery Area Commodore Komputer Society (MACKS), Charles Russell, P.O. Box 210126, Montgomery, AL 36121-0126, (205) 279-6750

Commodore Club-South, William J. Freeman, P.O. Box 324, Pinson, AL 35126, (205) 854-3496

Scottsboro Commodore "64" users group, Richard Radon, Rt. 5, Box 255, Scottsboro, AL 35768

ARKANSAS

Conway County Computer Users Group, Rt. 2, Box 69, Morrilton, AR 72110

CALIFORNIA

The Central California Commodore Computer Club (C-5), Jim Crawford, 3440 De Anza Ave., Merced, CA 95340, (209) 723-0751, ext. 58

Southern Orange County Commodore Komputer Services Group (S.O.C.C.K.S.), Tony Hardy, The Wizard's Exchange, 26421 Avenida Deseo, Mission Viejo, CA 92691, BBS: (714) 472-0934

Commodore User Group (forming), Gregg C. Ramos, 24285 Sunnymead Blvd., #157, Sunnymead, CA 92388

COLORADO

Colorado Commodore Computer Club, c/o Ral Sandberg, 64 Mountain Shadows Lane, Castle Rock, CO 80104

The "Local Folks Computer Club", c/o S. Martin, 1653-130 Rd., Glenwood Springs, CO 81601

Western Slope Commodore User's Group, P.O. Box 4142, Grand Junction, CO 81502

Commodore Condor Club, Don Musich, 1680 Lewis St., Lakewood, CO 80215, (303) 233-1543

CONNECTICUT

Greater New Haven Commodore User Group, P.O. Box 796, North Haven, CT 06473, (203) 776-7447

DELAWARE

Lower Delaware Commodore Computer Club, Paul Nys, 110 Strawberry Way, Rehoboth Beach, DE 19971

FLORIDA

Public Domain Users Group, P.O. Box 1442, Orange Park, FL 32067

GEORGIA

Commodore's Telecommunications Users Group (CTUG), Isaac Culver III, P.O. Box 143, Glenwood, GA 30428, BBS: (912) 523-5295

ILLINOIS

Western Illinois Commodore Users Group, Galesburg Chapter, Randy Fox, 195 Olive St., Galesburg, IL 61401

Jacksonville Area Commodore Users' Group, Greg Simpson, P.O. Box 135, Murrayville, IL 62668, (217) 882-5481

INDIANA

Columbus Commodore Club, Walt Hutton, 2676 Lafayette St., Columbus, IN 47201

Commodore Users Group of Rush County (CUGOR), Mike Kilgore, 829 N. Willow St., Rushville, IN 46173, (317) 932-3839 or Vance Mosley, Box 22, Manilla, IN 46150, (317) 544-2571

IOWA

Tri-State Commodore Users Club, John K. Gallaher, 108 Blondeau, Keokuk, IA 52632

KANSAS

High Plains Commodore Users Group, Alan Clingingsmith, 1307 Western Plains, Hays, KS 67601, (913) 625-6266

MARYLAND

Commodore Computer Kids (for ages 7–17), Dan Mullaney, 403 Avery Ct., Joppa, MD 21085

MASSACHUSETTS

South Shore Commodore, Wayne Johnson, P.O. Box 2195, Quincy, MA 02269, (617) 472-2754

MICHIGAN

B.H.S. Computer Club, c/o Ronald Ruppert, Belleville High School, 501 W. Columbia, Belleville, MI 48111

Northern Genesee County Commodore Users Group (N.G.C.C.U.G.), John Richards, P.O. Box 250, Clio, MI 48420

Future World Users Group, P.O. Box 54, Wayne, MI 48184

MINNESOTA

Metro-Area Commodore Computer Club, Box M, Mendota, MN 55150, (612) 729-0232

MISSISSIPPI

Commodore Computer Club, Sean White, Rt. 9, Box 1400, Hattiesburg, MS 39401

MISSOURI

C.B.U.G., Michael Jett, 1925 Treasure Dr., Kennett, MO 63857

Commodore 64 User Group, Bryce Jones, 820 E. Line, Kirksville, MO 63501

NEBRASKA

Pathfinders 64, 2133 Clarmar St., Fremont, NE 68025, (402) 727-1276; 721-4346; 727-1608

NEW JERSEY

Plasma Physics Lab User Group, Earle Sheaffer, Princeton University, P.O. Box 451, Princeton, NJ 08544

Commodore Computer Collection Club, Mel Friedman, 72 Pine Dr., Roosevelt, NJ 08555, (609) 448-5186

NEW MEXICO

Taos Area Commodore User's Group, David Hull, P.O. Box 5089, Taos, NM 87571, (505) 758-4458

NEW YORK

Adirondack C-64 Users Group, Jean Kerst, P.O. Box 99, Blue Mountain Lake, NY 12812

Bronx-64 Users Group, c/o Dave Rivera, P.O. Box 47 Cornell Station, Bronx, NY 10473

Canastota Users of Commodore Computers (C.U.C.C.O.), c/o Frank Mitchell, 220 Lamb Ave. Canastota, NY 13032

Commodore Users Group of Greater New York, Elmo Christian or James Wattson, 190–25 Woodhull Ave., Hollis, NY 11423, (718) 776-0808; 693-6118

HCHS C-64 User Group, c/o Mr. Szkolar, 71 E. 94th St., New York, NY 10128

The Niagara Falls Commodore Club, Bill Asklar, 2405 Willow Ave., Niagara Falls, NY 14305

Computer Literacy and Programming (CLAP), Jonathan Lieberman, 7 Tuttle Dr., Ossining, NY 10562, (914) 941-2378

D-BUG, Charles Wagner, 78-23 91st Ave., Woodhaven, NY 11421

OHIO

Dayton Area VIC-20 Users Group, Darryl Johnson, 4454 St. James Ave., Dayton, OH 45406, (513) 278-3653

Commodore Hammondsville Users Group of Ohio (C.H.U.G.O.), Randy Zimmer, P.O. Box 7, S.R. 213, 6N642, Hammondsville, OH 43930. *Note: This group is for handicapped computer users.*

Commodore Erie Bay Users Group (CEBUG), Rudy Dudics, P.O. Box 1461, Sandusky, OH 44870

OREGON

Lane County C-64 Users Group, P.O. Box 11316, Eugene, OR 97440, (503) 726-2131

Springfield Commodore Users Group, 4400 Franklin Ave., Suite 1443, Eugene, OR 97403, (503) 741-2522

PENNSYLVANIA

Fort Washington 64, Howard S. Bacon, 1311 Barton Dr., Fort Washington, PA 19034

Reading Commodore Users Group, 1020 Pear St., Reading, PA 19601, (215) 373-6813

RHODE ISLAND

R.I. Commodore Users Group (RICUG), Joe Osborne, 4 Mowry Ave., Johnston, RI 02919, (401) 231-3537

SOUTH CAROLINA

Commodore Kids of America, Kelly W. Etheredge, Rt. 8, Box 280, Sumter, SC 29150, (803) 469-8861

TENNESSEE

Springfield Commodore Computer Club, Paul M. Bell, Rt. 1, Box 166, Springfield, TN 37172, (615) 384-4050

TEXAS

Tri-State Commodore Users Group, Mike Williamson, P.O. Box 8971, Amarillo, TX 79114-8971, (806) 355-2465

Commodore Exchange, Bill Hunter, 106 Catalpa, Lake Jackson, TX 77566

VERMONT

Commodore Users Group (forming), Darlene Colburn, R.R. 1, Box 3242, Rutland, VT 05701, (802) 775-5321

VIRGINIA

Henry County Commodore Computer Club, Rt. 8, Box 67, Martinsville, VA 24112,

The Richmond Area Commodore Enthusiasts (T.R.A.C.E.), Bill Uhler, 2316 Lafayette Ave., Richmond, VA 23228, (804) 266-0601

WASHINGTON

Marsteken Commodore 64 User Group (forming), Steve Sowders, 714 Ryan Ave., Sumner, WA 98390, (206) 863-1236

Blue Mountain Commodore Users, Jim Godfrey, 550 S. 2nd Ave., Walla Walla, WA 99362-3149, (509) 529-4663

WEST VIRGINIA

C-64 Programmers of America, Elmer Duncan, Rt. 1, Box 119A, Meadow Bridge, WV 25976, (304) 392-5391

WYOMING

Central Wyoming User's Group, P.O. Box 1428, Riverton, WY 82501

Outside The U.S.

AUSTRALIA

Lismore C-64 User Group, John Grimmond, Richmond Hill Rd., Wollongbar, Via. Lismore, New South Wales, Australia, (066) 2442320

Southport Commodore Computer Users Group, (S.C.C.U.G.), Box 790, Southport, Queensland, Australia 4215

CANADA

Manitoba Users Group (M.U.G.), Mike Orloff, 41-33 Weatherstone Place, Winnipeg, Manitoba, Canada R2J 2S9, (204) 257-3346

C64 North Bay Users Group, Bob Lavallee, 790 Laurentian Ave., North Bay, Ontario, Canada P1B 7V2, (705) 476-2805

Niagara Commodore Users Group, Ian Kerry, 12-44 Queenston St., St. Catherines, Ontario, Canada L2R 2Y9, (416) 688-6464

Saskatoon Commodore Users Group, c/o Vera Heinz, P.O. Box 1944, Saskatoon, Saskatchewan, Canada S7K 3S5

Commodore User Group, Warwick E. Beadle, 46 Klondike Rd., Whitehorse, Yukon, Canada Y1A 3M1

DENMARK

MIDTJYDSK Computer Club (M.C.K.), Postbox 10, DK-7470 Karup J., Denmark, Phone: 06-662254 (for calls within Denmark)

ITALY

IHT Division: Users, Via Borgonuovo 19, 20121 Milano, Italy

WEST GERMANY

H.U.G. 64, Box 10, 61st M.P. Co., APO New York 09165, Phone: 06-183-71963. *Note: Located in Hanau, West Germany*

GIZZMO'S, c/o Wes Knapp, Box 3517, APO New York 09009. *Note: Located in Kaiserslautern, West Germany*

WEST INDIES

Caribbean Commodore Computer Club, Jim Lynch, P.O. Box 318, St. Johns, Antigua, West Indies, (809) 462-4965

HORIZONS

Charles Brannon
Program Editor

It's been a year since we looked at the Covox Voice Master, a hardware/software combination for the 64 that lets you record and play back speech. Since then, Covox has developed improved hardware, and innovative new software. The original Voice Master was a small box that plugged into the user port. A small plastic microphone attached to the box. The new Voice Master plugs into the paddle port, and uses a headset microphone/earphone combination. You can divert the computer sound to the earphone, a plus for those who don't wish to disturb a coworker or roommate.

The principle of the Voice Master is quite simple—it digitizes any sound from the microphone, then reconstructs the sound and plays it back through the SID chip. It's like a tape recorder that uses your computer memory as storage.

Sound digitization works by breaking up time into discrete units. A sound frequency is just the number of changes in volume per unit of time. For example, some unfortunate computers generate sound by sending clicks to a speaker. The faster the click, the faster the buzz sounds, which approximates higher frequencies. If you turn this idea around, you can break up a single tone into a number of clicks. To be more sophisticated, each click can represent one of 16 volume levels from no sound (0) to a loud sound (15). So what we think of as continuous, uninterrupted speech, music, or tones can actually be divided into discrete "sound particles."

Time Atoms

Of course, the tiniest sound particle can't be used. Although some physicists suspect that time itself is divided into discrete units, where some unit would be the indivisible unit of time, it would take a huge number of these time atoms to fill a microsecond. Instead, we must approximate. Indeed, the ear (and the brain) can work only so fast. Let's just slice time into arbitrary units, say 1000 per second. Then you sample the sound 1000 times per second. Each sampling is the volume level of the sound at that time.

Since each sampling is a single number, it can be stored and processed by a computer. When you play back these volume levels at 1000 times per second, you hear a rough approximation of the sound. By increasing the sampling rate, you get closer and closer to the actual sound. At some point, you just can't tell the difference. Since the highest frequency audible to the human ear is around 20,000 cycles per second, it's quite adequate to sample 44,000 bits per second. But at this rate, it takes 5500 bytes to store one second of sound.

This didn't stop the developers of compact discs. A compact disc (CD) with a music capacity of 20 megabytes can store a whole record album, and play it back flawlessly, since the bits are stored as pits in a plastic disc, then read by a laser. And at 44,000 bits per second, not only can you not tell that the sound is digitized, but also there is no distortion as you find with vinyl records or magnetic tape. This technology is returning to computers. New mass storage techniques are using compact discs (which can store up to 550 megabytes) to store huge enyclopedias of data. There are already read/write laser discs with unprecedented storage capacity though the cost per kilobyte is not yet competitive with hard discs or floppies.

If your technology is less ambitious, though, it can be very affordable, and less voracious of memory. The Covox Voice Master uses hardware that samples sound up to 12,500 bits per second. Although the sound is somewhat rough, it's quite recognizable. Unlike other voice synthesizers, which produce electronically generated sounds or play back someone else's digitized voice, the Voice Master's voice is your own. Again, like a digital tape recorder, you can record and playback almost any sound. The system is not limited to recording and playback. Special software lets you train it to recognize a small vocabulary of words, and, programmed to analyze the frequency of sound, to turn your voice into a musical instrument.

Before using it, you must calibrate the unit with your computer. This is easy to do with the calibration program and a small screwdriver. You also adjust a gain control to set the sensitivity, which is useful if there's a lot of background noise.

Voice Wedge

The package comes complete with software, including wedges that add commands to BASIC. For voice recording/playback, you use the command LEARN *number*. This waits for you to say something and records it for up to eight seconds or until you stop speaking. The phrase is stored into a slot of memory identified as a *number* from 0 to 63. You can then playback the speech with PLAY *number*.

A SPEED command lets you change the speed at which the word is played. Changing the speed also affects the pitch. RATE lets you alter the sampling rate from 4000 up to 12,500 bits per second. A lower RATE saves memory at the cost of sound quality. You can save memory without sacrificing quality by speaking slightly faster and in a higher pitch than normal when recording, then playing it back at a lower speed. You could probably improve voice quality if you talked slowly and at a lower than normal pitch (which takes more time and memory to record), then played it at a higher speed. There's up to 41K of memory available for digitization, allowing more than a full minute of speech. Of course, the more memory you allocate for digitizing, the less is available for your BASIC program.

You can also save and load vocabularies of recorded words. The improved vocabulary loader speeds up the effective transfer rate of the 1541 disk drive, as long as your house current runs at 60 cycles per second (a rate precisely followed in the U.S. and Canada, but not in many European countries). This can extend the actual amount of speech you can play back, simply by playing files continuously. It's important to note that you only need the Voice Master hardware when recording the speech (it listens to the microphone and turns the volume into an analog signal suitable for conversion to digital by the SID chip's paddle ports). The software plays the recorded speech without any help from the hardware. A simplified and shorter machine language program removes the wedge commands (which saves memory), letting you use SYS commands to load vocabularies and play them from your own programs without any need for the Voice Master hardware.

Digital Pizza

It's also worth noting that you aren't limited to recording speech. As a digital recorder, the Voice Master can record and playback any sound. I've digitized songs from the radio, and invented strange sound effects that are much easier to use than programming the SID chip. Each "word" can actually be a phrase. With a predefined vocabulary of stock phrases, I used the Voice Master to order a pizza over the telephone. I recorded all the phrases I thought I'd need, then placed the SPEAK commands on the screen, ready to be cursored to and executed: the type of pizza, my phone number, address, a "yes" answer, a "no" answer, a "thank you," and the pizza order repeated in a different way, in case the pizza place said "What?" By listening to the questions and selecting the right response, I got the message through—and my pizza. It's a testament to the recognizability of the speech. It really sounds like a person talking (your own voice in fact), not like an alien from a videogame.

Example programs supplied with the Voice Master show some of its possibilities. A talking calculator asks you to speak the digits 0–9, +, −, =, ., *, /, and so on. You then type in calculations, and your own voice confirms what you're typing. The result of the calculation is also spoken. A talking clock records your pronunciation of the numbers one to twelve, and phrases like "a.m." and "o' clock." At the press of a key, the time is spoken. You can set an alarm that speaks a prerecorded message when it goes off.

Most voice synthesizers work with phonemes, the raw vowel and consonant components of speech, and can pronounce any word, though the speech sounds rather robotic, even with voice synthesizers capable of inflection. Voice Master is limited to 64 words, phrases, or sounds, but you can customize its vocabulary to a particular application. It's output is exactly like the input, though of a rougher quality.

Key Match

The fun doesn't stop with speech recording/playback. Another utility lets you train the computer to recognize your spoken input. The best analogy I've heard to describe this is how, given one key, you would find its match in a keychain. You would align the notches of each key with the master key. You've found the match when the notches line up. In voice recognition, the digital pattern of the input is compared to previously digitized patterns. The closest match "wins." Of course, this is only a crude explanation. The technical manual that explains the voice recognition goes into great detail, using advanced mathematics.

The recognition software adds commands to BASIC, letting you record, recognize, save, and load vocabularies. You need the hardware for both training and recognition. You have all the digitizing commands available to you as well. A sample program demonstrates voice recognition. You pronounce the names of eight colors, repeat this again to let the software average the slightly different way you may say a word, then say all the words again to record the sound of the words. You then enter recognition mode. Just speak the color "red," and you hear "red" repeated, and the screen border turns red. You have direct voice control over the screen border. With some programming, you could define your own set of recognizable vocabulary. Imagine reading a program listing into the computer instead of typing it in.

The recognition is far from perfect, though. It can only easily recognize words that clearly sound different, and usually only words spoken by the same person who trained the program. If you're careless or inconsistent with your pronunciation, it will fail to recognize the word, or pick the wrong one. It helps to train the same word several times, since this refines the average. There's a noticeable delay between speaking a word and getting a response, although the delay is less than a second at worst. Despite these limitations, the voice recognition is startling and fascinating to explore. You almost have the illusion that the computer understands what you're saying.

The Electric Kazoo

Although these features alone make the Voice Master a powerful product, the Covox engineers are inventing even more applications for it. Take the Voice Harp, for example. Just hum into the microphone, and the note you hum is translated into a SID chip tone. It's like a computerized kazoo that can simulate several musical instruments. You can choose to whistle if your humming's not up to par. The Voice Harp just hums with you in real time, and can display the note you're singing. It can recognize and play three-voice harmonies. Unfortunately, it doesn't record your notes for later playback. For that you use the Composer program.

The Composer lets you hum a whole song into the microphone. It presents a scrolling staff. Every note you hum jumps right onto the staff. The program keeps track of the timing for you, so long hums become whole notes, and short hums become eighth notes. When you pause, the program inserts rests. You can speed up or slow down the overall tempo, transpose the whole song up or down a half-step, save and load complete songs, and customize the sound to act like many common musical instruments. The editor lets you work with individual notes. You can scroll the staff left and right, raise or lower the pitch of a note, change its duration, delete a note, insert an eighth rest, and insert a note by humming into the microphone.

Musical Magic

The Covox Composer is a liberator. For the first time I've been able to compose songs without needing any real knowledge of music. The instant feedback of the scrolling staff and the computer's echoing of your singing lets you home in on the right sound. This can be a great boon for learning music, and improving one's ability to sing on key. If you sing consistently off-key, you can still transpose the music into the right place.

At last, your own voice, which takes little training to play, can be a real musical instrument. Even though the program could be improved (it can't keep up with a normal singing pace, and only permits you to record one voice), it works like no other composer program available. It will be interesting to see what Covox comes up with next.

