

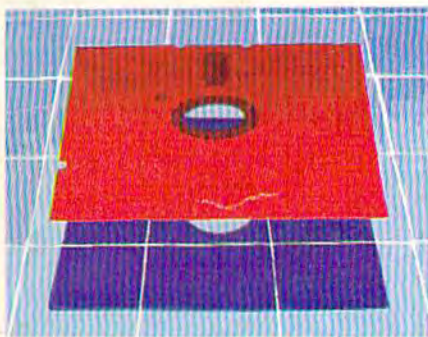
Custom Characters For VIC And 64

COMPUTE!'s GAZZETTE™

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November 1983
Issue 5 Vol. 1, No. 5
63380 \$3.25 in Canada

For Owners And Users Of **Commodore VIC-20™** And **64™** Personal Computers

Getting Started With A Disk Drive



A disk drive is much more than just a fast tape drive. This new series begins where the manual leaves off. Part I: The basics of floppy disks.

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With this utility you can easily add favorite routines to new programs, saving time and effort. A must for every programmer's toolbox.

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For VIC-20 And 64



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Action Game For VIC-20 And 64



The sky is falling! Only you, as Chicken Little, can save the world by hurling stones at the falling pieces of sky. But if you get bonked on the head....

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**Machine Language
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WORD PROCESSING HAS NEVER BEEN SIMPLER

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for the
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- Disk storage and retrieve

functions with password protection,

- Document chaining allows you to print documents of unlimited length,
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- Upper and lowercase without additional hardware.

Brøderbund's Bank Street Writer comes complete with Tutorial and Utility programs, a comprehensive reference man-

Bank Street WRITER™

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College of Education and Intentional Educations.

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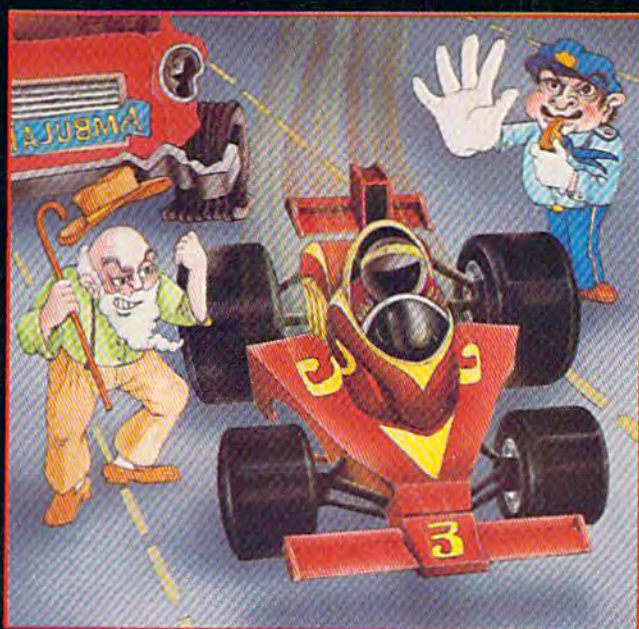


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So your sweet tooth has gotten out of hand again? Well, this time the sheriff is after you and he's no sweetheart. There he is now! Quick! Grab all the candy in sight and dive for the doorway! Don't look now, the doors are rotating... better be good at getting out of sticky situations, 'cause if you hit the wall you're stuck with it! There's plenty of candy here and many more levels to cross, so get on the move, sugar!

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CAN A COMPUTER MAKE YOU CRY?

■ Right now, no one knows. This is partly because many would consider the very idea frivolous. But it's also because whoever successfully answers this question must first have answered several others.

● Why do we cry? Why do we laugh, or love, or smile? What are the touchstones of our emotions?

▲ Until now, the people who asked such questions tended not to be the same people who ran software companies. Instead, they were writers, filmmakers, painters, musicians. They were, in the traditional sense, artists.

■ We're about to change that tradition. The name of our company is Electronic Arts.

SOFTWARE WORTHY OF THE MINDS THAT USE IT.

We are a new association of electronic artists united by a common goal — to fulfill the enormous potential of the personal computer.

● In the short term, this means transcending its present use as a facilitator of unimaginative tasks and a medium for blasting aliens. In the long term, however, we can expect a great deal more.

▲ These are wondrous machines we have created, and in them can be seen a bit of their makers. It is as if we had invested them with the image of our minds. And through them, we are learning more and more about ourselves.

■ We learn, for instance, that we are more entertained by the involvement of our imaginations than by passive viewing and listening. We learn that we are better taught by experience than by memorization. And we learn that the traditional

distinctions — the ones that are made between art and entertainment and education — don't always apply.

TOWARD A LANGUAGE OF DREAMS. In short, we are finding that the computer can be more than just a processor of data.

● It is a communications medium: an interactive tool that can bring people's thoughts and feelings closer together, perhaps closer than ever before. And while fifty years from now, its creation may seem no more important than the advent of motion pictures or television, there is a chance it will mean something more.

▲ Something along the lines of a universal language of ideas and emotions. Something like a smile.

■ The first publications of Electronic Arts are now available. We suspect you'll be hearing a lot about them. Some of them are games like you've never seen before, that get more out of your computer than other games ever have. Others are harder to categorize — and we like that.

WATCH US. We're providing a special environment for talented, independent software artists. It's a supportive environment, in which big ideas are given room to grow. And some of America's most respected software artists are beginning to take notice.

● We think our current work reflects this very special commitment. And though we are few in number today and apart from the mainstream of the mass software marketplace, we are confident that both time and vision are on our side.

▲ Join us.

We see farther.



ELECTRONIC ARTS





TO LEARN MORE about our growing number of titles -- and to receive a free poster of the artists pictured here -- stop by your favorite computer store or software center. If you need help finding the Electronic Arts dealer nearest you, write us at 2755 Campus Drive, San Mateo, California 94403 or call (415) 571-7171.

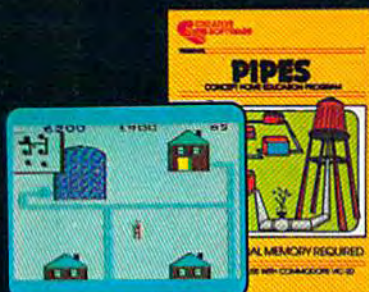
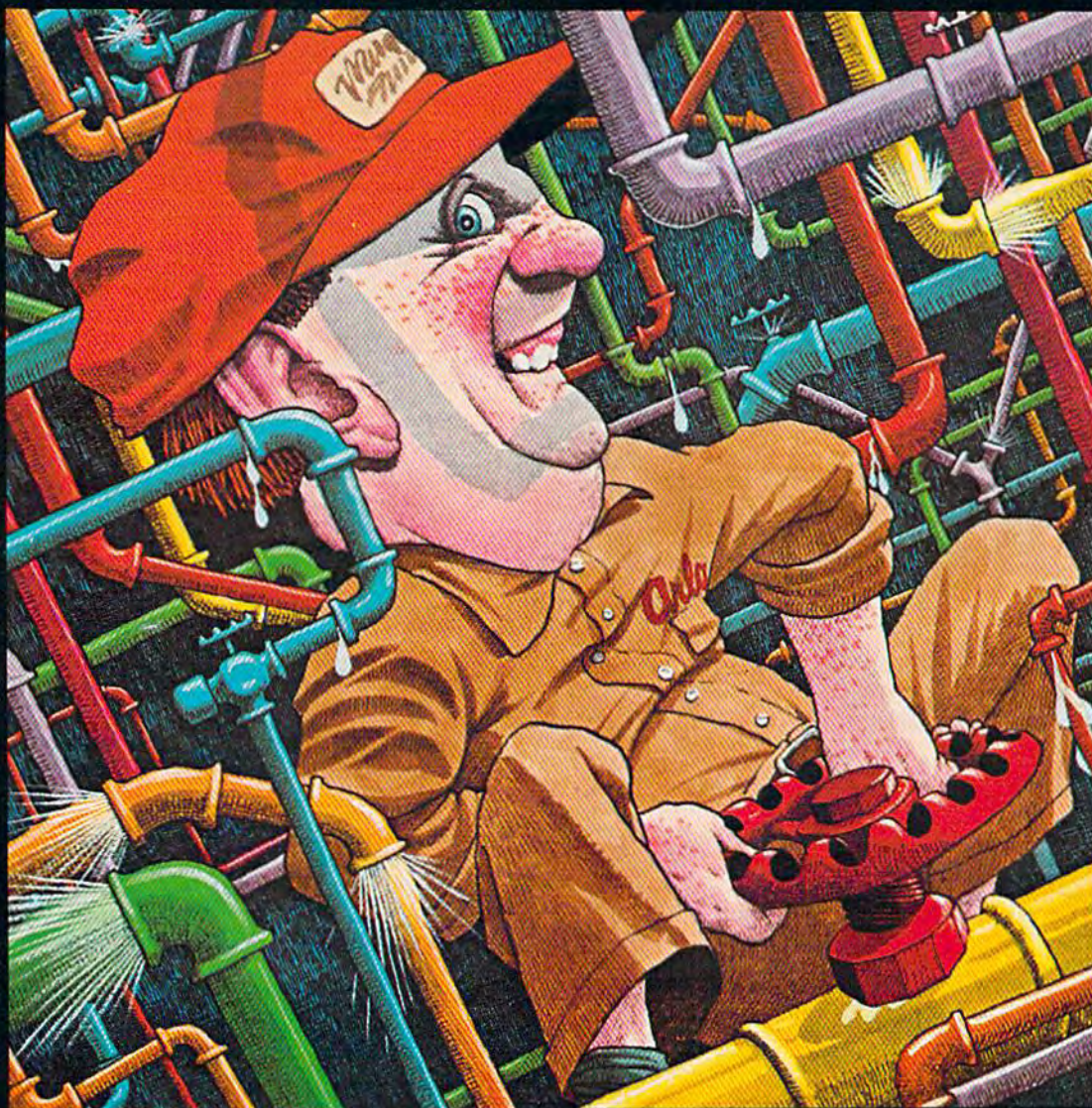
SOFTWARE ARTISTS? "I'm not so sure there are any software artists yet," says Bill Budge. "We've got to earn that title." Pictured here are a few people who have come as close to earning it as anyone we know.

That's Mr. Budge himself, creator of PINBALL CONSTRUCTION SET, at the upper right. To his left are Anne Westfall and Jon Freeman who, along with their colleagues at Free Fall Associates, created ARCHON and MURDER ON THE ZINDERNEUF.

Left of them is Dan Buntin of Ozark Softscape, the firm that wrote M.U.L.E. To Dan's left are Mike Abbot (top) and Matt Alexander (bottom), authors of HARD HAT MACK. In the center is John Field, creator of AXIS ASSASSIN and THE LAST GLADIATOR. David Maynard, lower right, is the man responsible for WORMS?

When you see what they've accomplished, we think you'll agree with us that they can call themselves whatever they want.

HELP WANTED:



Arlo is a hard-working plumber, but a touch absent-minded. He's building a water supply system for the whole neighborhood, and he really has his hands full. Help Arlo decide what kind of pipe to buy and where to put it... his limited budget doesn't leave him much margin for error. Figure out the shortest, most economical way to get everyone hooked up... and just hope poor Arlo has remembered to open and close the right valves. A marvelously entertaining and challenging exercise in planning, economics and spatial relationships for all ages.

PIPES. For the VIC-20 and Commodore 64.

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THE EDITOR'S

notes

Good News for Commodore users... Jim Dionne, former Canadian sales manager for Commodore, has been appointed vice president of sales and marketing for Commodore. In this capacity he'll report directly to vice-chairman and founder Jack Trameil. We applaud this move, since for many years Mr. Dionne has been cognizant of, and responsive to, the needs of users and the marketplace.

Will the IBM home computer knock Commodore out of the low-end personal computer market? We think not, for two main reasons. The IBM entry is projected to arrive with a price tag around \$700 for the basic unit. While the price and name will certainly sell it well, Commodore has shown it's quite ahead of the game in successive generation introduction of hardware and features. Even if sales of the 64 were impacted by an IBM entry, we suggest that not many months would pass before a mid-level, full-featured computer would arrive from Commodore with a price tag no one could touch. And we certainly don't mean to imply that the 64 is currently vulnerable; nothing on the market can yet match its capabilities at its current price.

We've been predicting increasing availability of software for the VIC and 64. Word from the field is that it's coming in droves as everyone from major existing vendors to smaller start-ups move to support the 1.5 million machines currently installed. Judging from a recent article in *Electronic News* (Vol. 29, No. 1459), most of that software will be sold on disk. Commodore indicated that their original projection that 70 percent of 64s would be sold with a disk drive was low. Actually, sales with disk drives are running at 90 percent.