Covox, Inc.
675-D Conger Street
Eugene, OR 97402
$89.95 (including software)

Bug-Swatter:
Modifications And Corrections

• The Plus/4 and 16 programs for "Understanding Sorts" (May) do not work as listed. An old version of the listing program was accidentally used to print these programs; it does not recognize newer commands like COLOR or GRAPHIC, and thus substituted commands from BASIC 2.0. We apologize for any inconvenience this may have caused readers. Here are the programs listed correctly:

Bubble Sort

```
10 S=99:DIML%(S):COLOR4,7,1:COLOR0,1:COLO
   R1,2:GRAPHIC1,1
20 FORT=1TOS:L%(T)=RND(0)*S*3+12:X=L%(T):
   Y=2*T:DRAW1,X,Y:NEXT:TI$="000000"
30 FORI=S-1TO1STEP-1:FORT=1TOI
40 IFL%(T)>L%(T+1)THENGOSUB70:TE=L%(T):L%
   (T)=L%(T+1):L%(T+1)=TE
50 NEXT:NEXT:T$=TI$:POKE239,0
60 GETKEYA$:GRAPHICS0,1:PRINTS"ITEMS SORT
   ED IN "MID$(T$,3,2)":"MID$(T$,5,2)".":
   END
70 Y=2*T:X=L%(T):DRAW0,X,Y:Y=2*(T+1):X=L%
   (T+1):DRAW0,X,Y
80 Y=2*T:X=L%(T+1):DRAW1,X,Y:Y=2*(T+1):X=
   L%(T):DRAW1,X,Y:RETURN
```

Shell Sort

```
10 S=99:DIML%(S),M%(S):COLOR4,7,1:COLOR 0
   ,1:COLOR1,2:GRAPHIC 1,1
20 FORT=1TOS:L%(T)=RND(0)*S*3+12:X=L%(T)
30 M%(T)=2*T:Y=M%(T):PRINT1,X,Y:NEXT:TI$=
   "000000":G=INT(S/2)
40 N=0:FORI=1TOS-G
50 IFL%(I)>L%(I+G)THENGOSUB100:T=L%(I):L%
   (I)=L%(I+G):L%(I+G)=T:N=1
60 NEXT:IFN=1THEN40
70 G=INT(G/2):IFG>=1THEN40
80 T$=TI$:POKE239,0
90 GETKEYA$:GRAPHICS0,1:PRINTS"ITEMS SORT
   ED IN "MID$(T$,3,2)":"MID$(T$,5,2)".":
   END
100 Y=M%(I):X=L%(I):DRAW0,X,Y:Y=M%(I+G):X
    =L%(I+G):DRAW0,X,Y
110 Y=M%(I):X=L%(I+G):DRAW1,X,Y:Y=M%(I+G)
    :X=L%(I):DRAW1,X,Y:RETURN
```

Quicksort

```
10 S=99:DIML%(S),M%(S),S%(20):COLOR4,7,1:
   COLOR 0,1:COLOR1,2:GRAPHIC 1,1
20 FORT=1TOS:L%(T)=RND(0)*S*3+12:X=L%(T)
30 M%(T)=2*T:Y=M%(T):DRAW1,X,Y:NEXT:TI$="
   000000":S%(1)=1:S%(2)=S:P=2
40 L=S%(P):P=P-1:F=S%(P):P=P-1:I=F
50 J=L:D=L%((F+L)/2)
60 IFL%(I)<DTHENI=I+1:GOTO60
70 IFL%(J)>DTHENJ=J-1:GOTO70
80 IFI<=JTHENGOSUB150:T=L%(I):L%(I)=L%(J)
   :L%(J)=T:I=I+1:J=J-1
90 IFI<=JTHEN60
100 IFF<JTHENP=P+1:S%(P)=F:P=P+1:S%(P)=J
110 F=I:IFF<LTHEN50
120 IFP<>0THEN40
130 T$=TI$:POKE239,0
140 GETKEYA$:GRAPHICS0,1:PRINTS"ITEMS SOR
    TED IN "MID$(T$,3,2)":"MID$(T$,5,2)".
    ":END
150 Y=M%(I):X=L%(I):DRAW0,X,Y:Y=M%(J):X=L
    %(J):DRAW0,X,Y
160 Y=M%(I):X=L%(J):DRAW1,X,Y:Y=M%(J):X=L
    %(I):DRAW1,X,Y:RETURN
```

• Subscribers to the GAZETTE DISK may have noticed that the example programs from "Understanding Sorts" (May) do not print the time taken to complete each sort. The Disk menu program changes the character color to that of the screen color, effectively making the final message invisible. After the sort is finished, press a key to get out of the hi-res screen, change the cursor color, and enter the appropriate POKE to change the background color. Or, press RUN/STOP–RESTORE and run the program a second time to make the message visible.

• The instructions for entering the VIC version of "Alien Armada" (May) are incorrect. As the article indicated, it runs on an unexpanded VIC, but must be entered on a VIC with at least 8K expansion. Step 2 of the instructions moves BASIC safely out of the way, but leaves the beginning of screen memory at 4096, where it will interfere with Alien Armada. To correct this, change step 2 to: **POKE648,28: SYS58648: POKE44,30: POKE7680,0: NEW** and then load and run MLX.

• The wedge routine from "Free VIC" and "Free 64" from the April "Machine Language for Beginners" column is not disabled when you press RUN/STOP–RESTORE. Thus, readers who own a Datassette will have problems when trying to save or load. To turn off the wedge, 64 owners should **POKE770,131: POKE771,164**. VIC owners should enter **POKE770,131: POKE771,196**. Put the POKEs on the same line, separated by a colon.

Easy Load

Terry Hunt

There are many advantages to being able to load one program from another, but Commodore BASIC contains a bug that either scrambles the end of the second program or reduces the amount of memory available for the second program. Here's a step-by-step tutorial on how to chain programs (selecting a program from a menu and returning to the menu when you're finished). For the VIC and 64.

As a teacher, one of the most tedious tasks I face is keeping track of students' grades and averages. When I bought my VIC-20 and tape drive, I envisioned writing a fast, accurate gradebook program. The computer system gradually grew to include a 64, disk drive, and printer. My knowledge of programming grew to include both BASIC and machine language. And the program grew to fill up the 64's memory. It had to be split into separate programs.

The main program is very short. It prints a list of options like Create Student File, Enter Grades, Average Grades, and so on. The user then makes a choice.

In order to use a menu driven program, you have to be able to chain programs together to have the program currently in memory load another program as selected by the operator from the menu. For example: My gradebook program has a "Master Menu" from which an operator can choose what operation he wishes to perform. There are nine different choices he can make, one of which is to "Make Class Lists." If he or she makes this choice, then the new program is loaded.

According to both the *VIC-20* and the *Commodore 64 Programmer's Reference Guide* this should be easy enough to do by using the LOAD command within a program. The program below, for example, should load the "Make Class Lists" program if the operator pressed 1.

```
1001 GET G$:IF G$=""THEN 1001
1002 IF G$="1" THEN LOAD "Make Class Lists",8
1003 (the program continues)
```

Unfortunately, using the LOAD command in program mode does not always work correctly.

A Memory Book

When you're new to computing, it's easy to become confused by some of the technical terms like bytes, pointers, vectors, and memory pages. But to understand the problems associated with LOAD, we need a brief introduction to memory.

Imagine a book that holds 256 pages of graph paper. The lines on each piece of paper divide the page into exactly 256 boxes. And you can put 256 different numbers (from 0 to 255) in each box. In some contexts, the numbers are instructions. In other situations, the numbers are information.

Inside a computer, memory (like our graph paper book) is organized into 256 pages of memory and each page contains 256 bytes of memory. Some memory is permanent (Read Only Memory, called ROM), as if you used an ink pen to write in the book. Other memory (Random Access Memory, or RAM) is volatile, it can change. In our graph paper book, RAM would contain information written in pencil. When you shut the book (turn off the computer), all pencil marks are erased.

The BASIC programming language is built into Commodore computers. When you enter a line like **10 PRINT"XYZ"** the computer translates your English-like commands into a series of numbers it understands and puts the numbers into memory. Type RUN, and it follows the instructions you gave it.

But you want the computer to start at the beginning of the program and stop when it reaches the end. That's why pointers are important. One such pointer is in the first page of memory (which is called *zero page* because programmers tend to start counting at zero). It points to the beginning of BASIC memory, where the program starts.

In our computer book, this would be like a table of contents on page number zero. When you type RUN, the computer checks the table of contents on the first page and finds an entry: Beginning of the BASIC Program...byte 1 on page 8 (the page numbers would be different on a VIC, but the idea is the same). It takes two bytes to specify a memory location, one for the byte number, one for the page number.

When you define a variable, the computer translates the characters into numbers it can use and stores these numbers in memory not already used by the program instructions. Again, it checks the table of contents—a zero page pointer—End of BASIC Program, Beginning of Variables...byte 89, page 13 (or wherever the program happens to end).

The Loading Problem

A LOAD from immediate mode reads the program from tape or disk and stores it into memory at the beginning of BASIC. The pointer to the end of memory/beginning of variables is reset. You then have to type RUN.

Loading a machine language program may cause problems with the end-of-memory pointer, so you should almost always type NEW before you SYS to the starting address.

If you load from inside a program, two things are different. The end of the program pointer is *not* reset—it's like inserting new pages (a new program) in our memory book, but leaving the table of contents unchanged. Also, you don't have to type RUN—after the second program is loaded, it runs automatically.

There's a good reason for keeping the old pointers. A program keeps its variables in a certain section of memory. If a long program loads a shorter program, the variables are kept intact, and can be used by the shorter program. But you'll have major problems if you load a longer program from a shorter one. Since the pointer to variables is not updated, any variables you use will be stored in a section of memory that overlaps the end of the second (longer) program.

Also, if you try to load a machine language program from a BASIC program, the computer will go into an endless loop. Let's say you include this line in your program:

```
50 LOAD"MLROUTINE",8,1
```

What happens? When the computer reaches line 50, it loads the ML routine. Since a LOAD from inside a program automatically includes a RUN, the BASIC program will run again. When it reaches line 50, the ML routine will load again. The program runs again, loads the ML again, runs again, loads again, and so on, never getting beyond line 50.

Fortunately, there are solutions available.

Dynamic Keyboard

By using the screen editor, you can cause the 64 or VIC to load, from disk or tape, and run a new program with little or no operator intervention. Here's how it's done:

```
10 POKE198,4
20 PRINT"{CLR}{2 DOWN}LOAD"CHR$(34)"PROGR
   AM";
30 PRINTCHR$(34)",8{HOME}";
40 POKE631,13:POKE632,82:POKE633,117:POKE
   634,13
50 END
```

Line 10 tells the computer that there are four characters in the keyboard buffer. Line 20 clears the screen and HOMEs the cursor, moves the cursor down two rows (this is where the commands will be printed to the screen), then prints the LOAD command along with the name of the new program. The CHR$(34) in both lines 20 and 30 prints quotes. The *,8* in line 30 is the device number (in this case the disk drive). The cursor is then moved to the HOME position at the top of the screen. Line 40 POKEs four characters into the keyboard buffer: a carriage return, the abbreviated RUN command (R and SHIFT-U), and another carriage return. The END command is necessary because it allows the screen editor to take control and execute any commands on the screen. It's important that the semicolons are included because they negate carriage returns, ensuring proper formatting of the commands. This program will work with either a VIC or 64. If you're using the Datassette instead of a disk drive, substitute a 1 for the 8 in line 30.

When the program reaches the END statement, it stops running the program, prints READY at the top of the screen, and waits for something from the keyboard. But we've fooled the computer with the POKEs. The number 4 in location 198 makes the computer think four characters have been typed. It reads them from the keyboard buffer (13 forces a carriage return over the line that says LOAD"PROGRAM",8). It loads and then runs, from immediate mode, which is exactly what we want.

The line numbers in the example are arbitrary. This program can be used as a subroutine within another program, and its location will be determined by the specific application. After some experimentation, you may discover a rather major problem—using it to load both BASIC and machine language programs. It's not that the program itself is at fault. It works wonderfully to load a BASIC program from another BASIC program. But ML routines don't load correctly (because we haven't entered NEW after the LOAD).

The most obvious addition for ML routines is to place a ",1" after the ",8" (or after the ",1" if you have a Datassette). This addition will cause the program to be loaded into memory at the same place from which it was saved.

But it's not that simple. Whenever a program—a machine language or BASIC program—is loaded into memory, the variable pointers (the registers that tell the computer where memory is available for storing variables) are set to *the top of the most recently loaded program*. I was loading my machine language programs in high memory, 49152 to be exact, well beyond the memory reserved for normal BASIC programs. Consequently, though much memory space was still unoccupied and thus available for variable storage, the computer did not recognize it as being available, resulting in an OUT OF MEMORY error.

Loading ML Programs From BASIC

One inelegant solution was to do a lot of PEEKs and POKEs before using the dynamic keyboard technique to load a machine language program. The general idea was to PEEK the pointers (the "table of contents") and POKE the numbers to a free section of memory. After the ML program is in memory, you then PEEK the numbers you saved and POKE them back to the pointers.

But it doesn't need to be that complex. Remember how loading ML (from inside a program) causes an endless loop? But variables are preserved. So this one line will take care of the problems:

```
10 IF A=0 THEN A=1:LOAD"MLPROGRAM",8,1
```

The first time the program runs, the variable A equals zero, so we change its value to one and load the machine language. Now the program runs again, but A equals one, so it skips over the LOAD command.

If you're working with chained programs, remember that it's fine to load a shorter BASIC program from a longer one (especially if you want to keep the variables intact). If you're loading a longer BASIC program, always use the dynamic keyboard technique from above. Finally, to load ML programs from BASIC, use a variable that switches from 0 to 1. With these techniques, you can break a very long program into shorter ones and move back and forth between them.

Disk Title Changer

Michael Broussard

One step in organizing any growing disk library is renaming disks. If you have a 1541 disk drive, this eight-line BASIC program does the job efficiently and fast. The article also explains how to read from and write to disk sectors. For the Commodore 64, VIC-20, Plus/4, or Commodore 16.

Before you can do anything useful with a disk, it must be formatted. And when you format a new disk, you have to choose a name for it. You may name it something ordinary, like DISK 15 if it's number 15 in your collection. Or you may give it an unusual name like UNICORN.

But many people name their disks according to what kind of programs are on them: GAMES 1 or UTILITIES 6/85, for example. Usually you're not sure what sort of programs or files will ultimately be stored on a new disk. As it fills up you may wish you had named it something else. Although the Commodore disk operating system (DOS) provides an easy way to rename files, it's not such a simple task to rename a disk. This eight-line BASIC program does the job. We'll see how the program works a little later, but first let's see how to use it.

One Response

First, a word of caution: The punctuation in the program is extremely important. Watch closely for quotation marks, parentheses, commas, colons, and semicolons. A typing mistake could potentially ruin one of your disks. It's a good idea to use "Automatic Proofreader" while you're entering the program.

Using the program is easy—load it (but don't type RUN yet), then insert a disk with a name you wish to change. Make sure the write-protect notch is not covered. Next, type RUN. The current name of the disk is displayed, and you're prompted for a new one. Enter the new name and press RETURN; the disk directory is updated and the name of the disk is changed. That's all there is to it.

You don't have to understand how it works to use it, but if you've been planning to learn some of the disk commands, this is a good time to begin. First let's take a brief look at how the disk operating system (DOS, for short) stores information on the disk.

Data on a disk is organized into 35 concentric rings, or tracks. These tracks are numbered, with track 1 being the outermost track, and track 35 being the last track, near the center of the disk. Each track, or "lap" around the disk is further divided into blocks, or sectors, each of which can store 256 bytes (characters) of data.

Most of the space on a disk is available for storing programs or files. But a few sectors are used by DOS as a directory to store housekeeping information, such as the disk's name, the names of all the files on the disk, and what sort of files they are (program files, sequential files, etc.). In addition, a block availability map (BAM) provides a chart telling which sectors are not being used so that DOS knows where it may put new files.

Whenever you save a program, a new file entry is placed in the directory, and the BAM is updated to reflect which blocks have been used. Conversely, when a file is scratched, the file entry is marked as free, and the BAM is changed so that the disk blocks that were used by the file are freed up.

But what does all this have to do with changing the name of the disk? Usually, the commands given to DOS are ones which manipulate files. These *high-level* commands cause the disk drive to execute fairly complex routines. When you load a program, DOS takes care of reading the directory to find out if your program is on the disk. Then it finds out where all the blocks of your program are, and it transfers them from disk to the memory of the computer. You don't care where all the pieces are—all you know is that your file is on the disk. DOS does the rest.

From inside a program, however, it's possible to do more primitive, *low-level* disk operations. For example, by naming a specific track and sector, you can read or write specific bytes from a particular block of data on the disk as opposed to reading or writing a whole file, which may consist of many blocks. By using this feature, you can change the name of a disk. Let's examine the program, line by line.

A Close-Up Look At Program Operation

The first thing the program does (line 10) is close the error channel (15) and then reopen it, sending it the Initialize command ("I0:") to force the disk drive to read the BAM. This is done to make sure there are no side effects from either a previous disk or a previous program which may have opened files on the disk and not closed them. Note that you can close a file that's closed, but you'll get an error if you try to open an already open file.

Next, channel 5 (an arbitrary choice) is opened as a buffer for reading from the disk. The number sign tells the drive to set aside one of its internal buffers. If you entered OPEN5,8,5,"#2" it would specify buffer two. Without a number ("#"), it means "we'll accept any available buffer." In most cases, you don't need to worry about which buffer is used. A string (B$) is then set to the null string (""). The current name of the disk will be read into B$.

Track 18, sector 0 contains directory header information, including the disk name. This is the block we're interested in changing, so we tell DOS to read the directory header block with the User-1 (U1:) block-read command in line 20. *Always read disk blocks with the U1: command; B-R (Block Read) is unreliable.* Notice the four numbers that follow U1: 5, 0, 18, and 0. The 5 is the channel number (from OPEN 5,8,5 in the previous line). The first 0 is the drive number—1541s are always drive 0 and (usually) device 8—and 18,0 means track 18, sector 0.

The U1: command reads a block from disk and puts it into a memory buffer inside the disk drive. Your computer doesn't have the information, however; it's still inside the drive. The second part of line 20 makes the drive set the buffer pointer ("B-P") to character number 144. B-P is followed by the channel number and character number. As you may have guessed, the name of the disk starts at 144 (hex $90).

We could read the whole block from the buffer, except for a small problem. Each block contains 256 bytes and Commodore BASIC allows a maximum of 255 characters in a string. We'd have to split the information into at least two strings to make it work correctly. The B-P command allows us to read only the disk name, and later only the name will be changed.

Line 30 of the program extracts the 16 characters of the disk name from the buffer inside the drive. The line that makes A$ into CHR$(ASC(A$+CHR$(0))) is not really necessary, but it's a good idea to include if you plan to read other sectors from disk. A zero sometimes translates into a null string rather than a CHR$(0). This conversion from ASCII to CHR$ takes care of any potential problems.

Line 40 prints the current disk name and 50 then asks for a new name, and a check is made to be sure it's 16 characters or less (16 is the maximum number of characters allowed for a filename). If necessary, line 60 pads the new name with shifted spaces to make it exactly 16 characters long.

In line 70, we use B-P again, to point the buffer to character 144. The new disk name, N$, is printed to channel 5 and into the buffer. The semicolon following N$ guarantees that a carriage return (CHR$(13)) is not appended to the end of the disk name.

But we haven't changed the name yet. What's happened so far is that a sector was read into a disk buffer, the disk name was extracted, and a new name was sent to the buffer. The buffer has been changed, but nothing has been written to the disk. We have to finish the job with the User-2, or U2: block-write command. *B-W (Block Write), like B-R, is unreliable. Always use U2: to write a block to disk.* Now we've successfully renamed the disk.

The last steps (line 80) are to read the error channel and initialize the disk. If everything worked properly, you should see DISK STATUS: 0 OK.

Why initialize the disk again? Try this experiment: Remove the PRINT#15,"I0" from line 80. Now run the program and change the name of a disk. LOAD"$",8 and LIST. Although the disk name has been changed, you'll see the old name. If you remove the disk, turn the drive off then back on, and load and list the directory, you'll see that the disk name *has* been changed. When the

1541 was initialized in line 10, the block availability map and disk header were read into a buffer. After the name change, you loaded the directory, but the disk drive looked at the two-letter ID and concluded that it didn't need to read the header again, because it was working with the same disk as before. Thus, you saw the old name. The disk drive recognizes disks by their two-letter IDs. If you have several disks with the same ID, you may run into problems. Initializing the drive helps you avoid the difficulties associated with duplicate IDs.

These eight lines make renaming disks as easy as renaming files.