Five issues old and approximately the sixth-largest magazine in the personal computing field. Again our thanks to you, our readers and writers, for your support and encouragement in the very successful launch of the *Gazette*. We're still looking for experienced writers and programmers to join our in-house staff. If you're interested, drop us a résumé, Attn: Personnel Office, COMPUTE! Publications, Inc., P.O. Box 5406, Greensboro, NC 27403.

A bit of history on the origins of your computers for those of you new to the industry. Commodore introduced the first fully integrated personal computer system in the summer of

1977. It was called the PET (Personal Electronic Transactor). It weighed 30 or 40 pounds, had a bulky metal case, built-in keyboard, green phosphor monitor, and tape cassette. The keyboard had tiny, calculator-type keys. The unit was first demonstrated at the Philadelphia Computer Show, and Commodore was immediately swamped. Personal computing was off and running. Commodore creatively financed much of the launch out of customers' pockets, with demand running so far ahead of production that the company was able to accept customer orders on a direct basis with full payment up front and expectation of a delivery within at least 90 days (frequently in the early days of shipping, that date went to 120 days or more). If you became distressed over lengthy delivery, your only option was to cancel your order, get a refund, and wait even longer. Your VICs and 64s are far more powerful and sophisticated than the \$800 PET, but that's where they came from. A whole new generation of computing was launched.



Editor In Chief

LEARNING with LEEPERTM



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Let Leeper give them a head start in reading, writing and math.
An award-winning collection of four preschool games for the Apple computer.

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Chief Executive Officer Robert C. Lock

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GAZETTE FEEDBACK

EDITORS AND READERS

Do you have a question or a problem? Have you discovered something that could help other VIC-20 and Commodore 64 users? Do you have a comment about something you've read in *COMPUTE!'s Gazette for Commodore*? "Gazette Feedback" wants to hear from you. Write to Gazette Feedback, *COMPUTE!'s Gazette*, P.O. Box 5406, Greensboro, NC 27403.

Disk Menu

In the August 1983 issue of *COMPUTE!'s Gazette*, a "Disk Menu" program was published. In the "How It Works" section of the article, the author recommended saving the program as the first program on the disk. My problem is that I already have programs on each disk. Is it possible to save the Disk Menu program as the first program on my disks anyway?

Kevin Bergmann

To begin with, you don't have to save Disk Menu as the first program on your disks. The author simply recommended this procedure because it makes it easier to load the menu. Entering `LOAD""*,8` automatically loads the first program on a disk, no matter what it is. If the first program happens to be Disk Menu, you can quickly flip through the on-screen directory to load and run the program you want.

You can insure that Disk Menu will be the first program on your disks by saving it immediately after formatting a blank disk with the `NEW` command.

On your partially full disks, you'll have to do a little rearranging to make Disk Menu the first program. Here's how:

1. Insert the disk you want to rearrange into the disk drive.
2. Enter `LOAD""$,8` and then `LIST` to get a disk directory.
3. Note the program at the top of the directory list. (Press `RUN/STOP` if necessary to keep the list from scrolling off the screen.) This is the first program on the disk, the one you'll have to move to make room for Disk Menu.
4. Now use the `COPY` command explained on page 16 of the VIC-1541 User's Manual. For example,

`CLOSE 15:OPEN 15,8,15,"COPY0:newfile=0:oldfile"` where newfile is a new filename you give the program, and oldfile is the existing filename as listed on the directory. Be sure to give the program a different filename. This makes another copy of the program elsewhere on the same disk.

5. Once you've copied the program elsewhere on the disk, you can safely delete the original with the `SCRATCH` command explained on page 17 of the manual. For example:

`CLOSE 15:OPEN 15,8,15,"SCRATCH0:oldfile"`

6. Now there are two possibilities. If Disk Menu is already on this disk, repeat steps 4 and 5. The `COPY` command will move Disk Menu to the front of the disk, and you can then `SCRATCH` the original. If Disk Menu isn't already on the disk, insert a disk that contains it. `LOAD` Disk Menu. Insert the first disk into the drive again. Then `SAVE` Disk Menu.

7. If you've done everything right, Disk Menu should now be the first program on the disk. You can find out by entering `LOAD""*,8`.

Customizing Controls

The July 1983 article "Snake Escape" stated that lines 200-230 could be changed to accept any key command. Despite careful study, I cannot figure out how to accomplish this. What I want is to move right using the `L` instead of the `K`. Can you explain?

Roger Bingham

The first thing you must do is determine the keycode number for `L`. Use the sample routine as explained in the Snake Escape article on page 56. We'll repeat it here:

```
1 PRINT PEEK(197):FOR I=1 TO 400:NEXT:GOTO 1
```

RUN this routine, and hold down the `L` key. The number running down the screen is the keycode for `L`. You don't mention whether you have a VIC-20 or Commodore 64, but the keycode for `L` is 21 on the VIC and 42 on the 64. Depending on your computer, this is the number you must substitute in line 210 of either the VIC or 64 version. Line 210 detects the keypress for a move to the right (as denoted in the `REM` statement). If you have a VIC, substitute 21 for the 44 in line 210. If you have a 64, substitute 42 for the 37 in line 210. Movement to the right will now be controlled by the `L` key.

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The Commodore 64™ is one of the most exciting home computers in memory.

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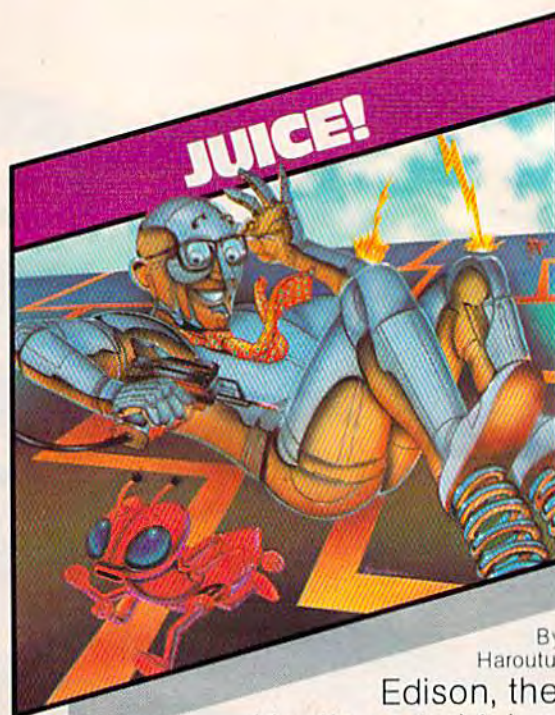
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Of course, if you'd rather not take our word for it, you don't have to. The experts at Electronic Games have called *Kid Grid* for Atari "one of the most compulsive, utterly addictive contests in the world of computer gaming."

They haven't seen anything yet.



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Haroutunian.

Edison, the kinetic android, leads a frustrating life.

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dots on our colorful
grid should be easy, right?

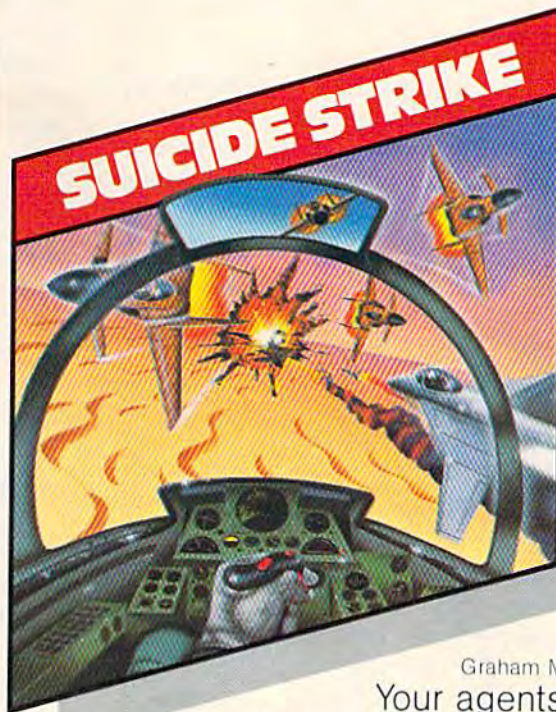
Wrong. Because the bullies
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Incidentally, you might want to see the October 1983 "Bug-Swatter: Modifications & Corrections." A reader modified the 64 version of Snake Escape to work with a joystick instead of the keyboard.

TV Interference

We have a VIC-20 and two color TVs. The VIC is hooked up to the one in the family room. The other TV is in the living room. If both the computer and the other TV are on, the TV reception is bad. This problem is especially bad on channel 2. My sister (12 years old) and I (13) like to use the computer but sometimes can't because of the TV reception. I hope you can help.

Daina Jauntirans

The problem you are experiencing is called RF (radio frequency) interference. All computer circuitry emits RF signals which can interfere with nearby TV sets, often even the TV to which the computer is attached. Some computers emit more interference than others. The federal government, through the Federal Communications Commission (FCC), regulates how much interference is permitted for home computer devices and videogame machines. The manufacturers, in turn, must build enough shielding into their devices to meet the regulations.

Chances are you have an older-model VIC-20. Newer-model VICs (and Commodore 64s) that we've seen emit much less RF interference than earlier models, thanks largely to improved shielding.

There are a few steps you can take to minimize this interference. One solution is to locate the computer as far away from your family's second TV as possible. This might not be practical in your case, though. From the floorplan map you drew in your letter, it appears the computer and second TV already are pretty far apart. Also, the family room seems to be the most logical place for your computer.

You might try reorienting the computer, its TV, and the second TV. Sometimes changing the direction the computer faces and rearranging its wires can make a difference. Experiment with this. Also try plugging the computer into another wall outlet that is on a different branch circuit than the living room TV.

Some people wrap several layers of aluminum foil around the cable connecting the computer to the TV. This can help if the interference is coming from the cable. Also try wrapping the RF modulator — the small metal box between the computer and the TV (not the switchbox).

There's one more thing you might check, too. You mentioned that the interference is worst on channel 2. Look at the RF modulator box and see what channel it is tuned to. The VICs we've seen have RF modulators that select between channels 3 and 4, but it's possible that yours selects between 2 and 3. If so, make sure it is switched to channel 3. If your RF modulator selects

between 3 and 4, try it on channel 4 (and remember in either case that the VIC's TV must be tuned to the same channel as the RF modulator). If there is no channel 4 in your area, this might reduce interference with channel 2 and yield a better computer picture. However, it also might cause new interference with channel 5 if there is a station on this channel in your area. The solution might be to switch the VIC to channel 4 when somebody in the living room is watching channel 2, and switch the VIC to channel 3 when somebody is watching channels 4 or 5.

For more information on correcting RF interference, you can write for a booklet prepared by the FCC entitled *How to Identify and Resolve Radio-TV Interference Problems*. The booklet is listed as Stock Number 004-000-00345-4, available from the U.S. Government Printing Office, Washington, D.C. 20402.

Stringy Floppy Chains

I very much enjoyed reading your review [COMPUTE!'s Gazette, July 1983] of the Entrepo Corporation (formerly Exatron) Stringy Floppy. I also liked the part on page 60 where you covered daisy chaining to the disk drive. I was almost ready to go out and invest in one. Your review, however, left me with one important question: does the Stringy Floppy have a serial port for us printer owners to daisy chain to?

James C. Nipert

Yes, the Stringy Floppy has two serial ports in the back — it can be at the end of the daisy chain or somewhere in the middle. No matter where it's located, it is addressed by its separate device number (20).

However, you might have trouble finding an Exatron Stringy Floppy now. The VIC and 64 models from Exatron were recently discontinued. Exatron was dissolved and is now known as Entrepo, Inc. Entrepo still manufactures Stringy Floppy drive assemblies, but no longer sells directly to the public. Instead, it sells the assemblies to other companies which finish the drives and then market the units under their own brand names. Sales of blank wafers are being handled the same way. Blank wafers are still available from one of these companies, A&J Microdrive (Sunnyvale, California). Jim Howell of A&J Microdrive says he may reintroduce the Stringy Floppy for the VIC and 64 sometime in the future, but there are no solid plans.

In the meantime, Stringy Floppies should be available this fall from another company, Unitronics (Oakland, California). Unitronics introduced its Waferdrive Module for the VIC and 64 at the Summer Consumer Electronics Show (see "News From The Summer CES," COMPUTE!'s Gazette, September 1983). Unitronics plans to sell the Waferdrives for less than \$100 (including 8K memory expansion on the VIC version) and make available some commercial software on wafers. ☐

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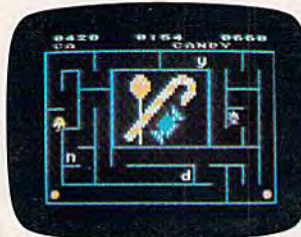
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improve your child's writing and reading abilities. And all of them help your child understand how to use the computer.