Power BASIC: Disk Title Changer

```
10 CLOSE15:OPEN15,8,15:PRINT#15,"IØ:":CLO
   SE5:OPEN5,8,5,"#":B$=""           :rem 119
20 PRINT#15,"U1:5,Ø,18,Ø":PRINT#15,"B-P:5
   ,144"                             :rem 221
30 FORJ=1TO16:GET#5,A$:A$=CHR$(ASC(A$+CHR
   $(Ø))):B$=B$+A$:NEXT              :rem 195
40 PRINT:PRINT"DISK NAME: ";B$       :rem 35
50 INPUT" NEW NAME";N$:IFLEN(N$)>16THENPR
   INT"MAXIMUM LENGTH IS 16":GOTO4Ø
                                     :rem 187
60 IFLEN(N$)<16THENN$=N$+CHR$(160):GOTO6Ø
                                     :rem 119
70 PRINT#15,"B-P:5,144":PRINT#5,N$;:PRINT
   #15,"U2:5,Ø,18,Ø":CLOSE5          :rem 192
80 INPUT#15,ER,ER$:PRINT"DISK STATUS:"ER;
   ER$:PRINT#15,"IØ":CLOSE15:END     :rem 108
```

SIMPLE ANSWERS TO COMMON QUESTIONS

QA

Tom R. Halfhill, Staff Editor

Each month, COMPUTE!'s GAZETTE *tackles some questions commonly asked by new Commodore users and by people shopping for their first home computer. If you have a question you'd like to see answered here, send it to this column c/o* COMPUTE!'s GAZETTE, *P.O. Box 5406, Greensboro, NC 27403.*

Q. ***The main chip in the Commodore 64 is the 6510, but there are a lot of other "support" chips. How do they interact? Do all microcomputers need a supporting cast of chips?***

A. Yes, all computers do need an entourage of support chips before they can do anything really useful.

The main brain of any computer is its *central processing unit* (CPU). This part of the computer is responsible for decoding the instructions in programs, carrying out the instructions, and then storing the results. In large mainframe computers, the CPU might be a box the size of a refrigerator containing hundreds of chips and miles of wiring. A *microcomputer* is usually defined as a computer which employs a *microprocessor* for its CPU. A microprocessor is a CPU which has been miniaturized to the point where it fits on a single chip of silicon, such as the Commodore 64's 6510 or the VIC-20's 6502.

The first microprocessor chip was made in 1971 by Intel and was called the 8008. Interestingly, microprocessors weren't invented to make microcomputers possible. Rather, they were designed as *process controllers*—tiny brains to control factory machinery. Next they were used to make electronic calculators. A couple of years later, some hobbyist got the idea of building a miniature computer system for personal use around a microprocessor. Because a microprocessor alone isn't capable of tackling the whole job, support chips were necessary.

For one thing, before the CPU can start fetching and decoding program instructions, the program has to be someplace where the CPU can find it. In other words, the program has to be in memory.

There are two general types of memory chips: Read Only Memory (ROM) and Random Access Memory (RAM). Both types can store programs. The difference is that ROM chips store data permanently, even when their power is shut off. RAM chips "remember" the information only as long as electricity is flowing.

Personal computers have both types of memory chips. ROM stores certain vital programs which the computer always needs in order to operate, such as the *operating system*. An operating system is comparable to the part of a human brain which controls such autonomous functions as your heartbeat, breathing, digestion, and so forth. Without these functions you couldn't survive, yet you don't have to consciously maintain them. Similarly, a computer's operating system looks after such details as allocating memory, checking the keyboard for keystrokes, and passing instructions to the CPU.

RAM is the computer's workspace—it temporarily stores the program and data the computer is currently working with. Using RAM for this purpose instead of ROM makes the computer a general-purpose device, because you can load different programs for different applications. A single-purpose computer that stores its application program in ROM instead of RAM is a *dedicated* device. An example would be an office word processor, or even a microwave oven with computerized timer controls.

In addition to RAM and ROM chips, the CPU also is supported by a video display processor, sometimes called a VDP. The video chip creates the screen display by sending the proper signals to the TV or monitor. It's the video chip, not the display device, that determines your computer's display format. For instance, the VIC-20's video processor is called the VIC (Video Interface Chip). It was designed to display 22 vertical columns of characters in 23 horizontal lines, and—without special programming tricks—it always displays 22 columns by 23 lines, even if you plug a VIC-20 into an 80-column monitor. Likewise, the Commodore 64's VIC-II video processor is set up to display 40 columns by 25 lines. The 80-column adapters you may have seen advertised are basically add-on video chips.

Still more support chips are required to control input/output with peripherals, such as disk drives, printers, game controllers, modems, and the keyboard. Many computers also have special chips for graphics and sound, such as the 64's Sound Interface Device (SID), a synthesizer chip. Other support chips may include realtime clocks and special math chips to speed up processing.

Often, to reduce costs and overheating problems, manufacturers combine several functions on a single chip. The Commodore 64 uses the same chip to read the joysticks and the keyboard, and the VIC-II chip is responsible for sprite graphics as well as the screen display.

Sleuth

(Article on page 39.)

> **BEFORE TYPING . . .**
>
> **Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.**

Program 1: Sleuth—VIC Version

```
15 Z=11:Z1=36879:Z2=104:Z3=25:Z4=36878:Z5
   =36877:Z6=3:S2=36875:S3=3           :rem 18
20 G1=3:G2=3                           :rem 109
25 PRINT"{CLR}":DIMA(5,4):GOTO8Ø :rem 225
3Ø GOSUB415                            :rem 125
35 CL=Ø:FORJ=ØTO3:FORI=ØTO4:A(I,J)=Ø:NEXT
   :NEXT:POKEZ1,Z3                     :rem 87
4Ø PRINT"{CLR}{BLU}{DOWN}ONE EVENING, WHI
   LE ON HOLIDAY AT LORD               :rem 214
45 PRINT"CRUMBLY'S MANSION YOU HEAR A SHO
   T AND                               :rem 52
5Ø PRINT"FIND LORD CRUMBLY DEAD" :rem 18Ø
55 PRINT"{DOWN}THE OTHER PEOPLE HERE ARE
   {DOWN}"                             :rem 129
6Ø FORI=ØTO4:PRINTTAB(5)A$(I):NEXTI
                                       :rem 191
65 PRINT:PRINT"HOW QUICKLY CAN YOU
   {3 SPACES}SOLVE THE MURDER?"        :rem 9Ø
7Ø PRINT"WHO HAD MOTIVE,WEAPON AND OPPORT
   UNITY?":POKE198,Ø                   :rem 179
75 PRINT"{DOWN}HIT ANY KEY";:WAIT198,1:PO
   KE198,Ø:PRINT"{CLR}":GOTO95         :rem 147
8Ø PRINT"{CLR}":A$(Ø)="{RED}{RVS}MAID WHI
   GGINS{OFF}{BLU}":A$(1)="{BLK}{RVS}SIR
   {SPACE}CHAUNCY{OFF}{BLU}"           :rem 181
85 A$(2)="{PUR}{RVS}MADAM LARUE{OFF}{BLU}
   ":A$(3)="{GRN}{RVS}BUTLER SNIPE{OFF}
   {BLU}"                              :rem 224
9Ø A$(4)="{BLU}{RVS}PROFESSOR BARD{OFF}
   {BLU}":A$(5)="{CYN}{RVS}LORD CRUMBLY
   {OFF}{BLU}":GOTO3Ø                  :rem 191
95 I=INT(RND(1)*5):LR(I)=1:I=INT(RND(1)*5
   )                                   :rem 15Ø
1ØØ FORJ=ØTO3:A(I,J)=1:NEXT            :rem 119
1Ø5 FORJ=ØTO2:C=Ø                      :rem 243
11Ø FORI=ØTO4                          :rem 6
115 IFA(I,3)=1THEN145                  :rem 151
12Ø IFC=2THEN145                       :rem 157
125 IFJ=ØTHEN135                       :rem 166
13Ø K=J-1:IFA(I,K)=1THEN145            :rem 22
135 IFRND(1)>.5THENA(I,J)=1            :rem 29
14Ø IFA(I,J)=1THENC=C+1                :rem 49
145 NEXTI                              :rem 34
15Ø NEXTJ                              :rem 31
155 CL=CL+1:W=INT(RND(1)*5):Y=INT(RND(1)*
    3):UV=INT(RND(1)*3)+1              :rem 1Ø9
16Ø VV=INT(RND(1)*3)+1:X=INT(RND(1)*5):IF
    X=WTHEN16Ø                         :rem 38
165 POKE2Ø4,1:PRINT"{CLR}{RVS}ONE OF THE
    {SPACE}SUSPECTS IS A COMPULSIVE LIAR
    {OFF}"                             :rem 222
17Ø PRINT:PRINT"DURING QUESTIONING:":PRIN
    T                                  :rem 8Ø
175 PRINTA$(W)" SAYS:":PRINT           :rem 188
18Ø ONY+1GOTO185,225,265               :rem 8Ø
185 IFA(X,Y)=ØTHEN215                  :rem 2Ø8
19Ø IFLR(W)=1THEN22Ø                   :rem 16Ø
195 ONUVGOTO2ØØ,2Ø5,21Ø                :rem 52
2ØØ PRINTA$(5):PRINT"WAS BLACKMAILING":PR
    INTA$(X):GOTO3Ø5                   :rem 62
2Ø5 PRINTA$(X):PRINT" HATED":PRINTA$(5):G
    OTO3Ø5                             :rem 96
21Ø PRINTA$(5):PRINT"SECRETLY KILLED":PRI
    NTA$(X);"'S LOVER":GOTO3Ø5         :rem 151
215 IFLR(W)=1THEN195                   :rem 169
22Ø PRINTA$(X):PRINT"HAD NO MOTIVE ":GOTO
    3Ø5                                :rem 131
225 IFA(X,Y)=ØTHEN255                  :rem 2Ø7
23Ø IFLR(W)=1THEN26Ø                   :rem 159
235 ONUVGOTO24Ø,245,25Ø                :rem 59
24Ø PRINTA$(X):PRINT"CARRIES A GUN":GOTO3
    Ø5                                 :rem 123
245 PRINT"A GUN WAS KEPT IN":PRINTA$(X);"
    'S ROOM":GOTO3Ø5                   :rem 99
25Ø PRINTA$(X):PRINT"JUST BOUGHT A GUN":G
    OTO3Ø5                             :rem 13Ø
255 IFLR(W)=1THEN235                   :rem 168
26Ø PRINTA$(X):PRINT"HAD NO ACCESS TO A G
    UN":GOTO3Ø5                        :rem 51
265 IFA(X,Y)=ØTHEN295                  :rem 215
27Ø IFLR(W)=1THEN3ØØ                   :rem 158
275 ONVVGOTO28Ø,285,29Ø                :rem 76
28Ø PRINTA$(X):PRINT"WENT TO BED VERY EAR
    LY":GOTO3Ø5                        :rem 186
285 PRINTA$(X):PRINT"HAD NOT BEEN SEEN
    {5 SPACES}SINCE DINNER":GOTO3Ø5
                                       :rem 133
29Ø PRINTA$(X):PRINT" WAS BY":PRINTA$(5);
    "'S ROOM JUST BEFORE THE SHOT":GOTO3Ø
    5                                  :rem 21Ø
295 IFLR(W)=1THEN275                   :rem 176
```

```
300 PRINTA$(X):PRINT"WAS WITH SOMEONE WHE
    N THE SHOT WAS FIRED":GOTO305 :rem 39
305 PRINT"{3 DOWN}{BLU}{RVS}YOUR OPTIONS
    {SPACE}ARE:":PRINT:PRINT"(1)GRILL SUS
    PECTS"                        :rem 162
310 PRINT"(2)MAKE ACCUSATION"     :rem 240
315 GETA$:IFA$="1"THEN155         :rem 136
325 IFA$<>"2"THEN315              :rem 70
330 PRINT"{CLR}{DOWN}WHO DID IT?":PRINT
                                  :rem 109
335 FORI=ØTO4:PRINTI"{LEFT}) ";A$(I):PRIN
    T:NEXT:POKE198,Ø              :rem 10
337 GETK$:IFASC(K$+CHR$(Ø))<48ORASC(K$+CH
    R$(Ø))>52THEN337              :rem 247
340 K=VAL(K$):IFA(K,3)=1THEN380   :rem 255
345 PRINT"{CLR}{DOWN}AFTER"CL"CLUES YOU":
    PRINT"HAVE ACCUSED THE WRONG PERSON"
                                  :rem 59
350 PRINT"{DOWN}BEFORE YOU CAN CORRECT YO
    UR MISTAKE, YOU ARE FRAMED FOR THE MU
    RDER"                         :rem 178
355 POKES2+3,15:FORI=ØTO6Ø:POKES2+2,128:N
    EXT:POKES2+2,Ø                :rem 83
360 PRINT:FORI=ØTO4:IFA(I,3)<>1THEN37Ø
                                  :rem 75
365 PRINTA$(I):A(I,3)=Ø           :rem 11
370 NEXT                          :rem 217
375 PRINT"WAS THE MURDERER!":GOTO39Ø
                                  :rem 210
380 PRINT"{CLR}{DOWN}"A$(K)" DID IT!":PRI
    NT"{DOWN}YOU CAUGHT THE KILLER AFTER"
    ;CL;"CLUES."                  :rem 194
385 A(K,3)=Ø:POKES2+3,15:N=195:FORJ=1TO4:
    N=N+1Ø                        :rem 218
390 FORI=ØTO4:IFLR(I)<>1THEN4ØØ   :rem 127
395 PRINT:PRINTA$(I):PRINT"WAS THE LIAR."
    :LR(I)=Ø                      :rem Ø
400 NEXT                          :rem 211
405 INPUT"{DOWN}ANOTHER CASE (Y/N)";Q$:IF
    Q$="Y"THEN35                  :rem 49
410 END                           :rem 108
415 PRINT"{CLR}{BLK}{7 DOWN}"SPC(Z-6)"S L
     E U T H":POKEZ1,Z2:POKEZ4,15:POKEZ6,
    Ø                             :rem 156
420 PRINT"{2 DOWN}"SPC(Z-1Ø);:FORQ=1TO4:R
    EADN,P:POKES2,N:POKES3,P:POKEG1,32:PO
    KEG1,33                       :rem 114
425 FORI=1TO8ØØ:NEXT:NEXT:A$="{WHT}
    {2 DOWN}U{S}{A}DI{DOWN}{5 LEFT}J{X}
    {Z}FK"                        :rem 84
430 READN,P:POKES2,N:POKES3,P:POKEG1,32:P
    OKEG1,33:FORI=1TO13ØØ:NEXT:FORQ=1TO4
                                  :rem 164
435 READN,P:POKES2,N:POKES3,P:POKEG1,32:P
    OKEG1,33:FORI=1TO3ØØ:NEXT:NEXT:N=185
                                  :rem 157
440 FORJ=1TO4:READN,P:POKES2,N:POKES3,P:P
    OKEG1,32:POKEG1,33            :rem 230
445 PRINTA$;:IFJ=2THENPRINT"{6 UP}";
                                  :rem 237
450 FORK=1TO8ØØ:NEXT:NEXT         :rem 102
455 POKES2,Ø:POKEZ5,220:POKEG2,128:POKEG2
    ,129:L=16                     :rem 227
460 IFL=ØTHEN47Ø                  :rem 172
465 L=L-1:POKEZ4,L:FORI=1TO3Ø:NEXT:GOTO46
    Ø                             :rem 165
470 POKEZ5,Ø:RETURN               :rem 207
475 DATA195,Ø,2Ø5,Ø,215,Ø,225,Ø,217,Ø,215
    ,Ø,2Ø9,Ø,2Ø5,Ø,2Ø1,Ø          :rem 180
480 DATA 195,Ø,2Ø5,Ø,215,Ø,225,Ø  :rem 17
```

Program 2: Sleuth—64 Version

These lines should be added to Program 1; see instructions in article.

```
1 POKE56,4Ø:CLR:FORA=679TO729:READB:POKEA
  ,B:NEXT                          :rem 41
2 DATA 173,136,2,9,128,168          :rem 2
3 DATA 169,Ø,17Ø,148,217,24        :rem 46
4 DATA 1Ø5,4Ø,144,1,2ØØ,232        :rem 23
5 DATA 224,26,2Ø8,243,169,255     :rem 154
6 DATA 149,217,169,Ø,133,251       :rem 99
7 DATA 169,216,133,252,162,3       :rem 98
8 DATA 16Ø,Ø,169,6,145,251        :rem 253
9 DATA 2ØØ,2Ø8,251,23Ø,252,2Ø2,16,242,96
                                  :rem 167
1Ø GOSUB54Ø                       :rem 122
15 Z=2Ø:Z1=53281:Z2=6:Z3=1:Z4=54296:Z5=54
   28Ø:S2=54273:Z6=5328Ø:G1=54276:rem 235
2Ø G2=54283:S3=54272:FORA=54272TO54296:PO
   KEA,Ø:NEXT:POKE54277,25:POKE54284,29
                                  :rem 25Ø
36 GOSUB 54Ø:FORA=ØTO4:C(A)=Ø:NEXT:rem 29
32Ø IFA$>CHR$(132)ANDA$<CHR$(137)THEN485
                                  :rem 224
475 DATA4,48,4,251,6,71,8,97,6,167,6,71,5
    ,152,4,251,4,18Ø,4,48          :rem 4Ø
48Ø DATA 4,251,6,71,8,97          :rem 164
485 S=ASC(A$)-121:GOSUB53Ø        :rem 2Ø9
49Ø POKE214,C(S-12):PRINTCHR$(13)"{UP}";
                                  :rem 147
495 POKE2Ø4,Ø:WAIT198,255:GETA$    :rem 27
5ØØ IFA$="←"THEN52Ø                :rem 47
5Ø5 IFA$>CHR$(132)ANDA$<CHR$(137)THEN535
                                  :rem 225
51Ø POKE2Ø5,3:WAIT2Ø7,1:PRINTA$;:IFPEEK(2
    14)=24THENPRINT"{UP}";        :rem 2Ø4
515 GOTO495                       :rem 118
52Ø C(S-12)=PEEK(214):WAIT2Ø5,3:WAIT2Ø7,1
    :POKE2Ø4,1:S=1:POKE648,4:PRINT"{CLR}"
                                  :rem 13Ø
525 GOSUB53Ø:GOTO165              :rem 195
53Ø POKE53272,PEEK(53272)AND15ORS*16:POKE
    648,S*4:SYS679:RETURN          :rem 14
535 WAIT2Ø5,3:WAIT2Ø7,1:POKE2Ø4,1:C(S-12)
    =PEEK(214):GOTO485            :rem 152
54Ø FORS=12TO15:GOSUB53Ø:PRINT"{CLR}":NEX
    T:S=1:GOSUB53Ø:PRINT"{CLR}":RETURN
                                  :rem 234
```

Space Gallery

(Article on page 46.)