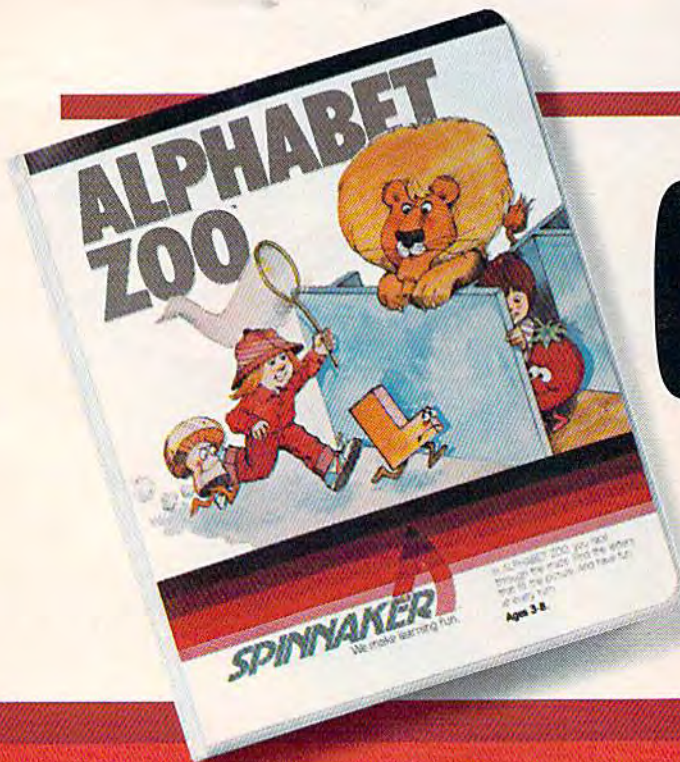
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SIMPLE ANSWERS TO COMMON QUESTIONS

TOM R. HALFHILL, EDITOR

QA

Each month, *COMPUTE!'s Gazette* for Commodore will tackle some questions commonly asked by new VIC-20/Commodore 64 users and by people shopping for their first home computer.

Q. The "Global Scan" program from the August 1983 issue of *COMPUTE!'s Gazette* seems to have an error on lines 500 and 510:

```
500 IF H1=0 THEN H1=1E-6
```

```
510 IF C=0 THEN C=1E-6
```

In Commodore BASIC, 1E is not a proper variable name. I don't understand how this could work. Please help a confused programmer with a little correction for this bug.

A. This is not a bug. You are correct that 1E would not be a proper variable name; in practically all BASIC dialects, variables must start with a letter, not a number. However, 1E is a proper constant using what's known as *scientific notation*. This is a shorthand method of expressing very large or very small numbers without long strings of zeroes. The ability to recognize and manipulate numbers expressed in scientific notation is built into the computer.

For instance, 1E-6 means 1×10^{-6} , or 0.000001. The number 10,000,000, expressed as 1×10^7 in scientific notation, would be entered on the VIC-20 or Commodore 64 as 1E7.

For more information on scientific notation, see the *VIC-20 Programmer's Reference Guide* (pp. 55-56) or the *Commodore 64 Programmer's Reference Guide* (pp. 4-6).

Q. I've been having some strange problems with my Commodore disk drive. Several files have

gotten mixed up on some of my disks. Sometimes when I load a program, pieces of another program are mixed up with it. Some files won't load right at all. My manual says to "initialize" each disk and I haven't been doing that. Could that be the cause of my problem? Also, I've been using a friend's disks on my disk drive. Could this cause problems?

A. You've zeroed in on your problem, all right. Initializing disks is *vital* to keep from garbling up your files. It's also possible that your disk drive is faulty, but true "hardware errors" are rare and should be suspected last.

Your problem, almost certainly, is the fault of a messed-up *Block Allocation Map* (BAM). Each disk contains a BAM. The BAM is a map of the remaining free space on the disk. The purpose of the BAM is to keep newly SAVED files from overwriting old ones. Before SAVEing a new file, the disk drive checks the BAM to find free room on the disk. It then avoids writing data to blocks which have already been used. But if the BAM somehow gets garbled, the disk drive may SAVE a new file atop an existing one without realizing it.

How can a BAM become scrambled? Failing to initialize a disk is the most common way. Whenever you initialize a disk, write to a disk, or call a disk directory, the disk drive reads the BAM off the disk and stores it in its memory. Trouble can happen when two disks have the same ID number (the two-character identifier you assign when first formatting a disk with the NEW command). Disk drives use the ID number to distinguish between different disks. If you swap disks that happen to have the same ID number and then attempt to SAVE a file, the disk drive will first check the ID, conclude that the disk has not been changed, and use the BAM already in memory. Chances are pretty slim that both disks have identical BAMs, so files get overwritten or



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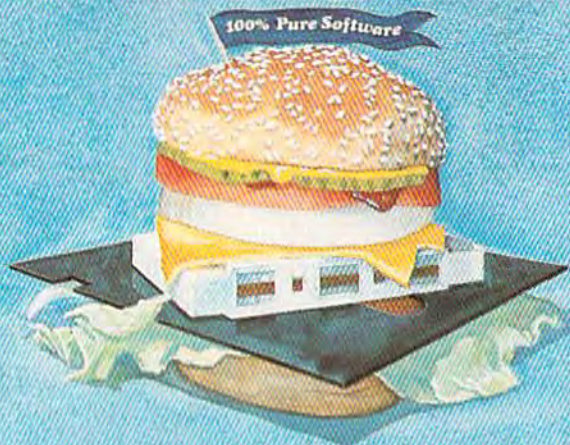
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scrambled. After this happens a couple of times, the BAMs themselves get messed up, and problems multiply.

To be safe, it's a good idea to initialize every time you swap disks in the drive. Without using a line number, enter:


CLOSE 15:OPEN 15,8,15,"I0":CLOSE 15 [press RETURN]

The drive's busy light will come on for a few seconds as the disk initializes. This insures that the disk's BAM is read into memory.

Another precaution when SAVEing programs on disk is to always precede the filename with a "0:" (on single-drive systems). Example:

SAVE"0:filename",8

To be really safe, you should make sure all your disks have unique ID numbers. If you sometimes use other people's disks on your system, give your own disks weird ID numbers that no one else would possibly think of, such as "Z=" or "9" or "/*". Such symbols are legal in Commodore disk ID numbers.

For a more detailed explanation on using Commodore disk drives, see Part I of the new series starting this month, "Getting Started With A Disk Drive." 



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Computer Graphics

The Age Of Electronic Art

Fred D'Ignazio, Associate Editor

Let's imagine we have a time machine. We climb on board. We shut the door. We set the controls for Cambridge, Massachusetts, in early 1961.

The time machine whirs. Our stomachs feel queasy, as if we were on a rapidly falling elevator.

The whirring stops. The door opens.

We are in a darkened laboratory. The hulking forms of giant computers tower overhead and surround us. In the laboratory is a young man, unshaven, gazing at the screen of a computer terminal.

The young man is Ivan Sutherland. Ivan is a graduate student at the Massachusetts Institute of Technology in Cambridge. He sits, frozen, in front of the computer. It is 3:30 in the morning. His wife and kids are home sleeping. But here he is, dead tired, half-asleep, and eyes glazed. Yet he has to be here. It is the only time he is allowed on the computer.

Sutherland stares at the computer screen. A shape appears. Sutherland grins. "Yaaaaaa-hoooo!" he cheers. He dances around the deserted lab.

Why is Sutherland so happy? Because he has just become the first human being to teach a computer to draw.

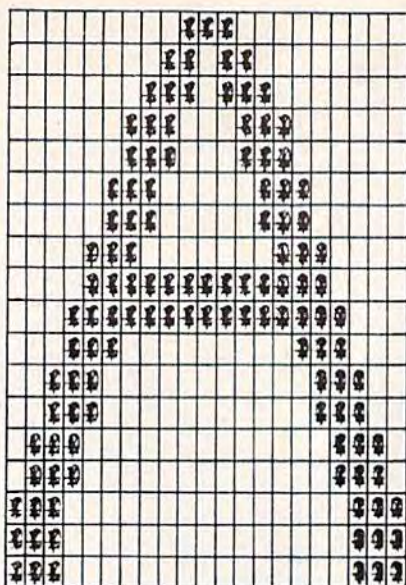
On the screen was a straight line. That's all: just a straight line. It was special because it was the first line ever drawn by a computer – and because it opened a whole new age of electronic art.





The view out the computer "window" of an Air Force flight simulator. The ultra-high resolution computer images of the jets and the ground below are in color, in 3-D, and in motion. (Courtesy Evans & Sutherland.)

More simple graphics: a giant letter A made from several characters printed one on top of the other with a printer. Note that the A is printed on a graph-paper grid of little blocks. (Reprinted from Creative Kid's Guide to Home Computers by permission of Doubleday & Company.)



Sutherland was excited about what he did. But he didn't stop there; he went on to teach the computer how to draw new things. He taught the computer to change the straight line into an elastic rubber band. He had the computer bend the line, shrink it, and stretch it.

He taught the computer to draw other shapes, too: circles, triangles, squares, and polygons. He taught the computer to spin the circles, rotate the triangles, and fold the squares like pieces of construction paper.

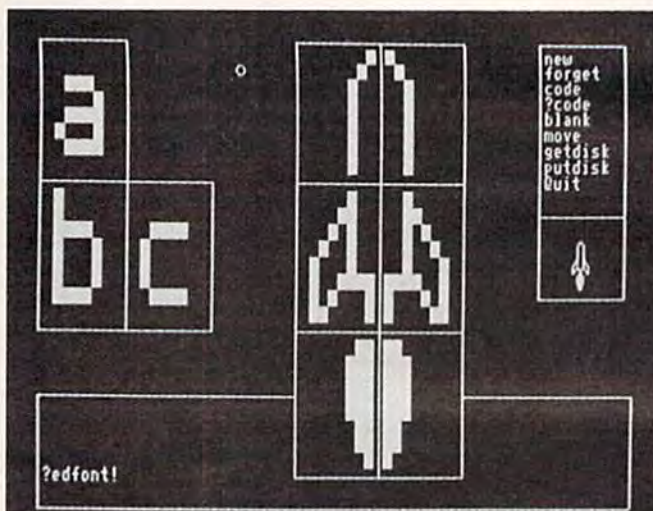
Sutherland published his findings in a book called *The Electronic Sketchpad*. His enthusiasm and knowledge about computer art inspired a whole generation of young people to learn how to teach computers to draw pictures.

Sutherland and his friend, David Evans, moved to Salt Lake City, Utah, and founded the

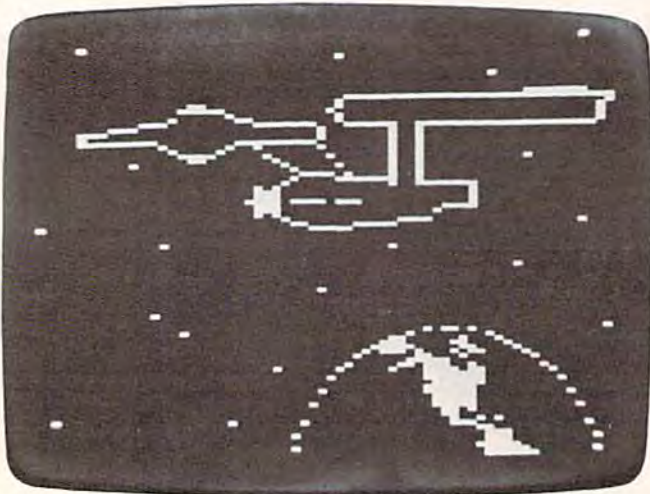
world's best computer graphics company, Evans & Sutherland.

Evans & Sutherland now builds million-dollar flight simulators for the U.S. Air Force. The simulators look like the inside of an airplane's cockpit – except that the “windows” are all computer screens. When a pilot trainee operates the controls of the plane, he or she is really controlling the computer. The computer images on the windows look like what pilots would see if they were flying a real plane.

Sutherland and his graphics computers are world-famous. Yet it all started one cold, dark morning when he taught a computer how to draw a straight line.



You can build complicated shapes by combining simple, rectangular building blocks or special graphics characters. Shown are three letters of the alphabet and a rocket. When the rocket is reduced, it becomes much more realistic. (Photo by Alice Collette. Courtesy of Rosetta Inc. Reprinted from *Small Computers* with permission of the publisher, Franklin Watts.)



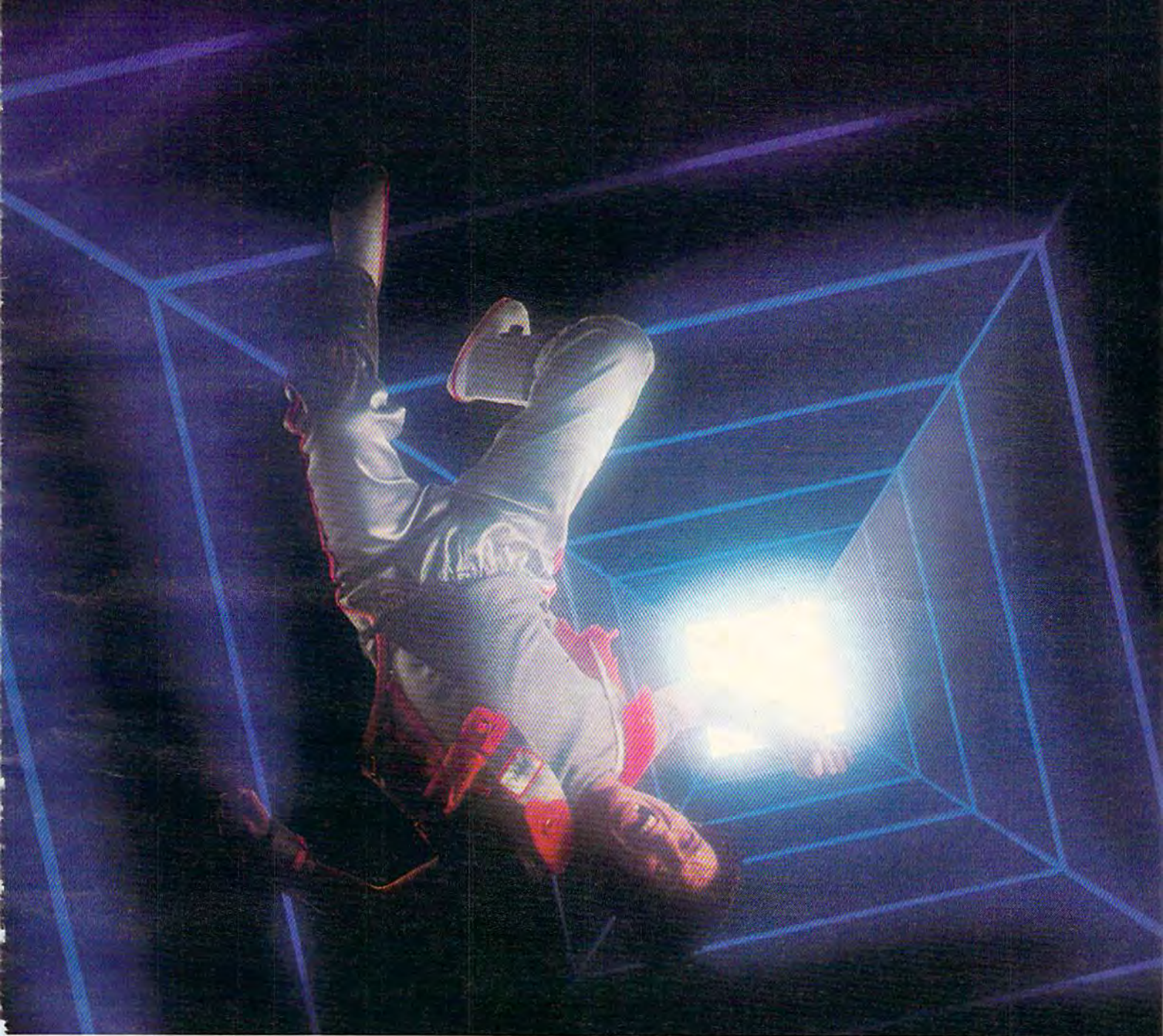
Picture of stars, Earth, and the Starship Enterprise. A computer program lights the pixels on the TV screen. (Courtesy RCA.)

Amazingly, your average personal computer is more powerful than Ivan Sutherland's warehouse-sized computer of 1961. Also, many of today's personal computers have graphics commands built right into their BASIC language. Sutherland had to program his computer to draw by feeding it commands written in long, snake-like strings of binary 1's and 0's. Modern computers can draw pictures with English-like commands such as PEN DOWN, DRAWTO, PLOT, and FILL.

Also, Sutherland's graphics were all in black and white. But today's computer graphics can be in color – from 16 colors on a VIC-20 and Commodore 64 up to 256 different colors on some machines.

But no matter how complicated computer graphics get, they must be built in one of three ways.

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Meet the Alienators. A fiendish bunch who've planted bombs throughout your Jupiter Command Headquarters.

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and try to work your way down, or try to hurdle him and defuse the bombs closest to you before they go off?

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So jump to it. And find out why Jumpman and Jumpman Jr. are on a level all their own.

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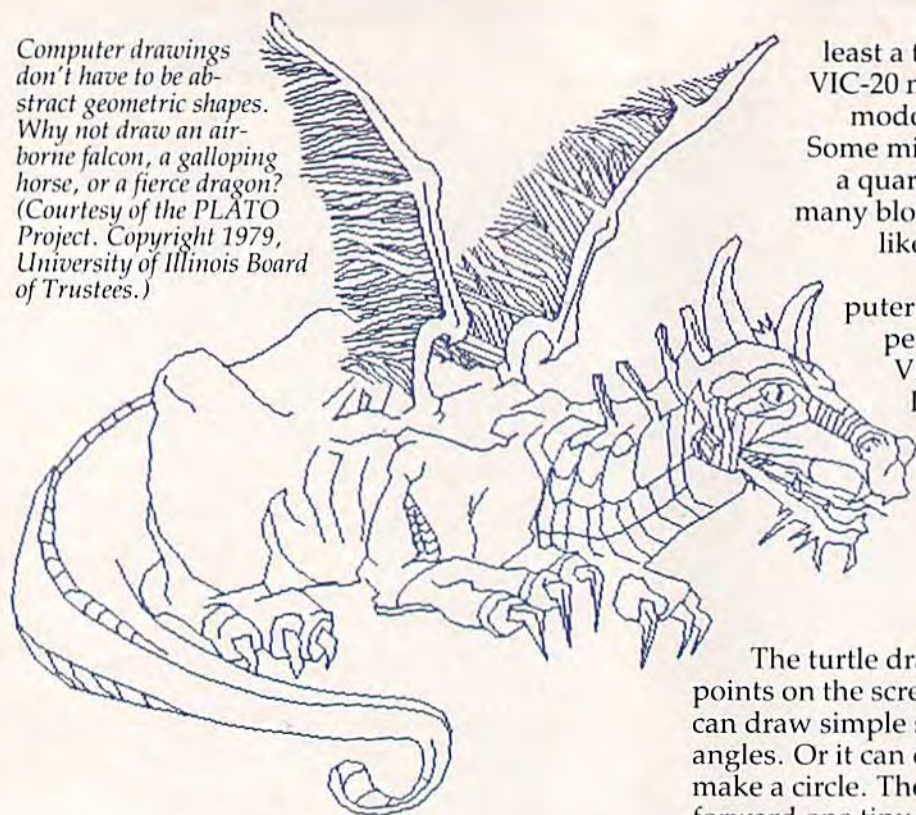
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Computer drawings don't have to be abstract geometric shapes. Why not draw an airborne falcon, a galloping horse, or a fierce dragon? (Courtesy of the PLATO Project. Copyright 1979, University of Illinois Board of Trustees.)



First, you can use letters or special graphics characters and combine them into some kind of shape. The shape might be a giant letter A, a monster's face, or a skyscraper. These kinds of graphics are holdovers from the days when most computer terminals used paper printers instead of video display screens.

Another way to draw pictures on a computer's TV screen is to divide the screen up into tiny blocks called *pixels* (for *picture elements*). The picture is built by filling in the blocks. It's like drawing rough pictures with graph paper and magic markers. Using this technique, you can make pictures of spaceships, human stick figures, or running horses.

Computers that can display large numbers of very small pixels are capable of creating images with finer resolution. The more pixels, the better. If your TV screen is divided into thousands of tiny building blocks, then the pictures look smooth and realistic. On the other hand, if the building blocks are big, then the pictures appear blocky and rough. The image which opens this article was created on a computer with ultra-high resolution – millions of pixels.

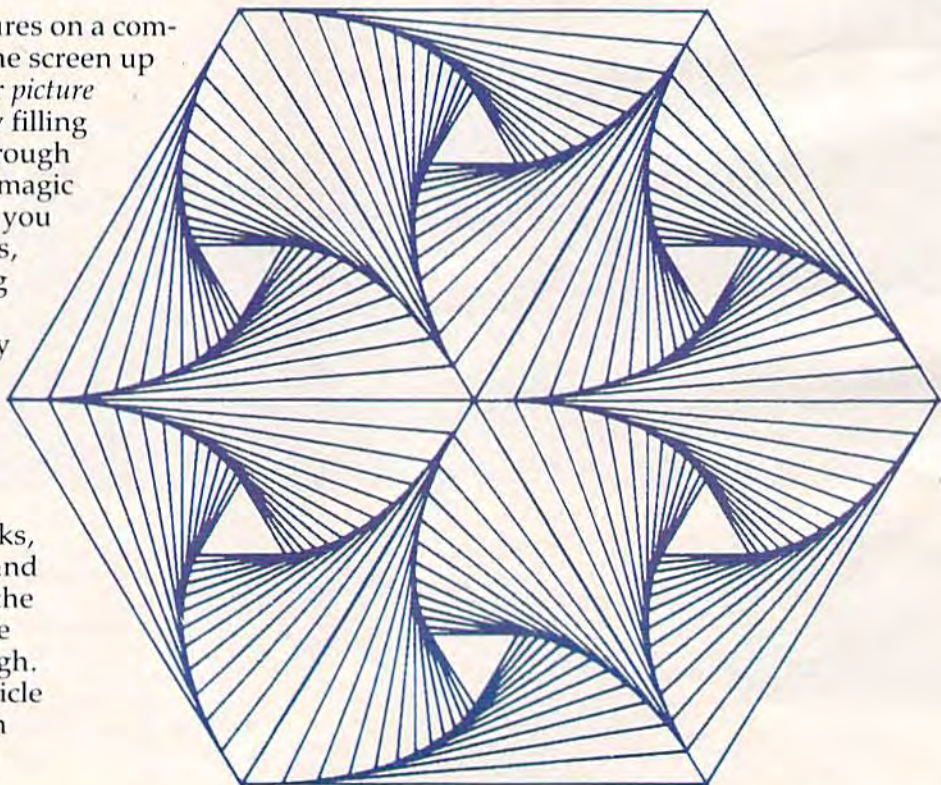
Most personal computers let you draw pictures using at

least a thousand blocks per screen. The VIC-20 maximum is 32,384; on the Commodore 64, up to 64,000 are possible. Some microcomputers let you use up to a quarter of a million blocks. With this many blocks on the screen, they look less like blocks and more like tiny dots.

Yet another way to create computer art is to use *turtle graphics*. Most personal computers, including the VIC and 64, can run the PILOT or Logo languages. In turtle graphics, a small, imaginary turtle (often the shape of a triangle) walks across the screen while leaving behind a trail. By issuing commands such as TURN 90 and FORWARD 10, shapes are drawn.

The turtle draws pictures by connecting two points on the screen with a straight line. The turtle can draw simple shapes such as squares or triangles. Or it can draw lots of little straight lines to make a circle. The turtle makes the circle by going forward one tiny space, then turning to the right one degree. Since it takes 360 degrees to make a circle, the turtle has to go forward and turn right 360 times.

The turtle doesn't have to stick to circles. It can make stars, snowflakes, even fierce dragons. It can make any number of complicated, beautiful



Simple shapes can be combined into beautiful, three-dimensional shapes with turtle graphics. (Courtesy of computer artist Joe Jacobson.)

WELCOME TO APSHAI. YOU'RE JUST IN TIME FOR LUNCH.



Boy, have you taken a wrong turn. One moment you're gathering treasure and the next you're being eyed like a side of beef.

You're in the Gateway to Apshai.[™] The new cartridge version of the Computer Game of the Year,* Temple of Apshai.[™]

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But first you'll have to consider your strategy.

Is it treasure you're after? Or glory? You'll live longer if you're greedy, but slaying monsters racks up a higher score.

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

They'll be eaten.

One player; Temple of Apshai, disk/cassette; Gateway to Apshai, cartridge, joystick control.