Requires MLX. See instructions in article.

```
2049 :Ø11,ØØ8,Ø1Ø,ØØØ,158,Ø5Ø,238
2055 :Ø48,Ø54,Ø5Ø,ØØ8,ØØØ,ØØØ,167
2061 :ØØØ,16Ø,ØØ5,169,Ø48,153,Ø36
2067 :222,ØØ3,136,Ø16,25Ø,16Ø,Ø38
2073 :Ø24,169,ØØØ,153,ØØØ,212,Ø71
2079 :136,Ø16,25Ø,169,Ø47,141,Ø22
2085 :Ø24,212,169,Ø26,141,Ø19,116
2091 :212,169,ØØ5,141,ØØ8,212,Ø22
2097 :169,Ø22,141,Ø12,212,Ø32,125
2103 :246,ØØ9,169,ØØ1,133,Ø19,12Ø
2109 :169,ØØØ,133,Ø66,Ø32,126,Ø75
2115 :Ø13,Ø32,231,Ø14,Ø32,Ø9Ø,223
2121 :Ø14,169,128,141,Ø18,212,243
2127 :169,1ØØ,141,Ø15,212,169,117
```

```
2133 :244,141,023,212,032,209,178
2139 :009,169,006,141,039,208,151
2145 :032,084,010,032,156,010,165
2151 :032,207,011,032,245,008,126
2157 :032,017,010,032,175,010,129
2163 :032,073,011,032,193,012,212
2169 :032,048,013,173,030,208,113
2175 :032,045,012,032,194,009,195
2181 :032,046,014,173,141,002,029
2187 :208,251,173,030,208,133,118
2193 :249,041,001,240,215,165,032
2199 :249,201,032,144,209,169,131
2205 :251,141,248,007,169,002,207
2211 :141,039,208,169,128,141,221
2217 :018,212,169,129,141,018,088
2223 :212,169,000,141,023,212,164
2229 :162,020,032,075,014,202,174
2235 :142,015,212,208,247,206,193
2241 :028,007,173,028,007,201,125
2247 :048,208,128,032,209,009,065
2253 :169,000,141,021,208,032,008
2259 :138,255,162,009,160,010,177
2265 :024,032,240,255,169,087,000
2271 :160,015,032,030,171,173,036
2277 :000,220,074,176,003,076,010
2283 :054,008,074,176,244,169,192
2289 :000,133,198,000,160,007,227
2295 :032,030,011,136,136,016,096
2301 :249,096,165,065,240,007,051
2307 :198,065,198,065,141,022,180
2313 :212,162,020,189,194,002,020
2319 :240,057,133,252,189,193,055
2325 :002,133,251,169,032,160,000
2331 :000,145,251,165,251,056,127
2337 :233,040,157,193,002,133,023
2343 :251,165,252,233,000,201,117
2349 :003,208,005,169,000,157,075
2355 :193,002,157,194,002,133,220
2361 :252,240,014,160,000,189,144
2367 :182,003,145,251,198,064,138
2373 :165,064,141,001,212,202,086
2379 :202,016,190,198,015,208,136
2385 :034,169,003,133,015,160,083
2391 :003,185,249,007,201,251,215
2397 :240,005,073,003,153,249,048
2403 :007,136,016,241,160,030,177
2409 :169,012,153,032,219,153,075
2415 :072,219,136,016,247,076,109
2421 :049,234,198,006,208,070,114
2427 :162,022,202,202,048,064,055
2433 :189,194,002,208,247,120,065
2439 :169,006,157,194,002,165,060
2445 :003,160,003,074,006,004,135
2451 :136,208,250,168,136,152,173
2457 :024,105,168,157,193,002,034
2463 :088,165,004,041,007,168,120
2469 :185,036,016,157,182,003,232
2475 :169,040,133,064,169,020,254
2481 :141,011,212,169,021,141,104
2487 :011,212,165,061,201,060,125
2493 :240,002,230,061,096,134,184
2499 :005,162,002,160,070,136,218
2505 :208,253,202,208,248,166,206
2511 :005,096,120,162,022,202,046
2517 :202,016,002,088,096,189,038
2523 :194,002,240,245,133,252,005
2529 :189,193,002,133,251,160,129
2535 :000,169,032,145,251,152,212
2541 :157,194,002,157,193,002,174
2547 :240,223,096,169,006,133,086
2553 :002,169,009,133,248,120,162
2559 :169,255,141,020,003,169,244
2565 :008,141,021,003,088,169,179
2571 :000,133,017,133,061,096,195
2577 :198,016,240,010,173,000,142
2583 :220,074,074,074,074,076,103
2589 :062,010,169,003,133,016,166
2595 :173,000,220,074,074,074,138
2601 :176,008,166,003,224,027,133
2607 :240,002,198,003,074,176,228
2613 :008,166,003,224,240,240,166
2619 :002,230,003,074,176,009,041
2625 :032,119,009,169,200,133,215
2631 :006,208,004,169,001,133,080
2637 :006,165,003,141,000,208,088
2643 :096,160,000,185,020,017,049
2649 :153,000,062,136,208,247,127
2655 :160,007,185,171,015,153,018
2661 :248,007,136,016,247,169,156
2667 :031,141,028,208,169,002,174
2673 :141,038,208,169,007,141,049
2679 :037,208,160,063,169,000,244
2685 :153,000,063,136,016,250,231
2691 :162,022,160,007,185,148,047
2697 :010,157,000,063,202,202,003
2703 :202,136,016,244,096,048,117
2709 :028,048,028,048,028,024,097
2715 :024,160,015,185,044,016,087
2721 :153,000,208,136,016,247,153
2727 :169,150,133,003,173,027,054
2733 :208,096,173,031,208,162,027
2739 :007,010,144,045,224,005,102
2745 :176,041,133,249,138,010,164
2751 :168,185,001,208,201,020,206
2757 :144,027,169,251,157,248,169
2763 :007,169,060,157,162,003,249
2769 :169,002,157,039,208,169,185
2775 :128,141,018,212,133,065,144
2781 :169,129,141,018,212,165,031
2787 :249,202,208,205,162,007,236
2793 :189,162,003,240,036,222,061
2799 :162,003,208,031,173,021,069
2805 :208,061,022,011,141,021,197
2811 :208,189,054,016,157,039,146
2817 :208,160,005,032,002,014,166
2823 :169,249,224,005,144,002,032
2829 :169,252,157,248,007,202,024
2835 :208,212,096,254,253,251,013
2841 :247,239,223,191,127,132,160
2847 :005,162,001,169,000,153,009
2853 :082,003,185,142,003,056,252
2859 :249,002,208,016,015,073,094
2865 :255,024,105,001,153,102,177
2871 :003,169,001,153,082,003,210
2877 :208,003,153,102,003,136,154
2883 :202,016,220,164,005,096,002
2889 :160,007,185,082,003,208,206
2895 :021,185,060,003,024,121,237
2901 :102,003,153,060,003,185,079
2907 :002,208,105,000,153,002,049
2913 :208,076,119,011,185,060,244
2919 :003,056,249,102,003,153,157
2925 :060,003,185,002,208,233,032
2931 :000,153,002,208,136,016,118
2937 :209,160,007,185,002,208,124
2943 :056,249,142,003,016,005,086
2949 :073,255,024,105,001,201,024
2955 :005,176,060,136,185,002,191
2961 :208,056,249,142,003,016,051
2967 :005,073,255,024,105,001,102
2973 :200,201,005,176,040,152,163
2979 :170,254,122,003,254,122,064
2985 :003,189,122,003,170,228,116
2991 :012,208,006,169,001,153,212
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2997 :122,003,170,189,255,255,151
3003 :153,142,003,136,202,189,244
3009 :255,255,153,142,003,200,177
3015 :032,030,011,136,136,016,048
3021 :174,096,173,027,212,041,160
3027 :015,133,005,010,024,101,243
3033 :005,168,185,062,016,133,018
3039 :012,200,185,062,016,141,071
3045 :185,011,141,193,011,133,135
3051 :020,200,185,062,016,141,091
3057 :186,011,141,194,011,133,149
3063 :021,160,009,177,020,153,019
3069 :142,003,136,016,248,160,190
3075 :255,162,001,152,157,122,084
3081 :003,232,232,200,200,192,044
3087 :007,208,244,169,031,141,047
3093 :021,208,162,003,169,249,065
3099 :157,249,007,202,016,250,140
3105 :162,007,189,054,016,157,106
3111 :039,208,202,016,247,096,079
3117 :173,021,208,010,010,010,221
3123 :162,004,010,176,126,202,219
3129 :208,250,230,017,165,017,176
3135 :201,005,208,106,169,000,240
3141 :141,021,208,032,209,009,177
3147 :162,010,160,012,024,032,219
3153 :240,255,169,003,160,016,156
3159 :032,030,171,230,019,165,222
3165 :019,201,005,208,003,238,255
3171 :028,007,169,000,133,017,197
3177 :166,019,032,205,189,169,117
3183 :060,056,229,061,133,005,143
3189 :010,010,024,101,005,133,144
3195 :249,162,014,160,021,024,241
3201 :032,240,255,169,000,166,223
3207 :249,032,205,189,164,249,199
3213 :032,002,014,162,050,032,177
3219 :075,014,202,208,250,160,032
3225 :000,132,061,185,104,217,084
3231 :041,015,201,010,208,005,127
3237 :169,032,153,104,005,136,252
3243 :208,239,032,156,010,032,080
3249 :207,011,032,245,008,165,077
3255 :019,201,004,144,004,169,212
3261 :001,133,066,096,162,006,141
3267 :173,021,208,010,010,010,115
3273 :133,249,006,249,144,061,019
3279 :189,002,208,056,237,000,131
3285 :208,201,005,144,006,201,210
3291 :250,176,002,144,028,173,224
3297 :027,212,074,197,002,176,145
3303 :036,032,017,013,176,031,024
3309 :189,002,208,153,008,208,237
3315 :189,003,208,153,009,208,245
3321 :076,012,013,173,027,212,250
3327 :197,248,176,009,173,005,039
3333 :220,197,248,176,002,144,224
3339 :220,202,202,208,187,096,102
3345 :173,021,208,160,003,010,080
3351 :176,014,173,021,208,025,128
3357 :044,013,141,021,208,152,096
3363 :010,168,024,096,136,208,165
3369 :236,056,096,000,032,064,013
3375 :128,198,062,208,066,169,110
3381 :004,133,062,162,006,254,162
3387 :009,208,189,009,208,201,115
3393 :212,176,037,165,066,240,193
3399 :042,173,113,018,201,032,138
3405 :240,035,224,006,208,031,053
3411 :189,008,208,205,000,208,133
3417 :240,023,176,006,254,008,028
3423 :208,076,114,013,222,008,224
3429 :208,076,114,013,173,021,194
3435 :208,061,119,013,141,021,158
3441 :208,202,202,208,196,096,201
3447 :000,000,223,000,191,000,021
3453 :127,169,147,032,210,255,041
3459 :032,046,014,169,015,160,055
3465 :000,153,000,216,153,000,147
3471 :217,153,000,218,153,000,116
3477 :219,136,208,241,169,048,146
3483 :160,005,153,233,004,153,095
3489 :212,003,136,016,247,169,176
3495 :000,141,033,208,169,053,003
3501 :141,028,007,169,028,032,066
3507 :210,255,169,006,141,032,224
3513 :208,160,032,162,024,024,027
3519 :032,240,255,169,194,032,089
3525 :210,255,202,016,244,162,006
3531 :003,160,034,024,032,240,184
3537 :255,169,207,160,015,032,023
3543 :030,171,162,004,032,233,079
3549 :013,162,011,032,233,013,173
3555 :162,018,032,233,013,096,013
3561 :160,032,024,032,240,255,208
3567 :169,179,160,015,032,030,056
3573 :171,160,005,185,222,003,223
3579 :153,001,006,136,016,247,042
3585 :096,134,005,192,000,240,156
3591 :035,056,162,006,202,048,004
3597 :026,189,233,004,105,000,058
3603 :157,233,004,157,212,003,017
3609 :201,058,208,238,169,048,179
3615 :157,233,004,157,212,003,029
3621 :056,176,227,136,208,221,037
3627 :166,005,096,160,255,200,157
3633 :185,212,003,217,222,003,123
3639 :240,247,176,001,096,160,207
3645 :005,185,212,003,153,222,073
3651 :003,153,001,006,136,016,126
3657 :244,096,138,072,162,050,067
3663 :160,000,136,208,253,202,014
3669 :208,248,104,170,096,162,049
3675 :018,160,000,024,032,240,053
3681 :255,032,183,014,169,185,167
3687 :162,030,032,206,014,032,067
3693 :189,014,032,195,014,169,210
3699 :032,162,030,032,206,014,079
3705 :032,183,014,032,195,014,079
3711 :169,032,162,030,032,206,246
3717 :014,032,213,014,032,195,121
3723 :014,169,145,032,210,255,196
3729 :169,032,162,031,032,206,009
3735 :014,032,213,014,032,189,133
3741 :014,032,195,014,169,032,101
3747 :162,032,032,206,014,162,003
3753 :023,160,004,032,219,014,109
3759 :162,023,160,024,032,219,027
3765 :014,096,169,152,032,210,086
3771 :255,096,169,151,032,210,076
3777 :255,096,169,141,032,210,072
3783 :255,169,018,032,210,255,114
3789 :096,032,210,255,202,208,184
3795 :250,096,169,223,032,210,167
3801 :255,096,024,032,240,255,095
3807 :169,049,160,018,032,030,169
3813 :171,096,160,000,032,219,139
3819 :011,032,156,010,032,084,048
3825 :010,032,245,008,169,030,223
3831 :162,008,160,009,024,032,130
3837 :240,255,169,020,160,018,091
3843 :032,030,171,162,018,160,064
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3849 :006,024,032,240,255,169,223
3855 :066,160,018,032,030,171,236
3861 :173,113,018,141,082,007,043
3867 :032,073,011,032,194,009,122
3873 :032,194,009,173,000,220,149
3879 :074,176,017,165,067,208,234
3885 :231,230,067,173,113,018,109
3891 :073,128,141,113,018,076,088
3897 :021,015,072,169,000,133,211
3903 :067,104,074,074,074,074,018
3909 :176,206,162,008,160,009,022
3915 :024,032,240,255,169,035,062
3921 :160,018,032,030,171,096,076
3927 :028,071,065,077,069,032,173
3933 :079,086,069,082,017,017,187
3939 :017,157,157,157,157,157,133
3945 :157,157,157,157,157,157,023
3951 :157,157,157,157,159,080,210
3957 :082,069,083,083,032,085,039
3963 :080,032,084,079,032,080,254
3969 :076,065,089,032,065,071,015
3975 :065,073,078,017,017,017,146
3981 :157,157,157,157,157,157,059
3987 :157,157,157,157,157,157,065
3993 :157,157,157,157,157,158,072
3999 :068,079,087,078,032,084,075
4005 :079,032,069,078,068,000,235
4011 :248,249,249,249,249,252,131
4017 :252,252,028,171,195,195,246
4023 :195,195,195,195,195,017,151
4029 :017,157,157,157,157,157,223
4035 :157,157,157,171,195,195,203
4041 :195,195,195,195,195,000,152
4047 :159,083,067,079,082,069,234
4053 :017,017,017,017,017,017,059
4059 :157,157,157,157,072,073,224
4065 :071,072,017,157,157,157,088
4071 :157,157,083,067,079,082,088
4077 :069,017,017,017,017,017,135
4083 :017,017,157,157,157,157,137
4089 :157,157,067,065,078,078,083
4095 :079,078,083,000,150,076,209
4101 :069,086,069,076,017,017,083
4107 :017,017,157,157,157,157,161
4113 :157,157,157,157,083,072,032
4119 :079,084,032,066,079,078,185
4125 :085,083,145,145,145,145,009
4131 :000,101,084,071,066,093,194
4137 :089,072,103,000,200,020,013
4143 :080,020,080,020,080,020,091
4149 :080,001,004,004,004,004,150
4155 :007,007,014,009,110,016,222
4161 :023,118,016,013,140,016,135
4167 :011,152,016,017,162,016,189
4173 :017,178,016,021,194,016,007
4179 :021,214,016,037,178,016,053
4185 :021,234,016,023,254,016,141
4191 :031,110,016,033,162,016,207
4197 :023,140,016,041,194,016,019
4203 :043,234,016,023,100,138,149
4209 :150,250,100,145,050,050,090
4215 :080,110,080,110,170,210,111
4221 :170,210,080,250,080,050,197
4227 :080,050,160,170,080,250,153
4233 :160,250,080,030,040,140,069
4239 :100,250,160,250,040,140,059
4245 :100,030,160,080,080,130,217
4251 :080,110,150,200,150,250,071
4257 :080,000,000,120,000,120,225
4263 :120,030,170,100,050,190,059
4269 :170,250,100,100,100,030,155
4275 :050,140,110,250,170,140,015
4281 :120,250,050,150,090,030,107
4287 :170,130,080,000,000,120,179
4293 :000,240,000,160,050,250,129
4299 :100,160,150,120,100,080,145
4305 :150,030,100,090,050,122,239
4311 :050,245,050,122,110,030,054
4317 :160,150,160,250,160,250,071
4323 :140,130,140,030,140,030,069
4329 :050,000,000,122,000,244,137
4335 :000,244,120,130,170,070,205
4341 :130,130,050,250,130,130,041
4347 :130,030,120,000,000,122,141
4353 :000,122,120,150,170,180,231
4359 :100,210,170,250,100,180,249
4365 :170,110,100,030,170,000,081
4371 :080,000,060,000,000,215,118
4377 :000,000,215,000,000,255,239
4383 :000,002,255,000,008,255,039
4389 :000,008,255,128,002,255,173
4395 :032,000,170,128,000,255,116
4401 :000,002,255,000,008,255,057
4407 :000,008,255,128,002,255,191
4413 :032,000,170,128,000,255,134
4419 :000,000,255,000,003,255,068
4425 :192,015,255,240,063,255,069
4431 :252,255,255,255,255,003,074
4437 :000,192,001,000,064,001,087
4443 :000,064,001,000,064,000,220
4449 :085,000,001,085,064,005,081
4455 :150,064,006,040,144,005,000
4461 :150,080,005,085,080,007,004
4467 :065,208,003,085,192,001,157
4473 :215,064,000,125,000,000,013
4479 :085,000,112,085,013,209,119
4485 :000,071,004,000,016,000,224
4491 :000,000,000,000,000,000,139
4497 :000,000,255,240,000,015,143
4503 :004,000,016,001,000,064,236
4509 :001,000,064,000,085,000,051
4515 :001,150,064,002,040,128,036
4521 :004,065,016,005,020,080,103
4527 :005,085,080,006,125,144,108
4533 :002,085,128,001,150,064,099
4539 :000,105,000,000,085,000,121
4545 :000,085,000,001,000,064,087
4551 :004,000,016,004,000,016,239
4557 :112,000,013,208,000,007,033
4563 :255,000,192,000,000,192,082
4569 :060,192,240,224,240,227,120
4575 :176,060,227,176,059,238,135
4581 :192,014,170,192,003,145,177
4587 :192,003,132,176,014,021,005
4593 :044,058,021,043,255,068,218
4599 :124,003,132,192,003,132,065
4605 :192,014,132,176,059,209,011
4611 :176,252,234,176,192,239,248
4617 :172,000,224,232,000,192,061
4623 :063,000,192,003,255,150,166
4629 :083,080,065,067,069,032,161
4635 :071,065,076,076,069,082,210
4641 :089,000,032,032,032,032,250
4647 :032,032,032,032,032,032,231
4653 :032,032,032,000,146,028,059
4659 :223,018,032,032,146,169,159
4665 :017,157,157,157,018,032,083
4671 :032,146,000,158,080,082,049
4677 :069,083,083,032,070,073,223
4683 :082,069,032,084,079,032,197
4689 :066,069,071,073,078,013,195
4695 :150,017,017,032,032,032,111
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4701 :032,032,032,032,032,032,029
4707 :032,032,072,069,065,084,197
4713 :032,083,069,069,075,069,246
4719 :082,000,032,013,013,013,008
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Zounds!

(Article on page 80.)

> **BEFORE TYPING . . .**
> **Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.**

Program 1: Bent Laser

```
10 FORL=54272TO54295:POKEL,0:NEXT:POKE542
   96,15                              :rem 16
20 POKE54277,8:POKE54278,255:POKE54276,23
                                      :rem 59
30 FORZ=1TO3:F1=2:REM NO. OF CYCLES
                                      :rem 73
40 FORY=1TO3:F2=8:REM RATIO OF LENGTHS
                                      :rem 86
50 POKE54273,F1:REM MAIN FREQUENCY:rem 49
60 FORX=1TO5:POKE54287,F2:REM PITCH
                                     :rem 152
70 F2=F2*1.4:NEXTX:F1=F1*1.5:NEXTY:REM PI
   TCH                               :rem 173
80 FORW=1TO10:POKE54287,F2:REM W IS TOP P
   ITCH                              :rem 171
90 F2=F2*1.05:NEXTW:NEXTZ:POKE54278,15
                                      :rem 44
```

Program 2: Three-Toed Wheel

```
10 FORL=54272TO54295:POKEL,0:NEXT:POKE542
   96,15                              :rem 16
20 POKE54277,8:POKE54278,255:POKE54276,21
                                      :rem 57
30 FORZ=1TO4:F1=20:REM NO. OF CYCLES
                                     :rem 122
40 FORY=1TO3:F2=100:REM NO. OF INCREMENTS
                                     :rem 222
50 POKE54273,F1:REM VOICE ONE FREQUENCY
                                     :rem 100
60 FORX=1TO5:POKE54287,F2:REM SPEED
                                     :rem 145
70 F1=F1*1.05:F2=F2*.1:REM HARMONIC CONTE
   NT                                :rem 250
80 NEXTX:NEXTY:NEXTZ:POKE54278,15:rem 169
```

Program 3: Minor Thriller

```
10 FORL=54272TO54295:POKEL,0:NEXT:POKE542
   96,15                              :rem 16
20 POKE54277,8:POKE54278,255:POKE54276,23
                                      :rem 59
30 FORZ=1TO3:F1=10:FORY=1TO6:F2=30:rem 74
40 POKE54273,F1                       :rem 59
50 FORX=1TO3:POKE54287,F2:REM RANGE
                                     :rem 138
60 F2=F2/1.2:NEXTX:F1=F1*1.5:NEXTY:rem 25
70 FORW=1TO8:REM LENGTH OF UP TO DOWN TIM
   E                                  :rem 18
80 POKE54273,F1                       :rem 63
90 POKE54287,5:FORV=1TO5:NEXTV     :rem 143
100 F1=F1/1.5:NEXTW:NEXTZ:POKE54278,15
                                      :rem 39
```

Program 4: Sliding Forest

```
10 FORL=54272TO54295:POKEL,0:NEXT:POKE542
   96,15                              :rem 16
20 POKE54277,8:POKE54278,255:POKE54276,21
   :F2=255                           :rem 196
30 FORZ=1TO50:POKE54287,F2:REM NO. OF CYC
   LES                               :rem 114
40 FORF1=255TO0STEP-20:POKE54273,F1:F2=F2
   -.4:NEXTF1:NEXTZ:POKE54278,15      :rem 8
```

Program 5: Ring Thing

```
10 FORL=54272TO54295:POKEL,0:NEXT:POKE542
   96,15:REM CLEAR SOUND CHIP, SET VOLUME
                                      :rem 50
20 POKE54277,8:POKE54278,255:POKE54276,23
   :REM ENVELOPE AND WAVEFORM        :rem 241
30 POKE54287,40:REM VOICE 3 FREQ. CONTROL
   S MAIN PITCH                       :rem 96
40 FORZ=1TO4:REM Z IS NO. OF CYCLES
                                      :rem 33
50 FORF1=255TO0STEP-6:POKE54273,F1:NEXTF1
   :REM STEP SIZE CONTROLS DOWN SPEED
                                     :rem 193
60 FORF1=0TO255STEP20:POKE54273,F1:NEXTF1
   :NEXTZ:REM STEP SIZE CONTROLS UP SPEED
                                       :rem 1
70 POKE54278,15:REM STOPS SOUND   :rem 114
```

Program 6: Gnir Gniht

```
10 FORL=54272TO54295:POKEL,0:NEXT:POKE542
   96,15:REM CLEAR SOUND CHIP, SET VOLUME
                                      :rem 50
20 POKE54277,8:POKE54278,255:POKE54276,21
   :REM ENVELOPE AND WAVEFORM        :rem 239
30 POKE54287,40:REM VOICE 3 FREQ. CONTROL
   S MAIN PITCH                       :rem 96
40 FORZ=1TO4:REM Z IS NO. OF CYCLES
                                      :rem 33
50 FORF1=255TO0STEP-6:POKE54273,F1:NEXTF1
   :REM STEP SIZE CONTROLS DOWN SPEED
                                     :rem 193
60 FORF1=0TO255STEP20:POKE54273,F1:NEXTF1
   :NEXTZ:REM STEP SIZE CONTROLS UP SPEED
                                       :rem 1
70 POKE54278,15:REM STOPS SOUND   :rem 114
```

TurboTape

(Article on page 30.)

Program 1: TurboTape Generator—64 Version

```
10 FI$="TURBO/64":D=1:REM CHANGE 1 TO 8 F
   OR DISK                           :rem 136
20 PRINT "{CLR}{3 DOWN}"TAB(11)"ENTERING
   {SPACE}TURBOTAPE{3 DOWN}"          :rem 12
30 FOR I=2049 TO 3461                 :rem 16
40 READ A:POKE I,A:CK=CK+A:NEXT       :rem 88
```

```
50 IF CK<>143099 THEN PRINT "{2 SPACES}
   {RVS}ERROR DETECTED IN DATA STATEMENTS
   !":STOP                          :rem 110
60 PRINTTAB(16)"{RVS}DATA OK{3 DOWN}":PRI
   NTTAB(4)"PRESS ANY KEY WHEN READY TO S
   AVE"                             :rem 253
70 GET A$:IF A$="" THEN 70          :rem 241
80 PRINT "{CLR}POKE 43,1:POKE 44,8:POKE 4
   5,134:POKE 46,13{2 DOWN}"         :rem 15
90 PRINT"SAVE"CHR$(34);FI$;CHR$(34);",";D
                                     :rem 46
100 POKE 631,19:POKE 632,13:POKE 633,13:P
   OKE 198,3:END                    :rem 148
2049 DATA 62,8,100,0,153,34          :rem 38
2055 DATA 147,17,17,17,34,163       :rem 151
2061 DATA 49,50,41,34,18,32          :rem 43
2067 DATA 84,85,82,66,79,83          :rem 79
2073 DATA 65,86,69,47,76,79          :rem 82
2079 DATA 65,68,32,146,17,17        :rem 113
2085 DATA 17,17,34,58,153,34        :rem 105
2091 DATA 32,32,32,32,82,69          :rem 47
2097 DATA 76,79,67,65,84,69          :rem 88
2103 DATA 32,84,79,58,17,17          :rem 58
2109 DATA 0,140,8,110,0,153          :rem 26
2115 DATA 34,32,32,32,32,32          :rem 31
2121 DATA 32,32,49,46,32,66          :rem 46
2127 DATA 65,83,73,67,32,82          :rem 62
2133 DATA 65,77,32,40,80,79          :rem 57
2139 DATA 73,78,84,69,82,32          :rem 72
2145 DATA 53,53,47,53,54,41          :rem 51
2151 DATA 17,34,58,153,34,32         :rem 96
2157 DATA 32,32,32,32,32,32          :rem 35
2163 DATA 50,46,32,70,82,79          :rem 55
2169 DATA 77,32,53,50,54,48          :rem 61
2175 DATA 54,32,84,48,32,53          :rem 56
2181 DATA 51,50,52,56,17,17          :rem 47
2187 DATA 0,199,8,120,0,151          :rem 45
2193 DATA 49,55,49,44,48,58          :rem 74
2199 DATA 133,34,32,32,32,32         :rem 93
2205 DATA 89,79,85,82,32,67          :rem 73
2211 DATA 72,79,73,67,69,32          :rem 64
2217 DATA 40,49,47,50,41,34          :rem 47
2223 DATA 59,65,36,58,139,65        :rem 118
2229 DATA 36,178,34,49,34,167       :rem 167
2235 DATA 151,49,55,49,44,49        :rem 114
2241 DATA 58,137,49,52,48,0          :rem 55
2247 DATA 216,8,130,0,139,65         :rem 98
2253 DATA 36,179,177,34,50,34       :rem 158
2259 DATA 167,49,50,48,0,245        :rem 111
2265 DATA 8,140,0,158,40,194         :rem 98
2271 DATA 40,52,53,41,170,50         :rem 87
2277 DATA 53,54,172,194,40,52       :rem 156
2283 DATA 54,41,171,56,49,50        :rem 105
2289 DATA 41,58,156,0,62,9           :rem 10
2295 DATA 150,0,153,34,147,17       :rem 146
2301 DATA 17,17,32,32,32,32          :rem 32
2307 DATA 78,79,87,32,76,79          :rem 82
2313 DATA 67,65,84,69,68,32          :rem 69
2319 DATA 65,84,58,34,194,40        :rem 114
2325 DATA 49,57,51,41,170,50         :rem 99
2331 DATA 53,54,172,194,40,49       :rem 153
2337 DATA 57,52,41,34,45,34          :rem 52
2343 DATA 194,40,49,55,52,41        :rem 103
2349 DATA 170,50,53,54,172,194      :rem 206
2355 DATA 40,49,55,53,41,34          :rem 52
2361 DATA 17,17,17,17,0,128          :rem 45
2367 DATA 9,160,0,78,36,178          :rem 64
2373 DATA 199,40,51,52,41,170       :rem 150
2379 DATA 34,78,65,77,69,34          :rem 80
2385 DATA 170,199,40,51,52,41       :rem 153
2391 DATA 58,80,36,178,78,36        :rem 123
2397 DATA 170,34,91,44,66,65        :rem 115
2403 DATA 44,69,65,93,34,58          :rem 65
2409 DATA 90,83,36,178,34,32        :rem 110
2415 DATA 32,79,82,32,83,89          :rem 66
2421 DATA 83,40,54,56,48,41          :rem 51
2427 DATA 34,170,80,36,0,195        :rem 100
2433 DATA 9,170,0,90,86,36            :rem 3
2439 DATA 178,34,32,32,79,82        :rem 115
2445 DATA 32,83,89,83,40,54          :rem 62
2451 DATA 56,51,41,34,170,78        :rem 102
2457 DATA 36,58,84,83,36,178        :rem 126
2463 DATA 34,84,85,82,66,79          :rem 75
2469 DATA 83,65,86,69,34,170        :rem 125
2475 DATA 80,36,58,84,86,36          :rem 73
2481 DATA 178,34,84,85,82,66        :rem 123
2487 DATA 79,86,69,82,73,70          :rem 83
2493 DATA 89,34,170,78,36,0          :rem 64
2499 DATA 239,9,180,0,153,34        :rem 110
2505 DATA 32,32,84,79,32,83          :rem 56
2511 DATA 65,86,69,58,32,34          :rem 64
2517 DATA 84,83,36,58,153,34        :rem 114
2523 DATA 32,32,163,163,163,163     :rem 244
2529 DATA 163,163,163,34,58,153       :rem 3
2535 DATA 44,90,83,36,34,17          :rem 57
2541 DATA 17,0,31,10,190,0          :rem 233
2547 DATA 153,34,32,32,84,79        :rem 110
2553 DATA 32,86,69,82,73,70          :rem 66
2559 DATA 89,58,32,34,84,86          :rem 79
2565 DATA 36,58,153,34,32,32        :rem 104
2571 DATA 163,163,163,163,163,163 :rem 97
2577 DATA 163,163,163,34,58,153       :rem 6
2583 DATA 44,90,86,36,34,17          :rem 63
2589 DATA 17,0,88,10,200,0          :rem 249
2595 DATA 153,34,32,32,84,79        :rem 113
2601 DATA 32,76,79,65,68,58          :rem 71
2607 DATA 32,76,79,65,68,32          :rem 69
2613 DATA 40,84,85,82,66,79          :rem 69
2619 DATA 32,78,79,84,32,78          :rem 76
2625 DATA 69,67,69,83,83,65          :rem 81
2631 DATA 82,89,41,34,58,153        :rem 111
2637 DATA 34,32,32,163,163,163      :rem 199
2643 DATA 163,163,163,163,0,0       :rem 141
2649 DATA 0,56,165,45,133,90        :rem 107
2655 DATA 233,130,133,95,165,46     :rem 255
2661 DATA 133,91,233,2,133,96       :rem 150
2667 DATA 165,171,208,6,169,0       :rem 160
2673 DATA 162,208,208,4,165,55      :rem 207
2679 DATA 166,56,133,88,133,174      :rem 16
2685 DATA 134,89,134,175,32,191       :rem 9
2691 DATA 163,230,89,165,88,166      :rem 17
2697 DATA 89,133,193,134,194,172     :rem 67
2703 DATA 0,3,140,166,2,172          :rem 35
2709 DATA 1,3,140,167,2,141          :rem 39
2715 DATA 0,3,142,1,3,164           :rem 190
2721 DATA 171,240,4,133,55,134      :rem 190
2727 DATA 56,162,255,32,142,251     :rem 252
2733 DATA 32,219,252,32,219,252     :rem 249
2739 DATA 32,209,252,176,75,160       :rem 5
2745 DATA 0,177,172,201,190,208     :rem 248
2751 DATA 240,232,169,32,224,6      :rem 197
2757 DATA 240,13,224,7,208,2         :rem 96
2763 DATA 169,157,224,11,208,5      :rem 206
2769 DATA 169,189,44,169,162,145     :rem 75
2775 DATA 172,200,24,177,172,101     :rem 40
2781 DATA 193,145,172,8,200,177       :rem 2
2787 DATA 172,201,160,240,249,40     :rem 43
2793 DATA 101,194,145,172,224,4     :rem 251
2799 DATA 176,188,157,170,2,232      :rem 14
2805 DATA 136,177,172,157,168,2       :rem 6
2811 DATA 232,169,76,157,166,2      :rem 210
2817 DATA 208,170,96,32,121,0       :rem 146
```

```
2823 DATA 168,32,115,Ø,192,148   :rem 2Ø1
2829 DATA 2Ø8,8,19Ø,1Ø4,Ø,2Ø8    :rem 15Ø
2835 DATA 1Ø,1Ø8,166,2,192,149   :rem 2Ø3
2841 DATA 2Ø8,249,19Ø,31,Ø,162   :rem 197
2847 DATA 128,1Ø8,166,2,169,Ø    :rem 158
2853 DATA 133,1Ø,32,212,225,169  :rem 243
2859 DATA Ø,32,213,255,176,56    :rem 158
2865 DATA 162,2Ø9,142,165,3,2Ø2  :rem 249
2871 DATA 142,167,3,169,96,141   :rem 213
2877 DATA 2Ø9,3,32,81,3,8        :rem 213
2883 DATA 169,145,32,21Ø,255,32  :rem 254
2889 DATA 216,245,4Ø,2Ø8,8,32    :rem 16Ø
2895 DATA 2Ø9,252,144,3,76,141   :rem 2Ø9
29Ø1 DATA 225,162,28,76,55,164   :rem 2Ø8
29Ø7 DATA 32,14,226,32,138,173   :rem 2ØØ
2913 DATA 32,247,183,165,2Ø,166  :rem 254
2919 DATA 21,96,76,249,224,169   :rem 225
2925 DATA 188,19Ø,2ØØ,16Ø,1,32   :rem 194
2931 DATA 189,255,169,1,17Ø,168   :rem 11
2937 DATA 32,186,255,134,171,32    :rem 1
2943 DATA 121,Ø,2Ø1,34,2Ø8,32    :rem 133
2949 DATA 136,23Ø,122,177,122,24Ø :rem 92
2955 DATA 4,2Ø1,34,2Ø8,8,198     :rem 1Ø9
2961 DATA 171,165,171,2Ø8,24Ø,169:rem 1Ø2
2967 DATA 32,19Ø,199,1,232,224   :rem 2Ø8
2973 DATA 17,144,242,32,121,Ø    :rem 141
2979 DATA 24Ø,86,169,34,32,255   :rem 221
2985 DATA 174,24Ø,79,19Ø,87,Ø    :rem 169
2991 DATA 133,78,134,79,19Ø,87   :rem 226
2997 DATA Ø,133,8Ø,134,81,19Ø    :rem 155
3ØØ3 DATA 1Ø,1,176,23Ø,162,9      :rem 83
3ØØ9 DATA 19Ø,237,Ø,157,44,3      :rem 96
3Ø15 DATA 2Ø2,16,247,162,44,16Ø  :rem 239
3Ø21 DATA 3,134,193,132,194,162  :rem 241
3Ø27 DATA 6Ø,134,174,132,175,7Ø  :rem 246
3Ø33 DATA 157,32,237,245,8,32    :rem 149
3Ø39 DATA 21,253,6,157,4Ø,176    :rem 151
3Ø45 DATA 131,169,16,133,183,32  :rem 246
3Ø51 DATA 147,246,19Ø,19,1,96    :rem 155
3Ø57 DATA 46,3,165,1,9,48        :rem 212
3Ø63 DATA 133,139,2Ø8,27,16Ø,3   :rem 195
3Ø69 DATA 185,43,Ø,153,78,Ø       :rem 53
3Ø75 DATA 136,16,247,48,183,23Ø    :rem Ø
3Ø81 DATA 78,2Ø8,2,23Ø,79,165    :rem 158
3Ø87 DATA 78,197,8Ø,165,79,229   :rem 233
3Ø93 DATA 81,96,88,162,Ø,16Ø     :rem 1Ø9
3Ø99 DATA Ø,132,192,173,17,2Ø8   :rem 2Ø2
31Ø5 DATA 41,239,141,17,2Ø8,165  :rem 246
3111 DATA 1,133,139,41,254,133   :rem 184
3117 DATA 1,2Ø2,2Ø8,253,136,2Ø8  :rem 239
3123 DATA 25Ø,12Ø,132,83,169,2   :rem 188
3129 DATA 19Ø,138,1,198,83,2Ø8   :rem 211
3135 DATA 247,169,9,133,83,165   :rem 214
3141 DATA 83,19Ø,138,1,198,83    :rem 158
3147 DATA 2Ø8,247,165,78,19Ø,138  :rem 61
3153 DATA 1,165,79,19Ø,141,1      :rem 96
3159 DATA 165,8Ø,19Ø,141,1,165   :rem 2Ø1
3165 DATA 81,19Ø,141,1,162,4      :rem 92
3171 DATA 19Ø,134,1,132,171,177  :rem 243
3177 DATA 78,19Ø,146,1,19Ø,4     :rem 1Ø7
3183 DATA 1,144,246,234,165,171  :rem 249
3189 DATA 19Ø,146,1,19Ø,141,1    :rem 146
3195 DATA 14Ø,16Ø,2,32,147,252   :rem 192
32Ø1 DATA 165,139,9,48,133,1      :rem 98
32Ø7 DATA 133,192,96,2Ø2,2Ø8,253  :rem 44
3213 DATA 96,162,3,44,162,5       :rem 48
3219 DATA 19Ø,134,1,133,189,24   :rem 199
3225 DATA 1Ø1,171,133,171,169,8  :rem 245
3231 DATA 133,164,19Ø,19Ø,1,166  :rem 243
3237 DATA 163,2Ø2,2Ø8,253,19Ø,19Ø :rem 91
3243 DATA 1,7Ø,189,162,13,144    :rem 146
3249 DATA 2,162,41,134,163,198   :rem 2Ø4
3255 DATA 164,24Ø,17,162,9,19Ø   :rem 2Ø2
3261 DATA 134,1,234,24Ø,223,165  :rem 237
3267 DATA 1,73,8,133,1,238         :rem Ø
3273 DATA 32,2Ø8,96,32,32,32      :rem 98
3279 DATA 32,32,32,32,32,32       :rem 41
3285 DATA 32,32,32,32,32,32       :rem 38
3291 DATA 32,173,17,2Ø8,41,239   :rem 2Ø2
3297 DATA 141,17,2Ø8,32,21,253   :rem 197
33Ø3 DATA 2ØØ,132,192,169,54,133  :rem 35
33Ø9 DATA 1,2Ø2,2Ø8,253,136,2Ø8  :rem 242
3315 DATA 25Ø,12Ø,169,248,141,6  :rem 246
3321 DATA 221,32,228,3,1Ø2,189   :rem 189
3327 DATA 169,2,197,189,2Ø8,245   :rem 15
3333 DATA 133,123,16Ø,9,32,212   :rem 185
3339 DATA 3,2Ø1,2,24Ø,249,196    :rem 149
3345 DATA 189,2Ø8,23Ø,32,212,3   :rem 195
3351 DATA 136,2Ø8,246,133,172,32  :rem 4Ø
3357 DATA 212,3,133,173,32,212   :rem 188
3363 DATA 3,133,174,32,212,3      :rem 88
3369 DATA 133,175,132,171,32,212  :rem 4Ø
3375 DATA 3,145,172,36,16,24     :rem 1Ø1
3381 DATA 1Ø1,171,133,171,32,219  :rem 33
3387 DATA 252,32,2Ø9,252,144,236  :rem 49
3393 DATA 32,212,3,14Ø,16Ø,2      :rem 83
3399 DATA 32,147,252,165,139,133  :rem 56
34Ø5 DATA 1,88,133,192,32,17Ø    :rem 147
3411 DATA 245,134,45,132,46,165  :rem 247
3417 DATA 189,197,171,76,154,225  :rem 65
3423 DATA 169,8,133,163,32,228   :rem 2Ø4
3429 DATA 3,1Ø2,189,198,163,2Ø8    :rem 6
3435 DATA 247,165,189,96,169,16   :rem 22
3441 DATA 44,13,22Ø,24Ø,251,173  :rem 235
3447 DATA 13,221,142,7,221,72    :rem 141
3453 DATA 169,25,141,15,221,1Ø4  :rem 242
3459 DATA 74,74,96               :rem 14Ø
```

Program 2: TurboTape Generator—VIC Version