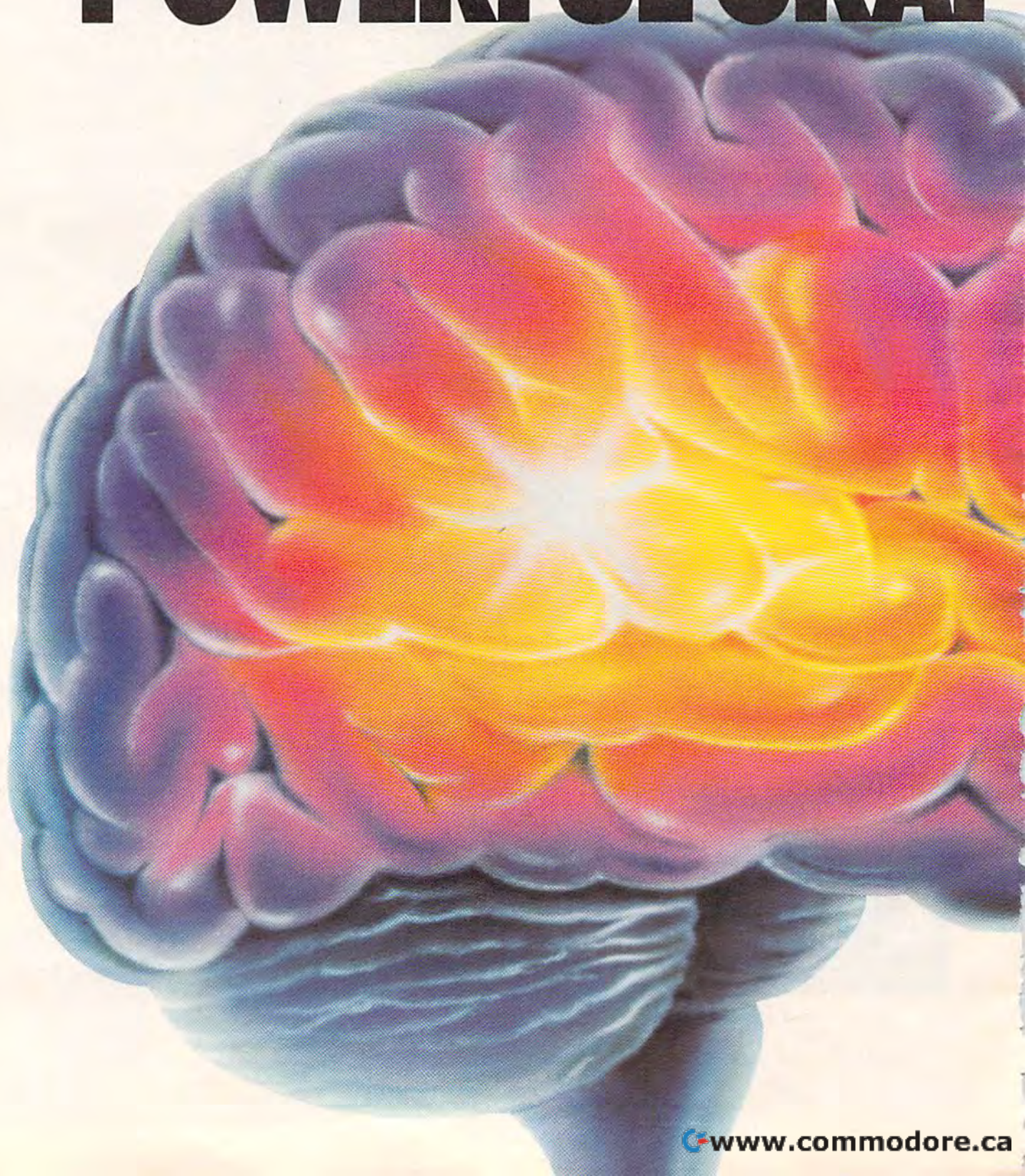
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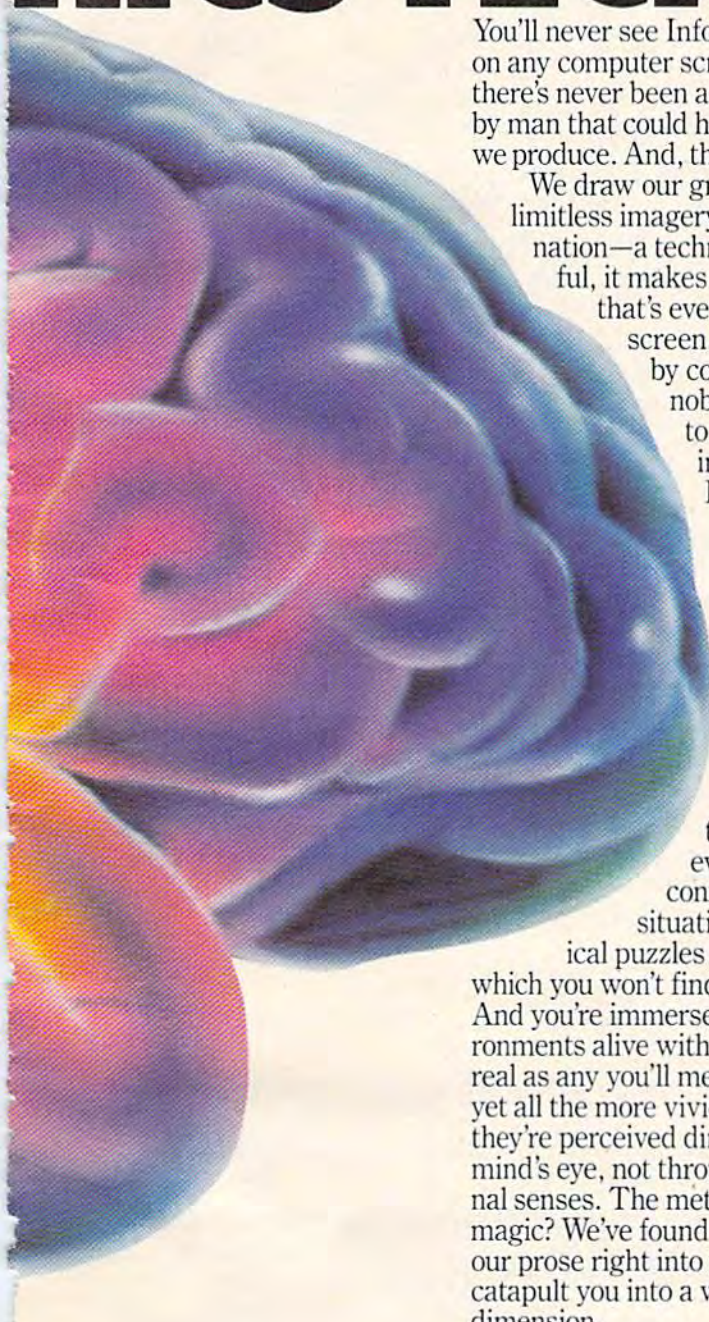


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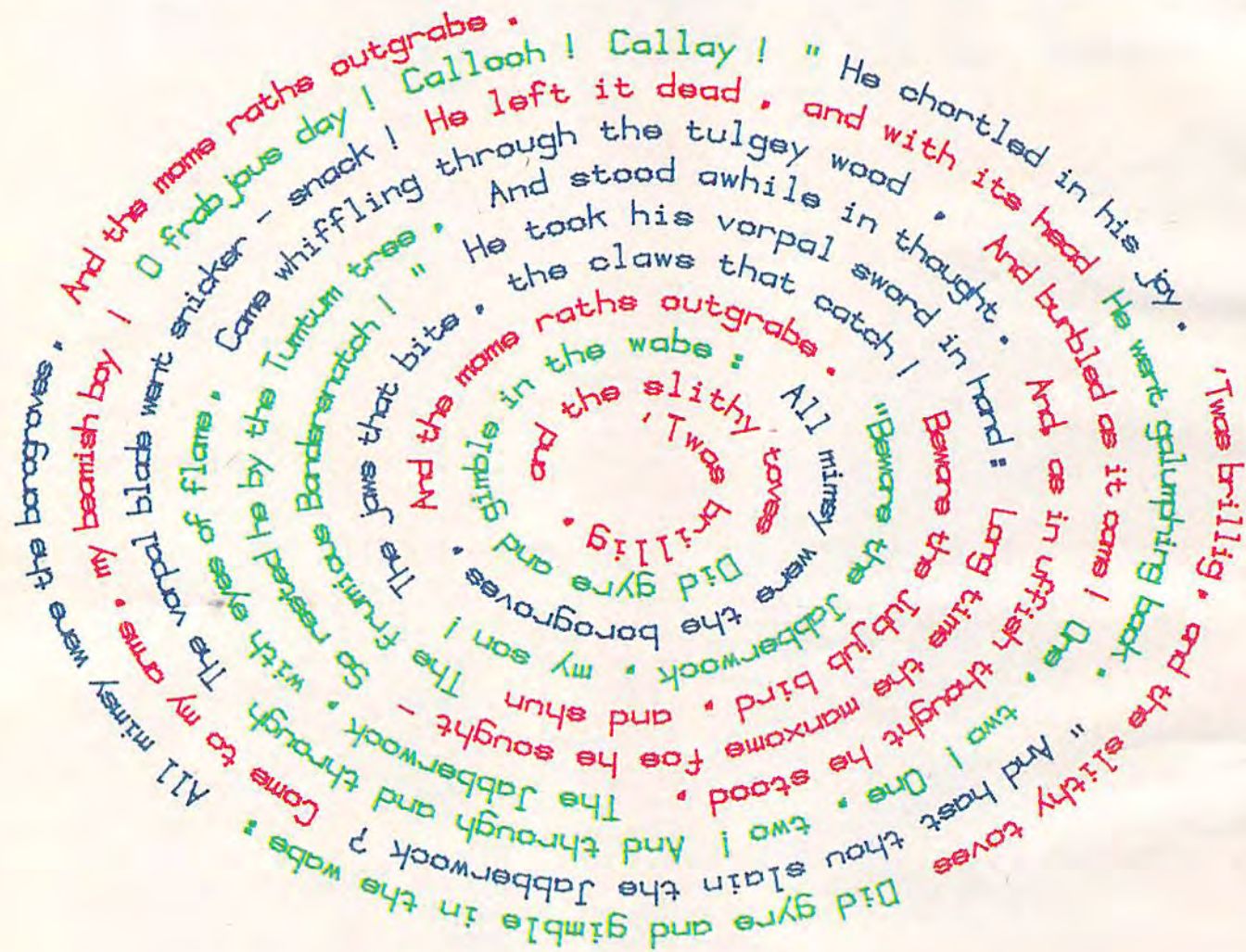
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The turtle usually draws with lines made up of dozens of blocks strung together. But its lines could be made up of special figures or letters of the alphabet (see printout).

One relatively new device is the *light pen*. The pen is wired to the computer. As you touch the tip of the pen to the screen and move it across the glass, it leaves an electronic "line." Some light



Jabberwocky

Until recently, the only way to make computer graphics was to type commands on the computer keyboard. But that's not the way traditional artists draw. They use pencils, pens, and paintbrushes. They draw the picture directly on a piece of paper. They don't have to type a PAINT command on their paintbrush, or a SKETCH command on their pencil.

pens draw in different colors. Others let you touch the screen and fill in a whole picture with a particular color. With a single touch, you could paint the sky blue, clouds white, or a robot metallic orange (see photo).

Another device is the graphics tablet. The tablet is a flat plastic rectangle or square. You mount a picture you want to trace on top of the tablet. Above your picture is a plastic arm, often with a magnifying glass on the end.

30 *COMPUTE!'s Gazette* November 1983

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Drawing pictures directly on the TV screen with a light pen. (Courtesy of Matsushita Electric.)

plastic arm above each line in the picture. The arm and the graphics tablet are wired to the computer. As you move the arm, it sends signals to the computer. These signals are an electronic copy of your picture, stored in the computer's memory. With just a couple of commands, you can get the computer to display the picture on the TV screen. It is fuzzier than the original, and the colors are different, but it is still very much like the picture you traced (see photo).

You can use a graphics tablet to make computer images of maps, photographs, shapes, drawings – almost anything. You also draw original pictures of your own on graphics tablets. An electronic copy is stored inside the computer and appears on the TV. On some computers, you can manipulate the picture once it is inside the computer: shrink it, expand it, change its colors, spin it around, or stretch it apart like Silly Putty (see picture made by duplicating birds).

Million-dollar mainframe computers are being used more and more to create graphics for things like flight simulators and Hollywood movies (such as last year's *TRON*). These computers are becoming so powerful that, sometimes, their pictures look like photographs of real people, real places, and real things.

Moviemakers and human artists are pro-



With a graphics tablet, you can copy maps, photographs, or diagrams into the computer by tracing them with the graphics arm wired to the computer. (Courtesy of Versawriter Inc.)

Don't let price get in the way of owning a quality printer.

Adding a printer to your computer makes sense. But deciding which printer to add can be tricky. Do you settle for a printer with limited functions and an inexpensive price tag or buy a more versatile printer that costs more than your computer? Neither choice makes sense.