```
1Ø FI$="TURBO/VIC":D=1:REM FOR DISK CHANG
   E 1 TO 8                          :rem Ø
2Ø PRINT "{CLR}{4 DOWN}{2 SPACES}ENTERING
    TURBOTAPE{5 DOWN}"             :rem 113
3Ø FOR I=4Ø97 TO 526Ø               :rem 2Ø
4Ø READ A:POKE I,A:CK=CK+A:NEXT     :rem 88
5Ø IF CK<>123822 THEN PRINT "{RVS}ERROR D
   ETECTED IN DATA STATEMENTS":STOP
                                    :rem 69
6Ø PRINTTAB(7)"{RVS}DATA OK{2 DOWN}":PRIN
   T"PRESS ANY KEY TO SAVE"        :rem 185
7Ø GET A$:IF A$=""THEN 7Ø          :rem 241
8Ø PRINT"{CLR}POKE 43,1:POKE 44,16:POKE 4
   5,141:POKE 46,2Ø{2 DOWN}"        :rem 58
9Ø PRINT"SAVE"CHR$(34);FI$;CHR$(34);",";"D
                                   :rem 243
1ØØ POKE 631,19:POKE 632,13:POKE 633,13:P
    OKE 198,3:END                  :rem 148
4Ø97 DATA 32,16,1ØØ,Ø,153,34       :rem 87
41Ø3 DATA 147,32,32,32,144,18     :rem 139
41Ø9 DATA 32,84,85,82,66,79        :rem 72
4115 DATA 83,65,86,69,47,76        :rem 76
4121 DATA 79,65,68,32,31,17        :rem 56
4127 DATA Ø,61,16,11Ø,Ø,158        :rem 34
4133 DATA 4Ø,194,4Ø,52,53,41       :rem 91
4139 DATA 17Ø,5Ø,53,54,172,194    :rem 2Ø5
4145 DATA 4Ø,52,54,41,171,55       :rem 96
4151 DATA 57,53,41,58,156,Ø        :rem 51
4157 DATA 112,16,12Ø,Ø,153,34     :rem 133
4163 DATA 78,79,87,32,65,84        :rem 78
```

```
4169 DATA 34,194,40,49,57,51      :rem 114
4175 DATA 41,170,50,53,54,172     :rem 148
4181 DATA 194,40,49,57,52,41      :rem 107
4187 DATA 34,45,34,194,40,49      :rem 112
4193 DATA 55,52,41,170,50,53       :rem 98
4199 DATA 54,172,194,40,49,55     :rem 169
4205 DATA 53,41,0,155,16,130       :rem 84
4211 DATA 0,78,36,178,199,40      :rem 109
4217 DATA 51,52,41,170,34,78      :rem 100
4223 DATA 65,77,69,34,170,199     :rem 171
4229 DATA 40,51,52,41,58,79        :rem 58
4235 DATA 80,36,178,78,36,170     :rem 165
4241 DATA 34,91,44,66,65,44        :rem 57
4247 DATA 69,65,93,0,229,16        :rem 65
4253 DATA 140,0,90,83,36,178      :rem 102
4259 DATA 34,83,89,83,40,54        :rem 69
4265 DATA 56,48,41,34,170,79      :rem 114
4271 DATA 80,36,58,90,86,36        :rem 66
4277 DATA 178,34,83,89,83,40      :rem 124
4283 DATA 54,56,51,41,34,170      :rem 101
4289 DATA 78,36,58,84,83,36        :rem 82
4295 DATA 178,34,84,83,65,86      :rem 129
4301 DATA 69,34,170,79,80,36      :rem 109
4307 DATA 58,84,86,36,178,34      :rem 123
4313 DATA 84,86,69,82,73,70        :rem 69
4319 DATA 89,34,170,78,36,0        :rem 63
4325 DATA 11,17,150,0,153,34       :rem 84
4331 DATA 17,144,18,84,79,32      :rem 108
4337 DATA 83,65,86,69,58,31        :rem 75
4343 DATA 17,34,58,153,84,83      :rem 112
4349 DATA 36,44,34,32,32,79        :rem 60
4355 DATA 82,34,58,153,90,83      :rem 114
4361 DATA 36,0,50,17,160,0        :rem 241
4367 DATA 153,34,144,18,84,79     :rem 168
4373 DATA 32,86,69,82,73,70        :rem 68
4379 DATA 89,58,31,17,34,58        :rem 75
4385 DATA 153,84,86,36,44,34      :rem 117
4391 DATA 32,32,79,82,34,58        :rem 63
4397 DATA 153,90,86,36,0,112      :rem 106
4403 DATA 17,170,0,153,34,17       :rem 89
4409 DATA 144,18,84,79,32,76      :rem 119
4415 DATA 79,65,68,58,31,17        :rem 70
4421 DATA 34,58,153,34,76,79      :rem 114
4427 DATA 65,68,32,79,82,32        :rem 68
4433 DATA 76,79,65,68,34,78        :rem 80
4439 DATA 36,44,34,32,40,84        :rem 55
4445 DATA 85,82,66,79,32,78        :rem 78
4451 DATA 79,84,32,82,69,81        :rem 71
4457 DATA 85,73,82,69,68,41        :rem 77
4463 DATA 0,0,0,56,165,45         :rem 199
4469 DATA 133,90,233,127,133,95     :rem 4
4475 DATA 165,46,133,91,233,2     :rem 155
4481 DATA 133,96,165,55,133,88    :rem 218
4487 DATA 133,174,166,56,134,89    :rem 17
4493 DATA 134,175,32,191,195,230   :rem 51
4499 DATA 89,165,88,166,89,133    :rem 242
4505 DATA 193,134,194,172,0,3     :rem 148
4511 DATA 140,166,2,172,1,3        :rem 35
4517 DATA 140,167,2,141,0,3        :rem 37
4523 DATA 142,1,3,133,55,134       :rem 88
4529 DATA 56,162,255,32,210,251   :rem 250
4535 DATA 32,27,253,32,27,253     :rem 151
4541 DATA 32,17,253,176,75,160    :rem 204
4547 DATA 0,177,172,201,190,208   :rem 250
4553 DATA 240,232,169,32,224,6    :rem 199
4559 DATA 240,13,224,7,208,2       :rem 98
4565 DATA 169,157,224,11,208,5    :rem 208
4571 DATA 169,189,46,169,162,145   :rem 70
4577 DATA 172,200,24,177,172,101   :rem 42
4583 DATA 193,145,172,8,200,177     :rem 4
4589 DATA 172,201,160,240,249,40   :rem 45
4595 DATA 101,194,145,172,224,4   :rem 253
4601 DATA 176,188,157,170,2,232   :rem 254
4607 DATA 136,177,172,157,168,2     :rem 8
4613 DATA 232,169,76,157,166,2    :rem 212
4619 DATA 208,170,96,32,121,0     :rem 148
4625 DATA 168,32,115,0,192,148    :rem 203
4631 DATA 208,8,190,102,0,208     :rem 141
4637 DATA 10,108,166,2,192,149    :rem 205
4643 DATA 208,249,190,29,0,76     :rem 162
4649 DATA 116,196,169,0,133,10    :rem 205
4655 DATA 32,209,225,169,0,32     :rem 152
4661 DATA 213,255,176,56,162,209   :rem 54
4667 DATA 142,161,3,202,142,163   :rem 244
4673 DATA 3,169,96,141,206,3      :rem 109
4679 DATA 32,81,3,8,169,145        :rem 67
4685 DATA 32,210,255,32,112,246   :rem 246
4691 DATA 40,208,8,32,17,253      :rem 103
4697 DATA 144,3,76,141,225,162    :rem 209
4703 DATA 28,76,55,196,32,11      :rem 108
4709 DATA 226,32,138,205,32,247   :rem 254
4715 DATA 215,165,20,166,21,96    :rem 204
4721 DATA 76,246,224,169,183,190   :rem 59
4727 DATA 202,160,1,32,189,255    :rem 201
4733 DATA 169,1,170,168,32,186    :rem 211
4739 DATA 255,134,171,32,121,0    :rem 195
4745 DATA 201,34,208,32,136,230   :rem 242
4751 DATA 122,177,122,240,4,201   :rem 237
4757 DATA 34,208,8,198,171,165    :rem 221
4763 DATA 171,208,240,169,32,190   :rem 50
4769 DATA 201,1,232,224,17,144    :rem 196
4775 DATA 242,32,121,0,240,90     :rem 141
4781 DATA 169,34,32,255,206,240     :rem 0
4787 DATA 83,190,85,0,133,78      :rem 120
4793 DATA 134,79,190,85,0,133     :rem 163
4799 DATA 80,134,81,190,12,1      :rem 106
4805 DATA 176,230,162,13,190,235   :rem 43
4811 DATA 0,157,44,3,202,16        :rem 39
4817 DATA 247,162,44,160,3,134    :rem 202
4823 DATA 193,132,194,162,60,134   :rem 47
4829 DATA 174,132,175,70,157,32     :rem 5
4835 DATA 133,246,8,32,138,255    :rem 210
4841 DATA 6,157,40,176,131,169    :rem 209
4847 DATA 16,133,183,32,44,247    :rem 209
4853 DATA 190,21,1,96,46,3          :rem 4
4859 DATA 173,28,145,133,251,9    :rem 215
4865 DATA 12,141,28,145,208,23    :rem 201
4871 DATA 160,3,185,43,0,153       :rem 98
4877 DATA 78,0,136,16,247,48      :rem 121
4883 DATA 179,230,78,208,2,230    :rem 211
4889 DATA 79,165,78,197,80,165    :rem 243
4895 DATA 79,229,81,96,88,162     :rem 190
4901 DATA 0,160,0,132,192,173     :rem 136
4907 DATA 28,145,133,251,9,12     :rem 153
4913 DATA 141,28,145,202,208,253   :rem 41
4919 DATA 136,208,250,120,132,83   :rem 44
4925 DATA 169,2,190,138,1,198     :rem 165
4931 DATA 83,208,247,169,9,133    :rem 217
4937 DATA 83,165,83,190,138,1     :rem 166
4943 DATA 198,83,208,247,165,78    :rem 25
4949 DATA 190,138,1,165,79,190    :rem 221
4955 DATA 141,1,165,80,190,141    :rem 200
4961 DATA 1,165,81,190,141,1       :rem 97
4967 DATA 162,4,190,134,1,132     :rem 150
4973 DATA 171,177,78,190,146,1    :rem 218
4979 DATA 190,6,1,144,246,234     :rem 162
4985 DATA 165,171,190,146,1,190     :rem 5
4991 DATA 141,1,140,160,2,32       :rem 87
4997 DATA 207,252,165,251,141,28   :rem 57
5003 DATA 145,133,192,169,27,141   :rem 42
5009 DATA 15,144,96,202,208,253   :rem 250
5015 DATA 96,162,3,44,162,5        :rem 50
```

```
5021 DATA 190,134,1,133,189,24    :rem 192
5027 DATA 101,171,133,171,169,8   :rem 247
5033 DATA 133,164,190,190,1,166   :rem 245
5039 DATA 163,202,208,253,190,190 :rem 93
5045 DATA 1,70,189,162,13,144     :rem 148
5051 DATA 2,162,41,134,163,198    :rem 197
5057 DATA 164,240,19,162,9,190    :rem 206
5063 DATA 134,1,234,240,223,173   :rem 238
5069 DATA 32,145,73,8,141,32      :rem 102
5075 DATA 145,141,15,144,96,32    :rem 202
5081 DATA 32,32,32,32,32,32        :rem 34
5087 DATA 32,32,32,32,32,32        :rem 40
5093 DATA 32,32,32,32,138,255     :rem 147
5099 DATA 200,132,192,202,208,253 :rem 89
5105 DATA 136,208,250,120,173,27   :rem 35
5111 DATA 145,41,63,141,27,145    :rem 191
5117 DATA 169,248,141,22,145,32   :rem 251
5123 DATA 225,3,102,189,169,2     :rem 148
5129 DATA 197,189,208,245,133,123:rem 108
5135 DATA 160,9,32,209,3,201       :rem 90
5141 DATA 2,240,249,196,189,208     :rem 4
5147 DATA 230,32,209,3,136,208    :rem 195
5153 DATA 246,133,172,32,209,3    :rem 196
5159 DATA 133,173,32,209,3,133    :rem 198
5165 DATA 174,32,209,3,133,175    :rem 202
5171 DATA 132,171,32,209,3,145    :rem 192
5177 DATA 172,36,16,24,101,171    :rem 197
5183 DATA 133,171,32,27,253,32    :rem 196
5189 DATA 17,253,144,236,32,209     :rem 3
5195 DATA 3,140,160,2,32,207       :rem 89
5201 DATA 252,165,251,141,28,145   :rem 37
5207 DATA 88,133,192,32,66,246    :rem 212
5213 DATA 134,45,132,46,165,189     :rem 0
5219 DATA 197,171,76,154,225,169   :rem 65
5225 DATA 8,133,163,32,225,3       :rem 94
5231 DATA 102,189,198,163,208,247:rem 105
5237 DATA 165,189,96,169,2,44     :rem 174
5243 DATA 45,145,240,251,173,29   :rem 251
5249 DATA 145,72,173,33,145,142   :rem 255
5255 DATA 21,145,104,10,10,96     :rem 138
```

TurboDisk

(*Article on page 34.*)

Program 1: 64 TurboDisk Creator

```
100 PRINT"{CLR}"TAB(206)"{WHT}TURBODISK P
    ROGRAM GENERATOR":PRINT:PRINT   :rem 2
110 PRINT"{CYN}INSERT DISK AND HIT {RVS}
    {SPACE}RETURN {OFF} WHEN READY":PRINT
    :PRINT                        :rem 115
120 GET A$:IF A$<>CHR$(13) THEN 120
                                  :rem 248
130 OPEN 2,8,2,"TURBODISK.OBJ,P,W":GOSUB
    {SPACE}1000                   :rem 100
140 PRINT#2,CHR$(0)CHR$(192);      :rem 78
150 FOR I=0 TO 435:READ A:CK=CK+A:PRINT#2
    ,CHR$(A);:NEXT I              :rem 224
160 IF A<>96 OR CK<>55976 THEN PRINT"
    {RVS}ERROR IN DATA LINES 49152-49584"
    :GOTO 300                      :rem 23
170 FOR I=0 TO 75:PRINT#2,CHR$(234);:NEXT
     I                            :rem 116
180 CK=0:FOR I=0 TO 443:READ A:CK=CK+A:PR
    INT#2,CHR$(A);:NEXT I          :rem 23
190 IF A<>160 OR CK<>45825 THEN PRINT"
    {RVS}ERROR IN DATA LINES 49664-50102"
    :GOTO300                       :rem 44
200 CLOSE 15:CLOSE 2:PRINT TAB(9)"{7}TURB
    ODISK.OBJ CREATED":PRINT:PRINT TAB(10
    );                             :rem 96
210 INPUT "ANOTHER COPY (Y/N)";A$:IF A$<>
    "Y" THEN END                  :rem 197
220 RUN                           :rem 137
300 CLOSE 2:CLOSE 15:OPEN 15,8,15,"S0:TUR
    BODISK.OBJ":CLOSE 15:END       :rem 45
1000 CLOSE 15:OPEN 15,8,15:INPUT#15,E,E$,
     T,S:IF E=0 THEN RETURN        :rem 71
1010 PRINT"DISK ERROR"E": "E$;T;S:rem 145
1020 CLOSE 15:OPEN 15,8,15,"I0:":CLOSE 15
     :END                         :rem 177
49100 REM ** 64 TURBODISK ML      :rem 240
49152 DATA 24,144,24,169,165,141   :rem 50
49158 DATA 48,3,169,244,141,49    :rem 221
49164 DATA 3,160,0,185,41,192     :rem 151
49170 DATA 240,6,32,22,231,200    :rem 184
49176 DATA 208,245,96,169,84,141   :rem 71
49182 DATA 48,3,169,192,141,49    :rem 220
49188 DATA 3,160,21,208,230,13    :rem 196
49194 DATA 84,85,82,66,79,68      :rem 142
49200 DATA 73,83,75,32,68,73      :rem 115
49206 DATA 83,65,66,76,69,68      :rem 135
49212 DATA 13,0,13,84,85,82        :rem 51
49218 DATA 66,79,68,73,83,75      :rem 137
49224 DATA 32,65,67,84,73,86      :rem 124
49230 DATA 65,84,69,68,13,0        :rem 64
49236 DATA 133,147,165,147,208,30:rem 102
49242 DATA 160,0,177,187,201,36   :rem 253
49248 DATA 240,22,162,16,169,160   :rem 50
49254 DATA 157,172,195,202,16,250:rem 102
49260 DATA 177,187,153,172,195,200
                                  :rem 158
49266 DATA 196,183,144,246,176,11:rem 114
49272 DATA 165,147,76,165,244,77   :rem 71
49278 DATA 45,87,0,0,32,169        :rem 65
49284 DATA 16,133,255,169,0,133     :rem 2
49290 DATA 251,169,194,133,252,169
                                  :rem 164
49296 DATA 0,133,253,169,5,133    :rem 209
49302 DATA 254,165,186,32,177,255:rem 110
49308 DATA 169,111,32,147,255,165:rem 106
49314 DATA 253,164,254,141,128,192
                                  :rem 152
49320 DATA 140,129,192,160,0,185   :rem 42
49326 DATA 125,192,32,168,255,200:rem 100
49332 DATA 192,6,208,245,160,0    :rem 201
49338 DATA 177,251,32,168,255,200:rem 106
49344 DATA 192,32,144,246,165,251:rem 104
49350 DATA 105,31,133,251,165,252  :rem 89
49356 DATA 105,0,133,252,165,253   :rem 45
49362 DATA 105,32,133,253,165,254  :rem 97
49368 DATA 105,0,133,254,32,174   :rem 253
49374 DATA 255,198,255,208,180,165
                                  :rem 170
49380 DATA 186,32,177,255,169,111:rem 112
49386 DATA 32,147,255,169,85,32    :rem 19
49392 DATA 168,255,169,67,32,168   :rem 77
49398 DATA 255,32,174,255,120,169:rem 115
49404 DATA 11,141,17,208,32,125   :rem 242
49410 DATA 193,44,0,196,48,83     :rem 164
49416 DATA 164,195,166,196,165,185
                                  :rem 175
49422 DATA 240,6,172,2,196,174    :rem 207
49428 DATA 3,196,132,174,134,175   :rem 59
49434 DATA 162,4,173,0,196,240    :rem 204
49440 DATA 21,32,101,193,32,125   :rem 239
49446 DATA 193,173,0,196,48,50    :rem 218
49452 DATA 240,6,32,99,193,24     :rem 164
```