Here's a refreshing option — the new, compact STX-80 printer from Star Micronics. It's the under \$200 printer that's whisper-quiet, prints 60 cps and is ready to run with most popular personal computers.

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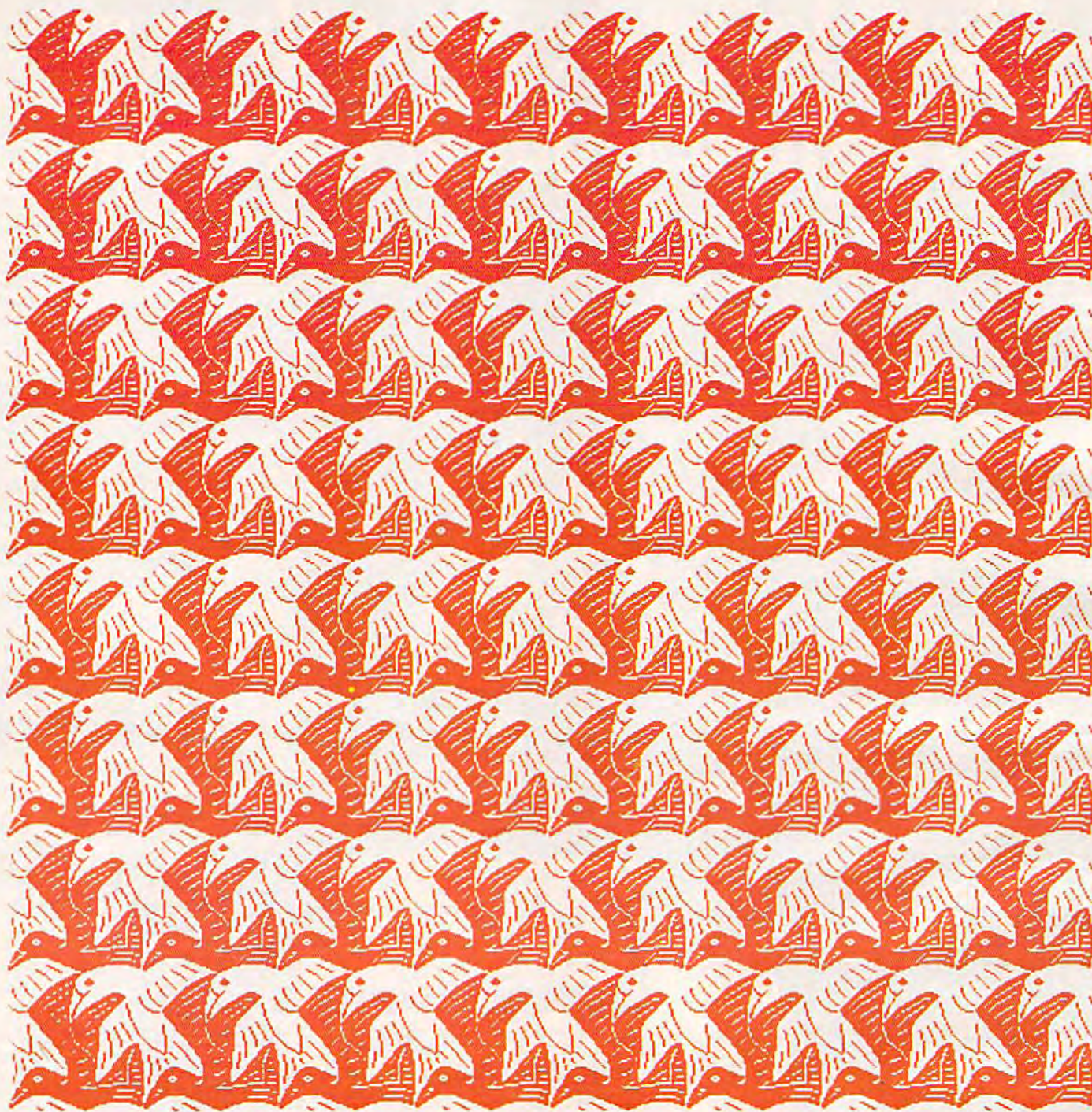
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The new STX-80 printer for only \$199.*

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In this picture, a single pair of birds was copied into the computer. The computer duplicated the two birds dozens of times to make this beautiful pattern. (Courtesy of the PLATO Project. Copyright 1979, University of Illinois Board of Trustees.)

programming computers to create movie and TV scenes that would be too expensive or impossible to stage with live human actors. In days gone by, a team of human artists would paint these scenes (called *mattes*). Now humans program computers to paint the scenes. And the scenes aren't frozen, like a still photo. The computer brings the scenes to life. They become realistic computer cartoons.

Computers that draw scenes for movies are

far too expensive to become personal computers today. But scientists are inventing a new generation of special-purpose computer chips that will soon drastically reduce the cost of these computers. Million-dollar computers can now fit on a \$5000 graphics chip. Hopefully, one day soon, these chips will be inside personal computers. The result will be the birth of a new era in computer graphics and electronic art.



nüFEKOP

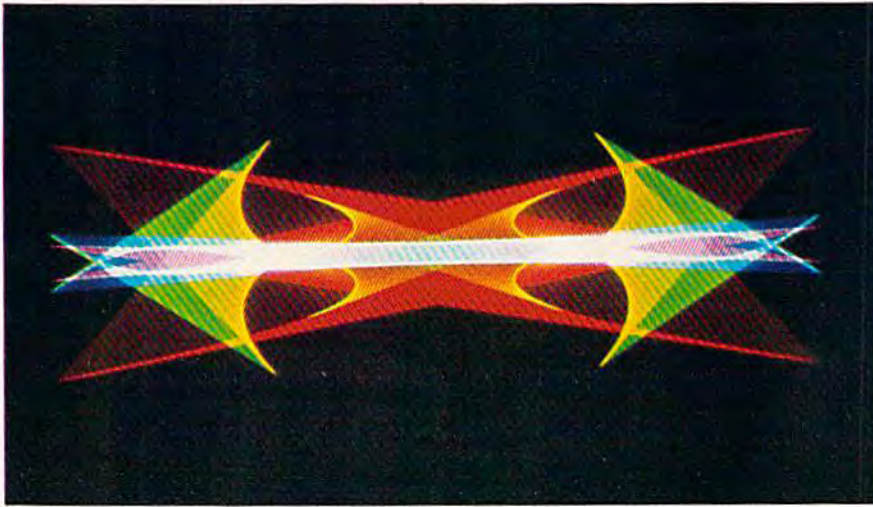
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This stunning picture was made on a supercomputer. But soon, pictures like this will be possible on everyday personal computers. (Courtesy of computer artist Dr. Melvin L. Prueitt, Los Alamos National Laboratory.)

Further Reading

For an overview of computer graphics and computer art, I recommend the following books:

D'Ignazio, Fred. *The Creative Kid's Guide to Home Computers*. New York: Doubleday and Company, Inc., 1981.

D'Ignazio, Fred. *Electronic Games*. New York: Franklin Watts, Inc., 1982.

D'Ignazio, Fred. *Messner's Introduction to the Computer*. New York: Simon & Schuster/Julian Messner, 1983. (This book contains my interviews with many of the pioneers in computer graphics and computer art.)

Greenberg, Donald (and others). *The Computer Image: Applications of Computer Graphics*. Reading,

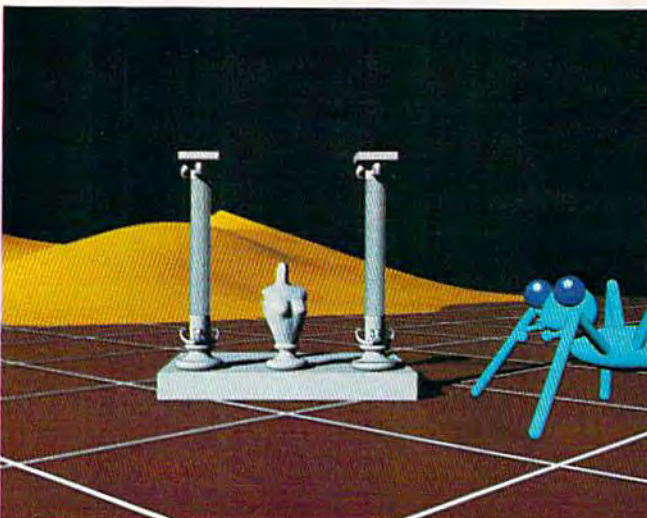
MA: Addison-Wesley, 1982. (This is an expensive book. But it has beautiful color pictures and is a good, clear introduction to computer graphics. I recommend it for your computer class at school or for your library.)

Leavitt, Ruth. *The Artist and the Computer*. New York: Harmony Books, 1976.

If you are ready to start creating computer art of your own, you should look at:

Myers, Roy. *Microcomputer Graphics*. Reading, MA: Addison-Wesley, 1982. (Lots of Apple II BASIC examples.)

Thornburg, David. *Picture This!* Reading, MA: Addison-Wesley, 1982. (Lots of examples in Logo and Atari PILOT.)



Electronic artists are programming computers to draw cartoon-like scenes and cartoon characters and creatures. (Courtesy of MAGI Inc.)



The hardest thing for computers to draw is people. Now scientists at Ohio State University and elsewhere are working to program computers to draw realistic pictures of human beings in action. (Courtesy of Dr. Charles Csuri, Ohio State University.)

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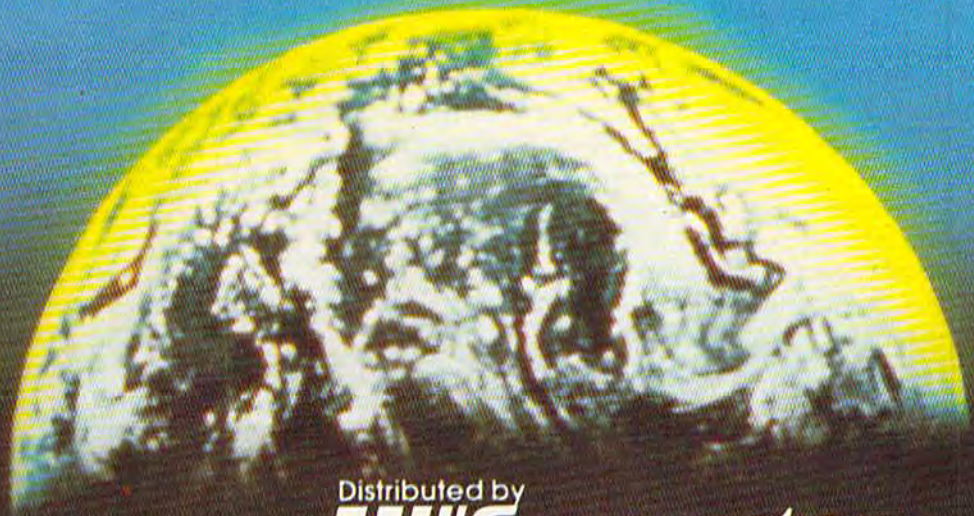
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The Inner World Of Computers

Part 1: Binary Numbers

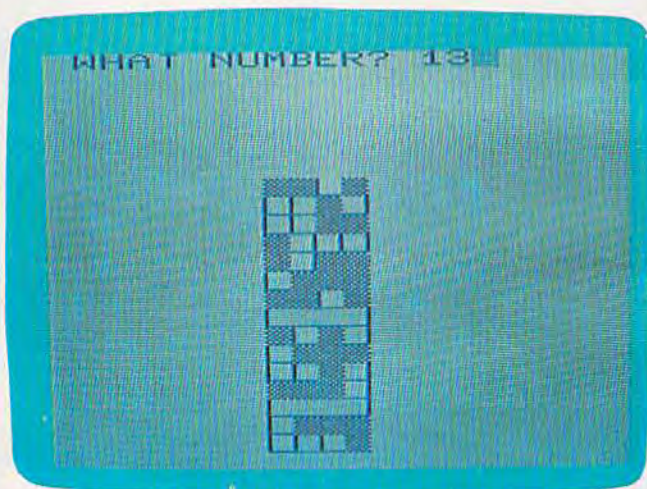
Tom Prendergast

Do you ever wonder what happens after you type RUN? What goes on inside the computer? How a machine can "think" just by manipulating numbers? This new series shows how computers work by explaining computer math in a nontechnical way. It's especially recommended for those who are following our monthly column "Machine Language For Beginners."

I hated math in school. I skipped more math classes than some people skip gym. Numbers made me numb. Especially when the teacher spent every period filling up the blackboard with funny little chalkmarks – then erasing the whole board before explaining what he'd done.

That's why I wouldn't buy a computer. They scared me. A computer is for numbers, right? And who needs a computer when you can buy a calculator that fits into your shirt pocket and costs a whole lot less! Then I bought a word processor to replace my typewriter – and discovered I'd bought a computer!

I discovered something else after I'd been running my computer-disguised-as-a-word-processor for a couple of months: that I shouldn't have been scared of computers in the first place. Because computers don't use numbers! Sure, they *do* numbers. Computers do addition, subtraction, multiplication, division – even square roots and sines and cosines and all that advanced mathematical stuff – but computers don't "understand" numbers any better than I did, or do.



"Binary Castle" is a simple program that lets you practice recognizing four-bit binary numbers (VIC version).

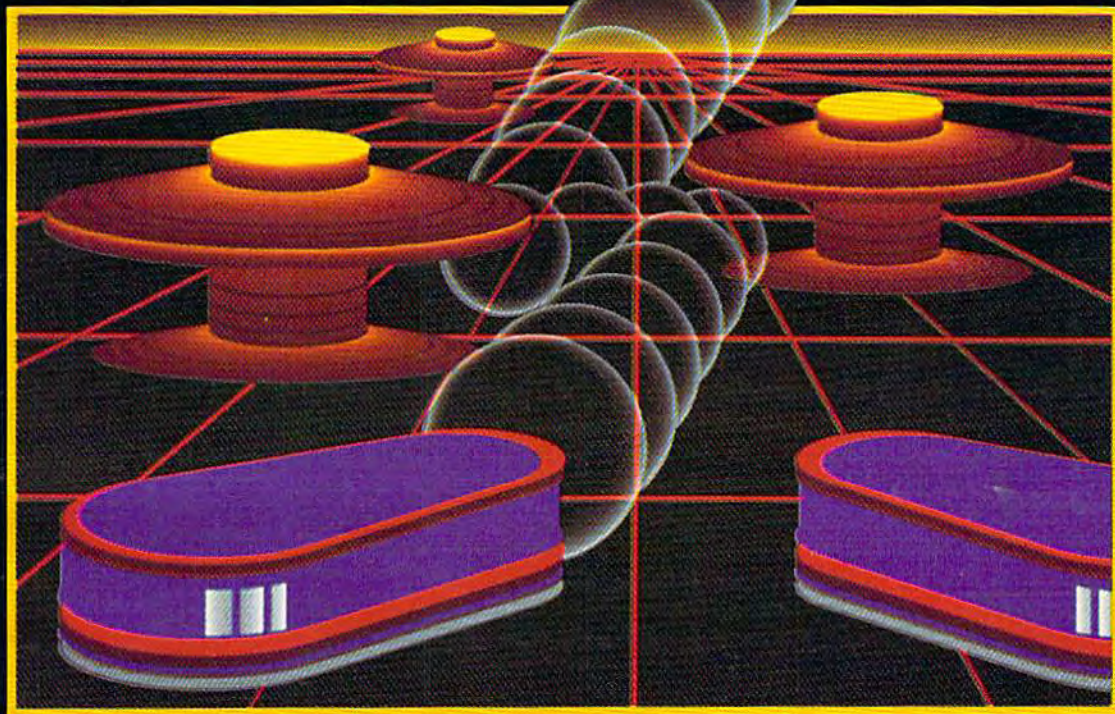
Maybe you think it's adding $2 + 2$, but all it's doing is setting little switches ON and OFF according to certain patterns.

We input a sequence of PATTERNS into the computer's memory – that's called programming – and when the program is run, these patterns are taken one-by-one and the computer's thousands of electronic switches are set according to these patterns. I like to think of it as little ELFS (ELec-tronic FingerS) setting those switches, but hard-headed number types insist it's *binary*.

"Here we go!" I can hear the groans. "Now he's gonna explain binary with rows of light bulbs turned on and off."

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Well, yes. I'm going to explain binary, and an easy way to learn binary numbers up to 15 – almost all the binary you'll ever need to know. But forget the light bulbs. All you get from turning a bunch of dumb light bulbs on and off is a lot of heat. Maybe light bulbs explain binary, but they don't explain computers.

Because a computer doesn't understand binary – or octal, or decimal, or hexadecimal – or any kind of numbers. But let's not split hairs. Whether a computer uses binary, or *we* use binary to tell the ELFS how to set a computer's switches, it amounts to the same thing. And while you don't have to know what's going on inside a computer to run one – any more than you need to know what's going on inside a clock to tell time – it's the binary manipulation of those switch-patterns that puts the magic into your computing. Let me repeat that.

Binary puts magic into your computing.

Binary also comes in handy if you decide to learn machine language someday, or even to understand how PEEK and POKE work in BASIC.

Position Is Everything In Life

Binary is easier if you take it a few bits at a time. Ones are the only digits that have any value in binary, so 1 equals one and 0 equals nothing. Not that zero just sits there and does nothing. The invention of zero was probably the greatest invention of all time, bigger than the wheel. A 1 floating around all by itself could be just a 1, or a 10, or 100, or 1000.

There's a difference, right? Zero acts as a "place holder" to show where we've positioned the 1. And that's important because a binary 1 *doubles* in value every move to the left – rather than multiplying by 10, as in our familiar decimal system. That's why, in binary, 10 equals 2, 100 equals 4, and 1000 equals 8.

We take the place system so much for granted in decimal (where every digit increases 10 times in value as it moves left) that we're liable to forget that when we go to another number system. So let's repeat:

Binary values double as we move to the left.

Study the list below for a moment to see the pattern:

Binary = Decimal

1 = 1
10 = 2 (2*1)
100 = 4 (2*2)
1000 = 8 (2*4)
1010 = 10 (8 + 2)
1100 = 12 (8 + 4)

Those are the even numbers (except for the 1) and here are the odd numbers:

Binary = Decimal

11 = 3 (2 + 1)
101 = 5 (4 + 1)
111 = 7 (4 + 3)
1001 = 9 (8 + 1)
1011 = 11 (8 + 3)
1101 = 13 (8 + 4 + 1)
1111 = 15 (8 + 4 + 3)

The 15-Cent Computer

I don't know about you, but my eyes glaze over when I look at tables of numbers. Words I can read, but numbers don't mean a thing unless I can attach something solid and meaningful to them. So what's more solid than money? Here's how piles of pennies show binary place values:



MAGIC NUMBERS

IF YOU THINK OF BINARY AS PILES OF PENNIES DOUBLING EVERY PLACE TO THE LEFT, IT'S EASY TO REMEMBER THE PLACE VALUES.



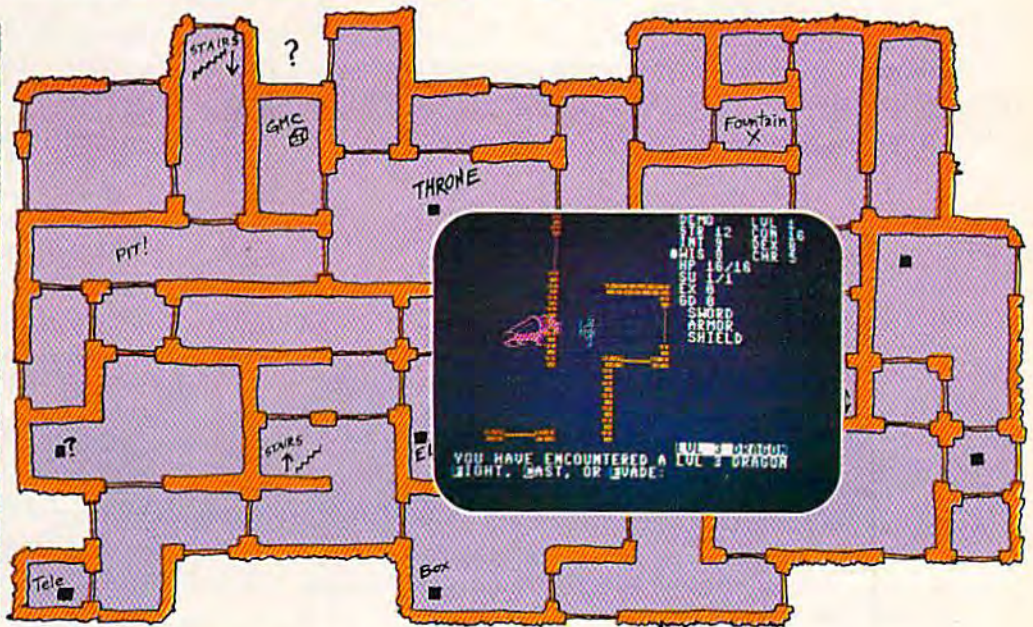
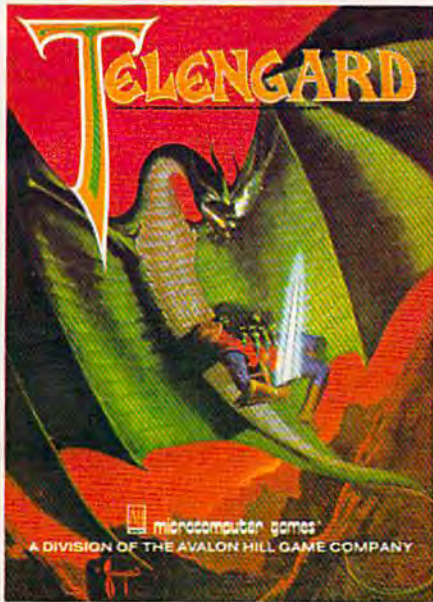
You can do the same thing, with real pennies. Collect 15 pennies right now. Put down one penny for first place, two pennies for second place, four pennies next, and eight pennies for the pile at the end. Four piles, right?

Now cut four paper circles the size of a penny to blank out any pile that may have a value of zero, and your 15-cent computer is ready to compute. (I glued my stacks of pennies together with white glue so that I wouldn't have to count out 8, 4, 2, and 1 each time, and pasted the paper circles on the bottoms so that I could set any pile to zero just by turning it upside down – but you can skip this refinement until you see whether you like the idea.)

Programming The 15-Cent Computer

Two seems to be the binary number most difficult

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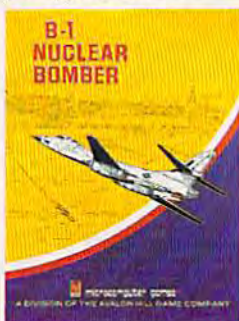
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for people to grasp (because it looks like our decimal 10). So let's make that our first "program."

Zero the 8- and 4-penny piles and the single penny with the blank paper circles (if you've got the paper circles pasted on, just turn the piles over so that the blank side is up). This leaves the second-place pile as is, the only pile that has a value. Your pennies should now look like this:



Now pick up the second-place pile and count the pennies. Two of them, right? If you think of the second binary place as always having a value of two, it's easy to visualize 10 (0010 with "leading zeroes") as a two!

Practice some more binary numbers, making sure you keep the 8-pile, the 4-pile, the 2-pile, and the single penny in that order. If a pile has a value, that value is added to any other values. So, for instance, 0000 – all zeroes – would be $0 + 0 + 0 + 0$, or zero; 0001 would be $0 + 0 + 0 + 1 = 1$; 0011 would be $0 + 0 + 2 + 1 = 3$, and so on. With every pile showing a value (1111), the number would be $8 + 4 + 2 + 1 = 15$.

Here are all the binary numbers to 15:

0000 = 0	0101 = 5	1010 = 10
0001 = 1	0110 = 6	1011 = 11
0010 = 2	0111 = 7	1100 = 12
0011 = 3	1000 = 8	1101 = 13
0100 = 4	1001 = 9	1110 = 14
		1111 = 15

The 15-cent computer is OK for binary up to 15, but what about the really big numbers? You won't need them. The VIC and the 64 automatically process decimal into binary. For *bit masking* and other tricky maneuvers, it's nice to know the binary for 255, 128, 64, 32, and 16, but we'll get into that next month. I'll also show you an easy way of converting any decimal number to binary.

For now, though, practice your 4-bit binary so that you'll be able to write or instantly recognize any binary number from 0 to 15.

Putting The Hex On Binary

Hexadecimal, or *hex* as it's usually called, is that funny combination of numbers and letters with a dollar sign, like \$F2 for instance. The dollar sign is here to tell you that what follows is a hex number and not the name of a plane or some creature from outer space, and the letters are there

because hex uses A, B, C, D, E, and F for the values 10, 11, 12, 13, 14, and 15. (In hex, \$10 = 16.)

Hang on now, because we're coming down the home stretch.

Hex is shorthand for binary.

I used to think the people who design computers dream up all those crazy number systems just to make it hard for us nincompoops. Good for your character, you might say. But hex saves you from going completely nuts trying to remember all those binary 1's and 0's when you're doing machine language because hex is shorthand for binary. Another beautiful thing about hex is that every four bits of binary is a *direct* conversion to hex. And that's the reason for keeping our binary to the 15-and-under limit for now.