```
49458 DATA 144,240,162,2,160,0      :rem 197
49464 DATA 189,0,196,145,174,200     :rem 59
49470 DATA 232,236,1,196,144,244     :rem 52
49476 DATA 189,0,196,145,174,200     :rem 62
49482 DATA 32,112,193,24,72,169       :rem 6
49488 DATA 27,141,17,208,104,166     :rem 58
49494 DATA 174,164,175,88,96,169     :rem 87
49500 DATA 4,44,169,0,56,176        :rem 109
49506 DATA 235,162,2,160,0,189      :rem 204
49512 DATA 0,196,145,174,200,232     :rem 42
49518 DATA 208,247,24,152,101,174:rem 100
49524 DATA 133,174,165,175,105,0     :rem 48
49530 DATA 133,175,96,160,0,173       :rem 0
49536 DATA 0,221,48,251,169,23      :rem 207
49542 DATA 141,0,221,173,0,221      :rem 185
49548 DATA 16,251,169,7,141,0       :rem 160
49554 DATA 221,162,4,202,234,208     :rem 42
49560 DATA 252,162,4,173,0,221      :rem 196
49566 DATA 10,8,10,38,149,40        :rem 107
49572 DATA 38,149,202,208,242,165:rem 108
49578 DATA 149,73,255,153,0,196      :rem 20
49584 DATA 200,208,204,96           :rem 221
49600 REM ** 1541 TURBODISK ML       :rem 86
49664 DATA 32,66,208,120,169,21       :rem 4
49670 DATA 141,7,28,169,18,160      :rem 215
49676 DATA 1,141,0,3,140,1          :rem 246
49682 DATA 3,32,205,5,169,3          :rem 58
49688 DATA 133,60,162,0,134,75      :rem 211
49694 DATA 240,43,160,0,177,59      :rem 215
49700 DATA 41,191,201,130,208,25     :rem 34
49706 DATA 200,200,200,185,169,6     :rem 42
49712 DATA 201,42,240,66,201,63     :rem 244
49718 DATA 240,4,209,59,208,7       :rem 167
49724 DATA 200,192,18,240,53,208     :rem 47
49730 DATA 234,230,75,166,75,224     :rem 56
49736 DATA 8,240,7,189,110,5        :rem 113
49742 DATA 133,59,208,206,173,0       :rem 2
49748 DATA 3,240,6,172,1,3            :rem 3
49754 DATA 76,19,5,169,255,141      :rem 225
49760 DATA 0,3,32,150,5,169          :rem 51
49766 DATA 58,141,7,28,88,76        :rem 135
49772 DATA 69,217,2,34,66,98        :rem 130
49778 DATA 130,162,194,226,230,59:rem 113
49784 DATA 160,0,177,59,141,0       :rem 160
49790 DATA 3,200,177,59,141,1       :rem 156
49796 DATA 3,32,205,5,32,150        :rem 104
49802 DATA 5,173,0,3,208,245        :rem 101
49808 DATA 169,58,141,7,28,96       :rem 182
49814 DATA 160,0,185,0,3,133         :rem 95
49820 DATA 133,169,2,141,0,24       :rem 146
49826 DATA 173,0,24,41,4,240         :rem 99
49832 DATA 249,169,0,141,0,24       :rem 155
49838 DATA 162,4,169,0,6,133        :rem 112
49844 DATA 42,10,6,133,42,10         :rem 94
49850 DATA 141,0,24,202,208,240     :rem 240
49856 DATA 72,104,72,104,169,0      :rem 210
49862 DATA 141,0,24,200,208,204     :rem 241
49868 DATA 96,172,1,3,132,7          :rem 67
49874 DATA 173,0,3,197,6,8           :rem 19
49880 DATA 133,6,40,240,16,169      :rem 209
49886 DATA 176,133,0,88,36,0        :rem 119
49892 DATA 48,252,120,165,0,201     :rem 253
49898 DATA 1,208,78,169,238,141      :rem 25
49904 DATA 12,28,169,6,133,50       :rem 159
49910 DATA 169,0,133,51,133,48      :rem 205
49916 DATA 169,3,133,49,32,82       :rem 169
49922 DATA 6,80,254,184,173,1       :rem 162
49928 DATA 28,153,0,3,200,208       :rem 152
49934 DATA 244,160,186,80,254,184:rem 115
49940 DATA 173,1,28,153,0,1          :rem 48
49946 DATA 200,208,244,32,224,248:rem 103
49952 DATA 165,56,197,71,240,4      :rem 221
49958 DATA 169,34,208,20,32,233       :rem 9
49964 DATA 245,197,58,240,4,169      :rem 25
49970 DATA 35,208,9,169,236,141      :rem 15
49976 DATA 12,28,96,24,105,24       :rem 167
49982 DATA 133,68,169,255,141,0      :rem 13
49988 DATA 3,32,150,5,169,58        :rem 124
49994 DATA 141,7,28,165,68,76       :rem 183
50000 DATA 200,193,32,88,6,76       :rem 146
50006 DATA 148,6,165,18,133,22      :rem 196
50012 DATA 165,19,133,23,165,6      :rem 194
50018 DATA 133,24,165,7,133,25      :rem 194
50024 DATA 169,0,69,22,69,23        :rem 104
50030 DATA 69,24,69,25,133,26       :rem 152
50036 DATA 32,52,249,162,90,32      :rem 198
50042 DATA 148,6,80,254,184,173     :rem 255
50048 DATA 1,28,217,36,0,208         :rem 95
50054 DATA 6,200,192,8,208,240      :rem 192
50060 DATA 96,202,208,233,169,32     :rem 43
50066 DATA 208,170,169,208,141,5     :rem 46
50072 DATA 24,169,33,44,5,24         :rem 99
50078 DATA 16,158,44,0,28,48        :rem 109
50084 DATA 246,173,1,28,184,160     :rem 253
50090 DATA 0,96,160,160,160,160     :rem 239
50096 DATA 160,160,160,160,160,160
                                    :rem 132
50102 DATA 160,160,160,160,160,160
                                    :rem 120
```

Program 2: 64 TurboDisk Loader

```
10 IF A=0 THEN A=1:LOAD "TURBODISK.OBJ",8
   ,1                                :rem 155
20 SYS 49152:NEW                     :rem 138
```

Program 3: VIC TurboDisk Loader

Translation by Ottis Cowper, Technical Editor

```
10 POKE 55,0:POKE 56,PEEK(56)-5:CLR:PRINT
   "{DOWN} VIC TURBODISK LOADER"   :rem 32
20 X=PEEK(56):A1=X*256:PRINT"{DOWN}WRITIN
   G BLOCK 1"                       :rem 188
30 FOR AD=A1 TO A1+464:READ DT:CK=CK+DT:I
   F DT<0 THEN DT=X-DT-1           :rem 236
40 POKE AD,DT:NEXT:IF CK<>54423 THEN PRIN
   T"{RVS}ERROR IN DATA":PRINT"LINES 1000
   -1770":STOP                       :rem 56
50 CK=0:A2=A1+512:PRINT"WRITING BLOCK 2"
                                     :rem 75
60 FOR AD=A2 TO A2+443:READ DT:CK=CK+DT
                                    :rem 162
70 POKE AD,DT:NEXT:IF CK<>45825 THEN PRIN
   T"{RVS}ERROR IN DATA":PRINT"LINES 2000
   -2730":STOP                       :rem 63
80 PRINT"DATA OK":PRINT"{DOWN}SYS"A1"TO A
   CTIVATE":PRINT"{DOWN}SYS"A1+3"TO DISAB
   LE"                              :rem 120
90 SYS A1                           :rem 218
999 REM ** VIC TURBODISK ML          :rem 21
1000 DATA 24,144,24,169,73,141      :rem 188
1010 DATA 48,3,169,245,141,49       :rem 149
1020 DATA 3,160,0,185,41,-1          :rem 20
1030 DATA 240,6,32,66,231,200       :rem 127
1040 DATA 208,245,96,169,84,141       :rem 1
1050 DATA 48,3,169,-1,141,49         :rem 92
1060 DATA 3,160,21,208,230,13       :rem 125
1070 DATA 84,85,82,66,79,68          :rem 75
1080 DATA 73,83,75,32,68,73          :rem 61
1090 DATA 83,65,66,76,69,68          :rem 76
1100 DATA 13,0,13,84,85,82          :rem 243
```

```
1110 DATA 66,79,68,73,83,75      :rem 68
1120 DATA 32,65,67,84,73,86      :rem 59
1130 DATA 65,84,69,68,13,0        :rem 3
1140 DATA 133,147,165,147,208,30  :rem 36
1150 DATA 160,0,177,187,201,36   :rem 191
1160 DATA 240,22,162,16,169,160  :rem 239
1170 DATA 157,172,-4,202,16,250  :rem 233
1180 DATA 177,187,153,172,-4,200  :rem 37
1190 DATA 196,183,144,246,176,5    :rem 5
1200 DATA 165,147,76,73,245,160  :rem 250
1210 DATA 0,185,138,-1,240,30    :rem 123
1220 DATA 32,66,231,200,208,245  :rem 233
1230 DATA 13,84,85,82,66,79       :rem 63
1240 DATA 76,79,65,68,73,78       :rem 76
1250 DATA 71,46,46,46,13,0       :rem 248
1260 DATA 77,45,87,0,0,32        :rem 202
1270 DATA 169,16,133,255,169,0   :rem 202
1280 DATA 133,251,169,-3,133,252  :rem 32
1290 DATA 169,0,133,253,169,5    :rem 152
1300 DATA 133,254,165,186,32,177  :rem 43
1310 DATA 255,169,111,32,147,255  :rem 39
1320 DATA 165,253,164,254,141,159 :rem 93
1330 DATA -1,140,160,-1,160,0    :rem 108
1340 DATA 185,156,-1,32,168,255  :rem 246
1350 DATA 200,192,6,208,245,160  :rem 239
1360 DATA 0,177,251,32,168,255   :rem 199
1370 DATA 200,192,32,144,246,165  :rem 37
1380 DATA 251,105,31,133,251,165  :rem 31
1390 DATA 252,105,0,133,252,165  :rem 238
1400 DATA 253,105,32,133,253,165  :rem 29
1410 DATA 254,105,0,133,254,32   :rem 180
1420 DATA 174,255,198,255,208,180:rem 102
1430 DATA 165,186,32,177,255,169  :rem 57
1440 DATA 111,32,147,255,169,85  :rem 252
1450 DATA 32,168,255,169,67,32   :rem 210
1460 DATA 168,255,32,174,255,120  :rem 44
1470 DATA 32,144,-2,44,0,-5       :rem 25
1480 DATA 48,76,164,195,166,196   :rem 19
1490 DATA 165,185,240,6,172,2    :rem 150
1500 DATA -5,174,3,-5,132,174    :rem 129
1510 DATA 134,175,162,4,173,0    :rem 138
1520 DATA -5,240,21,32,120,-2    :rem 112
1530 DATA 32,144,-2,173,0,-5      :rem 73
1540 DATA 48,43,240,6,32,118      :rem 94
1550 DATA -2,24,144,240,162,2    :rem 128
1560 DATA 160,0,189,0,-5,145      :rem 87
1570 DATA 174,200,232,236,1,-5   :rem 182
1580 DATA 144,244,189,0,-5,145   :rem 197
1590 DATA 174,200,32,131,-2,24   :rem 178
1600 DATA 166,174,164,175,88,96   :rem 13
1610 DATA 169,4,44,169,0,56       :rem 53
1620 DATA 176,242,162,2,160,0    :rem 135
1630 DATA 189,0,-5,145,174,200   :rem 188
1640 DATA 232,208,247,24,152,101  :rem 31
1650 DATA 174,133,174,165,175,105 :rem 96
1660 DATA 0,133,175,96,160,0      :rem 93
1670 DATA 173,17,145,41,2,208    :rem 146
1680 DATA 249,173,44,145,9,14    :rem 159
1690 DATA 141,44,145,173,17,145  :rem 251
1700 DATA 41,2,240,249,173,44    :rem 141
1710 DATA 145,41,253,141,44,145  :rem 240
1720 DATA 162,3,202,234,208,252  :rem 236
1730 DATA 162,4,173,17,145,74    :rem 150
1740 DATA 38,149,74,38,149,234   :rem 216
1750 DATA 234,202,208,242,165,149 :rem 92
1760 DATA 73,255,153,0,-5,200    :rem 135
1770 DATA 208,194,96             :rem 232
1999 REM ** 1541 TURBODISK ML     :rem 47
2000 DATA 32,66,208,120,169,21   :rem 185
2010 DATA 141,7,28,169,18,160    :rem 144
2020 DATA 1,141,0,3,140,1        :rem 170
2030 DATA 3,32,205,5,169,3       :rem 242
2040 DATA 133,60,162,0,134,75    :rem 134
2050 DATA 240,43,160,0,177,59    :rem 142
2060 DATA 41,191,201,130,208,25  :rem 230
2070 DATA 200,200,200,185,169,6  :rem 233
2080 DATA 201,42,240,66,201,63   :rem 183
2090 DATA 240,4,209,59,208,7     :rem 101
2100 DATA 200,192,18,240,53,208  :rem 232
2110 DATA 234,230,75,166,75,224  :rem 245
2120 DATA 8,240,7,189,110,5       :rem 41
2130 DATA 133,59,208,206,173,0   :rem 190
2140 DATA 3,240,6,172,1,3        :rem 186
2150 DATA 76,19,5,169,255,141    :rem 156
2160 DATA 0,3,32,150,5,169       :rem 242
2170 DATA 58,141,7,28,88,76       :rem 65
2180 DATA 69,217,2,34,66,98       :rem 64
2190 DATA 130,162,194,226,230,59  :rem 42
2200 DATA 160,0,177,59,141,0      :rem 84
2210 DATA 3,200,177,59,141,1      :rem 84
2220 DATA 3,32,205,5,32,150       :rem 27
2230 DATA 5,173,0,3,208,245       :rem 37
2240 DATA 169,58,141,7,28,96     :rem 113
2250 DATA 160,0,185,0,3,133       :rem 30
2260 DATA 133,169,2,141,0,24      :rem 85
2270 DATA 173,0,24,41,4,240       :rem 33
2280 DATA 249,169,0,141,0,24      :rem 93
2290 DATA 162,4,169,0,6,133       :rem 45
2300 DATA 42,10,6,133,42,10       :rem 22
2310 DATA 141,0,24,202,208,240   :rem 172
2320 DATA 72,104,72,104,169,0    :rem 137
2330 DATA 141,0,24,200,208,204   :rem 172
2340 DATA 96,172,1,3,132,7       :rem 249
2350 DATA 173,0,3,197,6,8        :rem 205
2360 DATA 133,6,40,240,16,169    :rem 143
2370 DATA 176,133,0,88,36,0       :rem 48
2380 DATA 48,252,120,165,0,201   :rem 186
2390 DATA 1,208,78,169,238,141   :rem 209
2400 DATA 12,28,169,6,133,50      :rem 91
2410 DATA 169,0,133,51,133,48    :rem 141
2420 DATA 169,3,133,49,32,82     :rem 100
2430 DATA 6,80,254,184,173,1      :rem 97
2440 DATA 28,153,0,3,200,208      :rem 82
2450 DATA 244,160,186,80,254,184  :rem 49
2460 DATA 173,1,28,153,0,1       :rem 242
2470 DATA 200,208,244,32,224,248  :rem 36
2480 DATA 165,56,197,71,240,4    :rem 158
2490 DATA 169,34,208,20,32,233   :rem 197
2500 DATA 245,197,58,240,4,169   :rem 208
2510 DATA 35,208,9,169,236,141   :rem 202
2520 DATA 12,28,96,24,105,24      :rem 93
2530 DATA 133,68,169,255,141,0   :rem 199
2540 DATA 3,32,150,5,169,58       :rem 49
2550 DATA 141,7,28,165,68,76     :rem 112
2560 DATA 200,193,32,88,6,76     :rem 106
2570 DATA 148,6,165,18,133,22    :rem 151
2580 DATA 165,19,133,23,165,6    :rem 153
2590 DATA 133,24,165,7,133,25    :rem 148
2600 DATA 169,0,69,22,69,23       :rem 53
2610 DATA 69,24,69,25,133,26     :rem 105
2620 DATA 32,52,249,162,90,32    :rem 146
2630 DATA 148,6,80,254,184,173   :rem 207
2640 DATA 1,28,217,36,0,208       :rem 42
2650 DATA 6,200,192,8,208,240    :rem 143
2660 DATA 96,202,208,233,169,32  :rem 254
2670 DATA 208,170,169,208,141,5  :rem 252
2680 DATA 24,169,33,44,5,24       :rem 53
2690 DATA 16,158,44,0,28,48       :rem 58
2700 DATA 246,173,1,28,184,160   :rem 197
2710 DATA 0,96,160,160,160,160   :rem 187
2720 DATA 160,160,160,160,160,160 :rem 75
2730 DATA 160,160,160,160,160,160 :rem 76
```

MLX

(Article on page 61.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: MLX—64 Version

```
10 REM LINES CHANGED FROM MLX VERSION 2.0
   0 ARE 750,765,770 AND 860          :rem 50
20 REM LINE CHANGED FROM MLX VERSION 2.01
    IS 300                             :rem 147
100 PRINT"{CLR}{6}";CHR$(142);CHR$(8);:PO
    KE53281,1:POKE53280,1              :rem 67
101 POKE 788,52:REM DISABLE RUN/STOP
                                       :rem 119
110 PRINT"{RVS}{39 SPACES}";           :rem 176
120 PRINT"{RVS}{14 SPACES}{RIGHT}{OFF}{*}
    £{RVS}{RIGHT} {RIGHT}{2 SPACES}{*}
    {OFF}{*}£{RVS}£{RVS}{14 SPACES}";
                                       :rem 250
130 PRINT"{RVS}{14 SPACES}{RIGHT} {G}
    {RIGHT} {2 RIGHT} {OFF}£{RVS}£{*}
    {OFF}{*}{RVS}{14 SPACES}";         :rem 35
140 PRINT"{RVS}{41 SPACES}"            :rem 120
200 PRINT"{2 DOWN}{PUR}{BLK} MACHINE LANG
    UAGE EDITOR VERSION 2.02{5 DOWN}"
                                       :rem 238
210 PRINT"{5}{2 UP}STARTING ADDRESS?
    {8 SPACES}{9 LEFT}";               :rem 143
215 INPUTS:F=1-F:C$=CHR$(31+119*F)
                                       :rem 166
220 IFS<256OR(S>40960ANDS<49152)ORS>53247
    THENGOSUB3000:GOTO210              :rem 235
225 PRINT:PRINT:PRINT                  :rem 180
230 PRINT"{5}{2 UP}ENDING ADDRESS?
    {8 SPACES}{9 LEFT}";:INPUTE:F=1-F:C$=
    CHR$(31+119*F)                     :rem 20
240 IFE<256OR(E>40960ANDE<49152)ORE>53247
    THENGOSUB3000:GOTO230              :rem 183
250 IFE<STHENPRINTC$;"{RVS}ENDING < START
    {2 SPACES}":GOSUB1000:GOTO 230
                                       :rem 176
260 PRINT:PRINT:PRINT                  :rem 179
300 PRINT"{CLR}";CHR$(14):AD=S         :rem 56
310 A=1:PRINTRIGHT$("0000"+MID$(STR$(AD),
    2),5);":";                         :rem 33
315 FORJ=ATO6                          :rem 33
320 GOSUB570:IFN=-1THENJ=J+N:GOTO320
                                       :rem 228
390 IFN=-211THEN 710                   :rem 62
400 IFN=-204THEN 790                   :rem 64
410 IFN=-206THENPRINT:INPUT"{DOWN}ENTER N
    EW ADDRESS";ZZ                     :rem 44
415 IFN=-206THENIFZZ<SORZZ>ETHENPRINT"
    {RVS}OUT OF RANGE":GOSUB1000:GOTO410
                                       :rem 225
417 IFN=-206THENAD=ZZ:PRINT:GOTO310
                                       :rem 238
420 IF N<>-196 THEN 480                :rem 133
430 PRINT:INPUT"DISPLAY:FROM";F:PRINT,"TO
    ";:INPUTT                          :rem 234
440 IFF<SORF>EORT<SORT>ETHENPRINT"AT LEAS
    T";S;"{LEFT}, NOT MORE THAN";E:GOTO43
    0                                  :rem 159
450 FORI=FTOTSTEP6:PRINT:PRINTRIGHT$("000
    0"+MID$(STR$(I),2),5);":";         :rem 30
451 FORK=0TO5:N=PEEK(I+K):PRINTRIGHT$("00
    "+MID$(STR$(N),2),3);",";          :rem 66
460 GETA$:IFA$>""THENPRINT:PRINT:GOTO310
                                       :rem 25
470 NEXTK:PRINTCHR$(20);:NEXTI:PRINT:PRIN
    T:GOTO310                          :rem 50
480 IFN<0 THEN PRINT:GOTO310           :rem 168
490 A(J)=N:NEXTJ                       :rem 199
500 CKSUM=AD-INT(AD/256)*256:FORI=1TO6:CK
    SUM=(CKSUM+A(I))AND255:NEXT        :rem 200
510 PRINTCHR$(18);:GOSUB570:PRINTCHR$(146
    );                                 :rem 94
511 IFN=-1THENA=6:GOTO315              :rem 254
515 PRINTCHR$(20):IFN=CKSUMTHEN530
                                       :rem 122
520 PRINT:PRINT"LINE ENTERED WRONG : RE-E
    NTER":PRINT:GOSUB1000:GOTO310:rem 176
530 GOSUB2000                          :rem 218
540 FORI=1TO6:POKEAD+I-1,A(I):NEXT:POKE54
    272,0:POKE54273,0                  :rem 227
550 AD=AD+6:IF AD<E THEN 310           :rem 212
560 GOTO 710                           :rem 108
570 N=0:Z=0                            :rem 88
580 PRINT"{£}";                        :rem 81
581 GETA$:IFA$=""THEN581               :rem 95
582 AV=-(A$="M")-2*(A$=",")-3*(A$=".")-4*
    (A$="J")-5*(A$="K")-6*(A$="L"):rem 41
583 AV=AV-7*(A$="U")-8*(A$="I")-9*(A$="O"
    ):IFA$="H"THENA$="0"               :rem 134
584 IFAV>0THENA$=CHR$(48+AV)           :rem 134
585 PRINTCHR$(20);:A=ASC(A$):IFA=13ORA=44
    ORA=32THEN670                      :rem 229
590 IFA>128THENN=-A:RETURN             :rem 137
600 IFA<>20 THEN 630                   :rem 10
610 GOSUB690:IFI=1ANDT=44THENN=-1:PRINT"
    {OFF}{LEFT} {LEFT}";:GOTO690       :rem 62
620 GOTO570                            :rem 109
630 IFA<48ORA>57THEN580                :rem 105
640 PRINTA$;:N=N*10+A-48               :rem 106
650 IFN>255 THEN A=20:GOSUB1000:GOTO600
                                       :rem 229
660 Z=Z+1:IFZ<3THEN580                 :rem 71
670 IFZ=0THENGOSUB1000:GOTO570         :rem 114
680 PRINT",";:RETURN                   :rem 240
690 S%=PEEK(209)+256*PEEK(210)+PEEK(211)
                                       :rem 149
691 FORI=1TO3:T=PEEK(S%-I)             :rem 67
695 IFT<>44ANDT<>58THENPOKES%-I,32:NEXT
                                       :rem 205
700 PRINTLEFT$("{3 LEFT}",I-1);:RETURN
                                       :rem 7
710 PRINT"{CLR}{RVS}*** SAVE ***{3 DOWN}"
                                       :rem 236
715 PRINT"{2 DOWN}(PRESS {RVS}RETURN{OFF}
     ALONE TO CANCEL SAVE){DOWN}":rem 106
720 F$="":INPUT"{DOWN} FILENAME";F$:IFF$=
    ""THENPRINT:PRINT:GOTO310          :rem 71
730 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
     {RVS}D{OFF}ISK: (T/D)"            :rem 228
740 GETA$:IFA$<>"T"ANDA$<>"D"THEN740
                                       :rem 36
750 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$:
    OPEN15,8,15,"S"+F$:CLOSE15         :rem 212
760 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                   :rem 3
762 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                       :rem 109
```

```
763 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                               :rem 69
765 K=S:POKE254,K/256:POKE253,K-PEEK(254)
    *256:POKE780,253                 :rem 17
766 K=E+1:POKE782,K/256:POKE781,K-PEEK(78
    2)*256:SYS65496                 :rem 235
770 IF(PEEK(783)AND1)OR(191ANDST)THEN780
                                    :rem 111
775 PRINT"{DOWN}DONE.{DOWN}":GOTO310
                                    :rem 113
780 PRINT"{DOWN}ERROR ON SAVE.{2 SPACES}T
    RY AGAIN.":IFDV=1THEN720        :rem 171
781 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO720            :rem 103
790 PRINT"{CLR}{RVS}*** LOAD ***{2 DOWN}"
                                    :rem 212
795 PRINT"{2 DOWN}(PRESS {RVS}RETURN{OFF}
     ALONE TO CANCEL LOAD)"          :rem 82
800 F$="":INPUT"{2 DOWN} FILENAME";F$:IFF
    $=""THENPRINT:GOTO310           :rem 144
810 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
     {RVS}D{OFF}ISK: (T/D)"         :rem 227
820 GETA$:IFA$<>"T"ANDA$<>"D"THEN820
                                     :rem 34
830 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$
                                    :rem 157
840 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                  :rem 2
841 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                    :rem 107
845 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                               :rem 70
850 POKE780,0:SYS65493               :rem 11
860 IF(PEEK(783)AND1)OR(191ANDST)THEN870
                                    :rem 111
865 PRINT"{DOWN}DONE.":GOTO310       :rem 96
870 PRINT"{DOWN}ERROR ON LOAD.{2 SPACES}T
    RY AGAIN.{DOWN}":IFDV=1THEN800
                                    :rem 172
880 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO800            :rem 102
1000 REM BUZZER                     :rem 135
1001 POKE54296,15:POKE54277,45:POKE54278,
     165                            :rem 207
1002 POKE54276,33:POKE 54273,6:POKE54272,
     5                               :rem 42
1003 FORT=1TO200:NEXT:POKE54276,32:POKE54
     273,0:POKE54272,0:RETURN       :rem 202
2000 REM BELL SOUND                  :rem 78
2001 POKE54296,15:POKE54277,0:POKE54278,2
     47                             :rem 152
2002 POKE 54276,17:POKE54273,40:POKE54272
     ,0                              :rem 86
2003 FORT=1TO100:NEXT:POKE54276,16:RETURN
                                     :rem 57
3000 PRINTC$;"{RVS}NOT ZERO PAGE OR ROM":
     GOTO1000                        :rem 89
```

Program 2: MLX—VIC Version

```
10 REM LINES CHANGED FROM VIC MLX VERSION
    2.00 ARE 581,582,765            :rem 166
100 PRINT"{CLR}{PUR}";CHR$(142);CHR$(8);
                                    :rem 181
101 POKE 788,194:REM DISABLE RUN/STOP
                                    :rem 174
120 PRINT "{2 DOWN}{7 SPACES}VIC MLX"
                                     :rem 89
200 PRINT"{2 DOWN}{PUR}{BLK}MACHINE LANGU
    AGE":PRINT"EDITOR VER 2.02{5 DOWN}"
                                    :rem 192
210 PRINT"{BLK}{3 UP}STARTING ADDRESS":IN
    PUTS:F=1-F:C$=CHR$(31+119*F)     :rem 97
220 IFS<256ORS>32767THENGOSUB3000:GOTO210
                                      :rem 2
225 PRINT:PRINT:PRINT:PRINT         :rem 123
230 PRINT"{BLK}{3 UP}ENDING ADDRESS":INPU
    TE:F=1-F:C$=CHR$(31+119*F)      :rem 158
240 IFE<256ORE>32767THENGOSUB3000:GOTO230
                                    :rem 234
250 IFE<STHENPRINTC$;"{RVS}ENDING < START
    {2 SPACES}":GOSUB1000:GOTO 230
                                    :rem 176
260 PRINT:PRINT:PRINT               :rem 179
300 PRINT"{CLR}";CHR$(14):AD=S       :rem 56
310 A=1:PRINTRIGHT$("0000"+MID$(STR$(AD),
    2),5);":";                       :rem 33
315 FOR J=A TO 6                     :rem 33
320 GOSUB570:IFN=-1THENJ=J+N:GOTO320
                                    :rem 228
390 IFN=-211THEN 710                 :rem 62
400 IFN=-204THEN 790                 :rem 64
410 IFN=-206THENPRINT:INPUT"{DOWN}ENTER N
    EW ADDRESS";ZZ                   :rem 44
415 IFN=-206THENIFZZ<SORZZ>ETHENPRINT"
    {RVS}OUT OF RANGE":GOSUB1000:GOTO410
                                    :rem 225
417 IFN=-206THENAD=ZZ:PRINT:GOTO310
                                    :rem 238
420 IF N<>-196 THEN 480             :rem 133
430 PRINT:INPUT"DISPLAY:FROM";F:PRINT,"TO
    ";:INPUTT                       :rem 234
440 IFF<SORF>EORT<SORT>ETHENPRINT"AT LEAS
    T";S;"{LEFT}, NOT MORE THAN";E:GOTO43
    0                               :rem 159
450 FORI=FTOTSTEP6:PRINT:PRINTRIGHT$("000
    0"+MID$(STR$(I),2),5);":";       :rem 30
455 FORK=0TO5:N=PEEK(I+K):IFK=3THENPRINTS
    PC(10);                          :rem 34
457 PRINTRIGHT$("00"+MID$(STR$(N),2),3);"
    ,";                             :rem 157
460 GETA$:IFA$>""THENPRINT:PRINT:GOTO310
                                     :rem 25
470 NEXTK:PRINTCHR$(20);:NEXTI:PRINT:PRIN
    T:GOTO310                        :rem 50
480 IFN<0 THEN PRINT:GOTO310        :rem 168
490 A(J)=N:NEXTJ                    :rem 199
500 CKSUM=AD-INT(AD/256)*256:FORI=1TO6:CK
    SUM=(CKSUM+A(I))AND255:NEXT     :rem 200
510 PRINTCHR$(18);:GOSUB570:PRINTCHR$(146
    );                               :rem 94
511 IFN=-1THENA=6:GOTO315           :rem 254
515 PRINTCHR$(20):IFN=CKSUMTHEN530
                                    :rem 122
520 PRINT:PRINT"LINE ENTERED WRONG":PRINT
    "RE-ENTER":PRINT:GOSUB1000:GOTO310
                                    :rem 129
530 GOSUB2000                       :rem 218
540 FORI=1TO6:POKEAD+I-1,A(I):NEXT:rem 80
550 AD=AD+6:IF AD<E THEN 310        :rem 212
560 GOTO 710                        :rem 108
570 N=0:Z=0                          :rem 88
580 PRINT"{+}";                      :rem 79
581 GETA$:IFA$=""THEN581             :rem 95
582 AV=-(A$="M")-2*(A$=",")-3*(A$=".")-4*
    (A$="J")-5*(A$="K")-6*(A$="L"):rem 41
583 AV=AV-7*(A$="U")-8*(A$="I")-9*(A$="O"
    ):IFA$="H"THENA$="0"            :rem 134
584 IFAV>0THENA$=CHR$(48+AV)        :rem 134
585 PRINTCHR$(20);:A=ASC(A$):IFA=13ORA=44
    ORA=32THEN670                   :rem 229
590 IFA>128THENN=-A:RETURN          :rem 137
```

```
600 IFA<>20 THEN 630                      :rem 10
610 PRINTCHR$(146);:GOSUB690:IFI=1ANDT=44
    THENN=-1:PRINT"{LEFT} {LEFT}";:GOTO69
    0                                     :rem 155
620 GOTO570                               :rem 109
630 IFA<48ORA>57THEN580                   :rem 105
640 PRINTA$;:N=N*10+A-48                  :rem 106
650 IFN>255 THEN A=20:GOSUB1000:GOTO600
                                          :rem 229
660 Z=Z+1:IFZ<3THEN580                    :rem 71
670 IFZ=0THENGOSUB1000:GOTO570            :rem 114
680 PRINT",";:RETURN                      :rem 240
690 S%=PEEK(209)+256*PEEK(210)+PEEK(211)
                                          :rem 149
692 FORI=1TO3:T=PEEK(S%-I)                :rem 68
695 IFT<>44ANDT<>58THENPOKES%-I,32:NEXT
                                          :rem 205
700 PRINTLEFT$("{3 LEFT}",I-1);:RETURN
                                          :rem 7
710 PRINT"{CLR}{RVS}*** SAVE ***{3 DOWN}"
                                          :rem 236
720 F$="":INPUT"{DOWN} FILENAME";F$:IFF$=
    ""THEN310                             :rem 128
730 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
    {RVS}D{OFF}ISK: (T/D)"                :rem 228
740 GETA$:IFA$<>"T"ANDA$<>"D"THEN740
                                          :rem 36
750 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$:
    OPEN15,8,15,"S"+F$:CLOSE15            :rem 212
760 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                      :rem 3
762 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                          :rem 109
763 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                                    :rem 69
765 K=S:POKE254,K/256:POKE253,K-PEEK(254)
    *256:POKE780,253                      :rem 17
766 K=E+1:POKE782,K/256:POKE781,K-PEEK(78
    2)*256:SYS65496                       :rem 235
770 IF(PEEK(783)AND1)OR(191ANDST)THEN780
                                          :rem 111
775 PRINT"{DOWN}DONE.":GOTO310            :rem 96
780 PRINT"{DOWN}ERROR ON SAVE.{2 SPACES}T
    RY AGAIN.":IFDV=1THEN720              :rem 171
781 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO720                  :rem 103
782 GOTO720                               :rem 115
790 PRINT"{CLR}{RVS}*** LOAD ***{2 DOWN}"
                                          :rem 212
800 F$="":INPUT"{2 DOWN} FILENAME";F$:IFF
    $=""THEN310                           :rem 144
810 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
    {RVS}D{OFF}ISK: (T/D)"                :rem 227
820 GETA$:IFA$<>"T"ANDA$<>"D"THEN820
                                          :rem 34
830 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$
                                          :rem 157
840 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                      :rem 2
841 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                          :rem 107
845 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                                    :rem 70
850 POKE780,0:SYS65493                    :rem 11
860 IF(PEEK(783)AND1)OR(191ANDST)THEN870
                                          :rem 111
865 PRINT"{DOWN}DONE.":GOTO310            :rem 96
870 PRINT"{DOWN}ERROR ON LOAD.{2 SPACES}T
    RY AGAIN.{DOWN}":IFDV=1THEN800
                                          :rem 172
880 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO800                  :rem 102
1000 REM BUZZER                           :rem 135
1001 POKE36878,15:POKE36874,190           :rem 206
1002 FORW=1TO300:NEXTW                    :rem 117
1003 POKE36878,0:POKE36874,0:RETURN
                                          :rem 74
2000 REM BELL SOUND                       :rem 78
2001 FORW=15TO0STEP-1:POKE36878,W:POKE368
     76,240:NEXTW                         :rem 22
2002 POKE36876,0:RETURN                   :rem 119
3000 PRINTC$;"{RVS}NOT ZERO PAGE OR ROM":
     GOTO1000                             :rem 89
```


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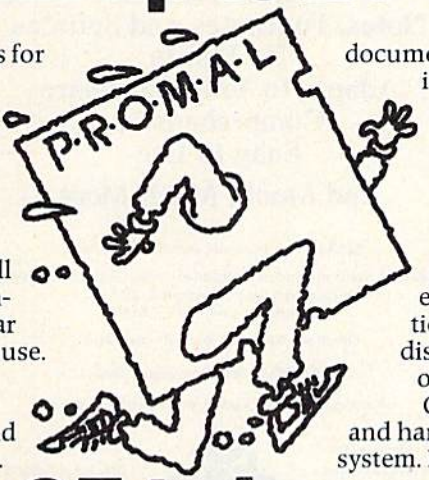

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(Sieve of Eratosthenes)

	PROMAL	BASIC	COMAL	FORTH	PASCAL
Execution Time (secs.)	**30**	630	490	51	55
Object Code Size (bytes)	**128**	255	329	181	415
Program Load Time (secs.)	**3.2**	3.8	6.3	11.2	23.5
Compile Time (secs.)	**8.5**	–	–	3.9	108

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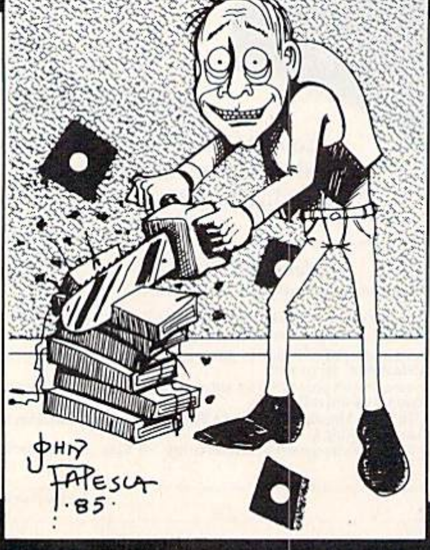

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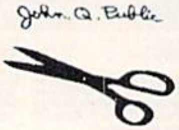

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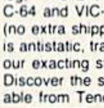

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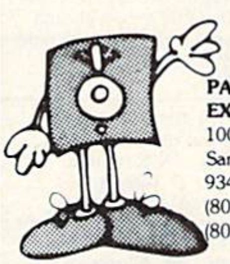

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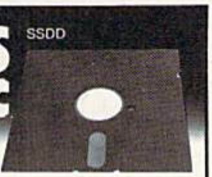

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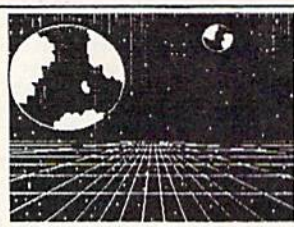

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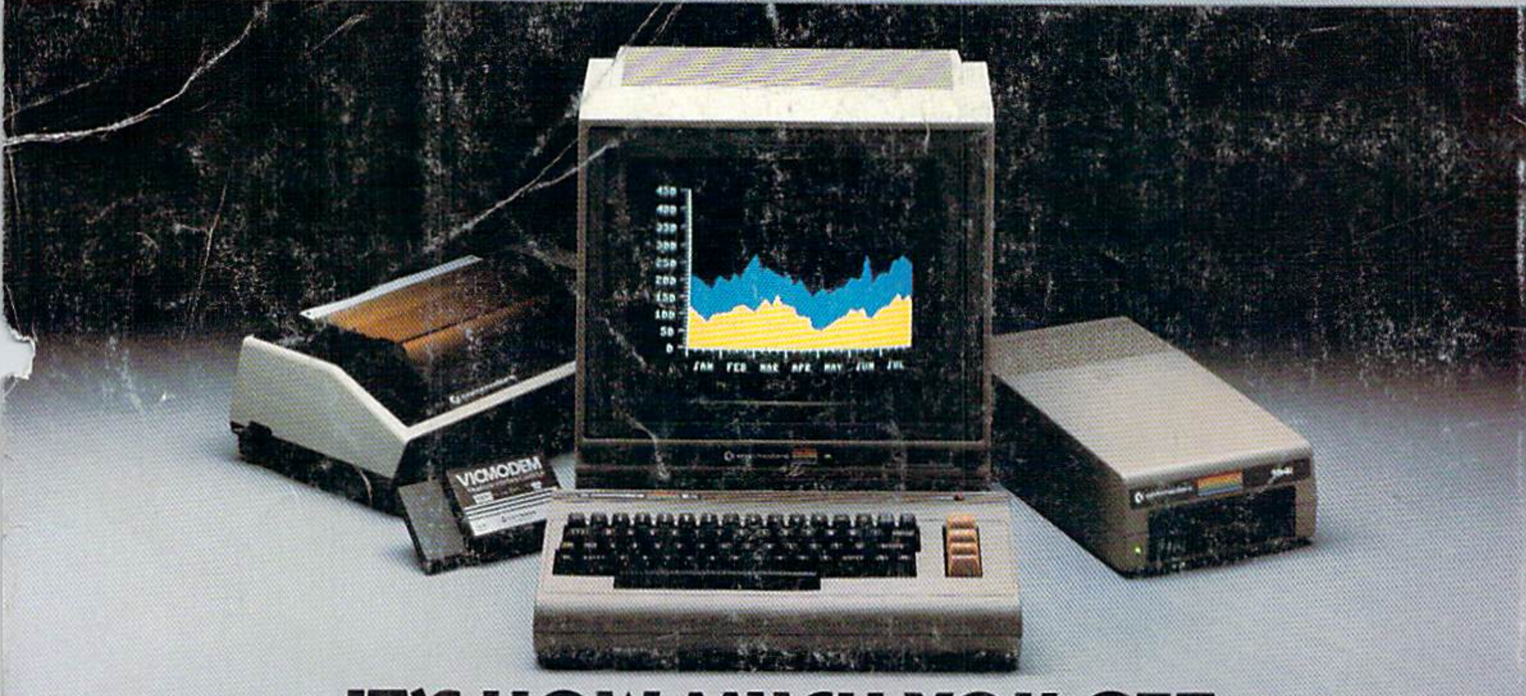

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