Take decimal 65535, for instance, the highest memory address on your 64 or VIC. 65535 is 1111111111111111 in binary, but \$FFFF in hex. Much easier to remember, right? Let's nibble on that for a bit (a *nybble* is four bits, half a *byte*). First we separate all those 1's into easier-to-handle 4-bit nybbles:

1111	1111	1111	1111
F	F	F	F

Then, presto! All we have to do is put the hex values for each nybble directly underneath, and that's our conversion: 65535 (decimal) = \$FFFF (hex). Hard to believe it's that simple, isn't it?

Sure, the far left nybble's F has a value of 61444, the F beside that has a value of 3840, the F next to that has a value of 240, and the first-place nybble's F has a value of 15 – but the computer doesn't know that. A computer doesn't understand numbers, remember? It just sets switches according to certain binary patterns. When a binary byte goes through the system, our little ELFS (ELectronic FingerS) turn on a switch wherever there's a 1, but when they see a hex F, they turn on four adjacent switches.

Although you can convert binary nybbles to hex, most programmers do it the other way around: they use hex to visualize the binary patterns they want to input. \$FF (1111 1111), for instance, is a pattern that turns every switch in the byte on; \$F0 (1111 0000) would turn on the four left switches – and turn off the four right switches; \$0F (0000 1111) turns off the four left switches and turns on the four right switches.

As you can see, you can do a lot of tricks if you input directly in hex, but you need a *machine language monitor* for that – such as the VICMON or HES MON cartridges, or the monitor program in *Machine Language For Beginners* (by Richard Mansfield; COMPUTE! Books). Without a monitor, you'll have to POKE in decimal. But more about that next month when I'll show you how to convert decimal to binary/hex.



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* Popular Computing, November, 1982
† Apple Softalk, April, 1982

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In the meantime, when you get tired of playing with your 15-cent computer, why not try building a binary castle?

Binary Castle

This is a little game you can quickly type into your VIC or 64 and have some fun with while you continue to sharpen up your binary. In this program, square graphics have been substituted for the pennies so that you can use the binary as blocks to build a castle that reaches high into the sky (to the border at the top of the screen).


That's if everything goes smoothly. But if you give even one wrong answer to the Wicked Witch of the Hex when she asks you what binary number the block represents, your castle will collapse and you'll lose all your blocks.

When you run the program, a 4-bit binary block will appear at the bottom of the screen, and you'll be asked what binary number it represents. If you answer – or guess – correctly, a new block will be placed on top, and again you'll be asked what binary number it is.

If you keep answering correctly, your castle will build higher and higher. If you do reach the sky, the game restarts and you can begin building another castle.

So, make one mistake at any time – answer with the wrong number – and the castle is reduced to "bits" with sound effects and lightning flashes. You then have your choice of giving up computing forever or building the castle from the ground up again. (You can always shut the game off until you simmer down, too.)

Incidentally, the blocks build on top of each other the way a part of the computer called the *stack* stores BASIC variables in the VIC and 64. So you'll not only be practicing your binary, you'll also be learning a little about what goes on inside your computer while the program is being run.

See program listings on page 198. 

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6.	Level 4/5 Multiplication & division - fractions
7.	Level 4/5 Addition & subtraction - decimals
8.	Level 4/5 Multiplication & division - decimals

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We solicit software for the VIC-20 and CBM 64. Royalties, license fees or purchases can be negotiated.

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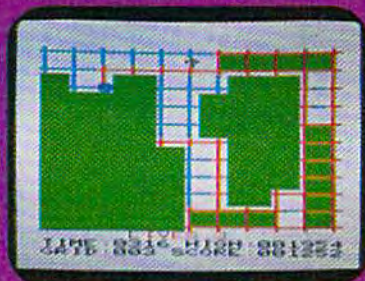
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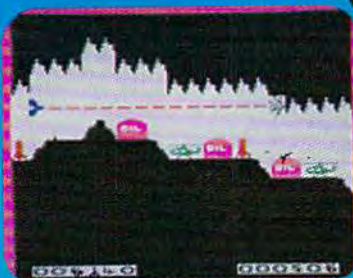


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Getting Started With A Disk Drive

Part I: The Basics

Charles Brannon, Program Editor

A disk drive can make loading and saving programs much easier and amplify the speed and power of your applications. However, a disk drive is more than just a fast cassette recorder — its greater sophistication can sometimes be confusing. This series explores the advantages of disk-based computing, and will explain everything covered in the *VIC-1540 or VIC-1541 User's Manual*, plus more.

Maybe you're tired of searching through a box of tapes, then waiting five or ten minutes for a long program to load. Perhaps you're using your computer and tape drive to keep track of an extensive data base, such as a record collection, and you're discovering that you can find an item faster yourself. You may even be plagued by tape errors and yearning for a reliable substitute.

On the other hand, the relatively low price of a Commodore disk drive (maybe more than your computer cost) may seem exorbitant just for higher speed and ease of use. And if you don't mind waiting ten minutes for a game to load, you probably don't need a disk drive. If, however, the tape drive is the weakest link in your system, you'll reap a substantial upgrade from the investment.

In any case, this series will make you aware of the unique advantages and the subtle problems of the Commodore 1540 and 1541 disk drives. We'll give you the information you need to get started, as well as tips to make the most of your drive.

Let's delve beneath the white or tan plastic case of your Commodore drive. Knowing how something works lends you insight when you're stumped.

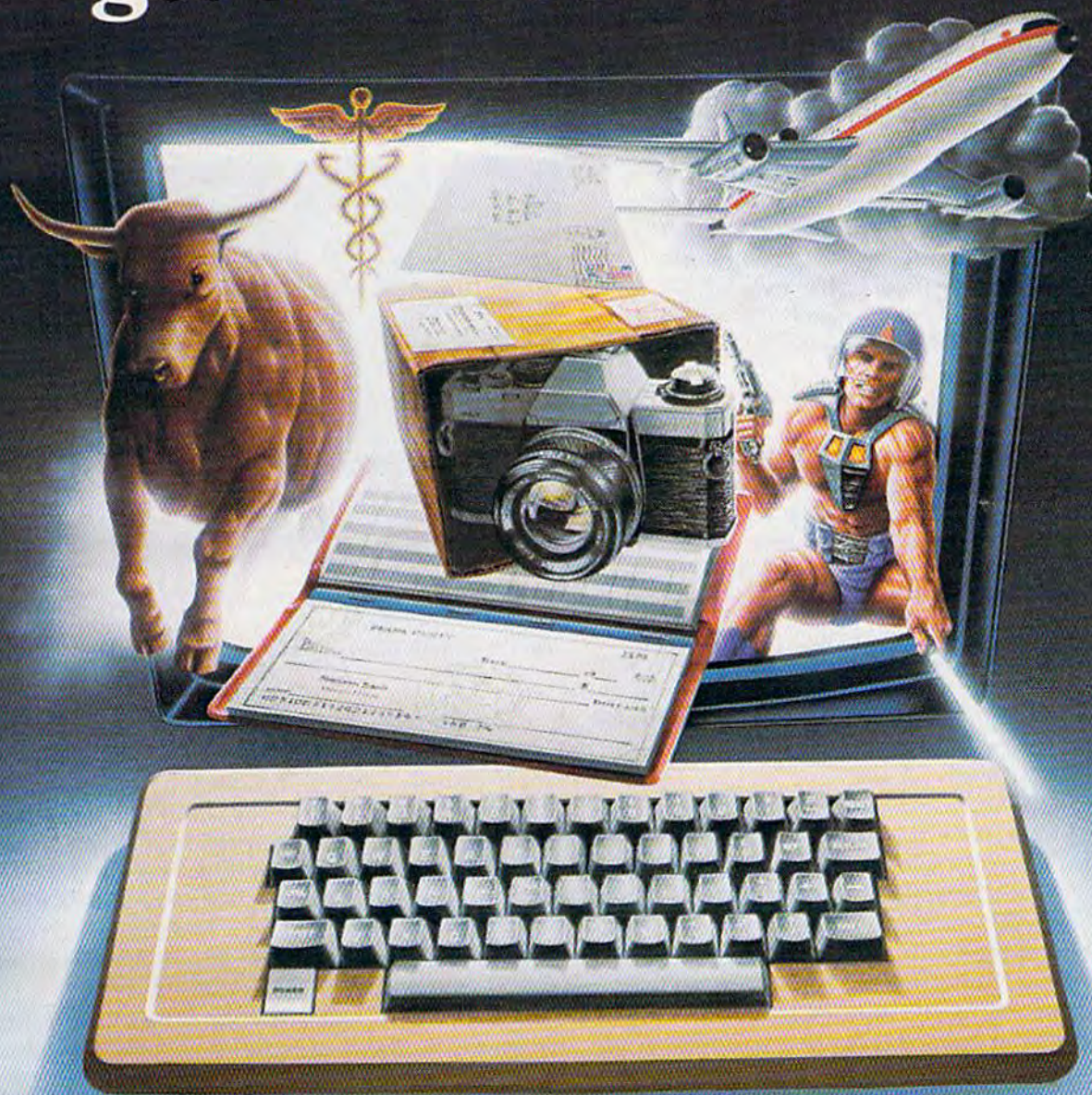
First, let's look at a typical diskette (we'll use the terms *disk* and *diskette* interchangeably unless there's a need for distinction). Refer to the cutaway view in Figure 1. The disk itself is like a thin, limp (hence "floppy") 45 rpm record, except it's enclosed in a plastic sheath. Floppy disks come in diameters of 8 inch (the original size) and 5¼ inch (called *minifloppies*). Minifloppies are most popular for personal computers. Recently, several companies have introduced *micro-floppies*, but so far no one can agree whether to standardize on the 3, 3¼, or 3½ inch size.

Disks themselves are made of flexible mylar coated with the familiar magnetic oxide of recording tape. A great deal of work has gone into improving the floppy disk, but the basic manufacturing process is the same.

The large disk-manufacturing companies (Scotch, Verbatim, BASF, Maxell, and others) stamp out disks from large sheets of coated mylar. All disks, single- and double-sided, single and double density (we'll explain these terms later) are stamped from the same sheet. The manufacturers then test the disks, grade them like eggs, and sort them into the various classes. It's somewhat disturbing to know that the average single side/single density disk (the lowest grade) had to fail several tests to fall into this grade.

However, the much greater demand for lower-priced single side/single density disks re-

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quires that some of the higher-grade disks be relabeled to satisfy this demand. Therefore, there is a good chance that your disk will be of higher quality than it is graded on the label.

When you insert the disk in a disk drive and close the door, the drive hub clamps down on the disk's center ring (see photo). Centering is not perfect. A common technique to improve the centering is to insert the disk while the motor is spinning (enter LOAD "\$",8).

The disk drive's read/write head, similar to a tape recorder's record/play head, must make good contact with the disk's surface. When the door is closed, a pressure pad bears down on the disk from above and presses the disk against the head. That's why the disk needs to be floppy, so it can flex with the pressure. Since the head is underneath, the drive writes to the underside of a disk. Be aware of this when handling a disk.

The moving head is mounted on a linear track that allows it to slide forward and backward across the surface. This is similar to linear-tracking record turntables. In fact, the record analogy is very useful in understanding how a disk drive works.

If your record player ran as fast as a disk drive (300 revolutions per minute), your favorite albums would sound like a high-pitched squeal. This should give you an appreciation of how fast a disk drive is compared to a cassette tape, which moves at only $1\frac{7}{8}$ inch per second. The high rpm's of a disk drive account for much of its speed, but are not the only factor. Equally important is the way a disk drive finds what it's looking for on a disk. Unlike a tape recorder, a disk drive can move its read/write head directly to the location where the data is recorded.

With a tape recorder (for either a stereo or a computer), you must search sequentially through the tape for a certain selection (program or song). In other words, the tape winds past a stationary record/play head, so the head has to wait until the right section of tape arrives. This method, called *sequential access*, is inefficient. You can press Fast Forward to speed up the winding, but finding the right spot is a haphazard process if you're not aided by a tape counter. Even with a tape counter, you will find that the numbers vary widely from recorder to recorder.

On a record player, however, you just lift the tone arm and move it to the desired track. You can move the tone arm directly to any track on the record, skipping over unwanted ones. A floppy disk also has tracks to which the disk drive's read/write head can move directly. This is *random access*.

Disk tracks are somewhat different than

record tracks, however. A record really has only one very long track which starts at the rim and spirals toward the center. On the other hand, disk tracks are concentric circles. Each track is further subdivided into arcs called *sectors*. Each sector holds a *block* of information. The sector size varies on different machines, but is 256 bytes on the Commodore 1540/1541 disk drive.

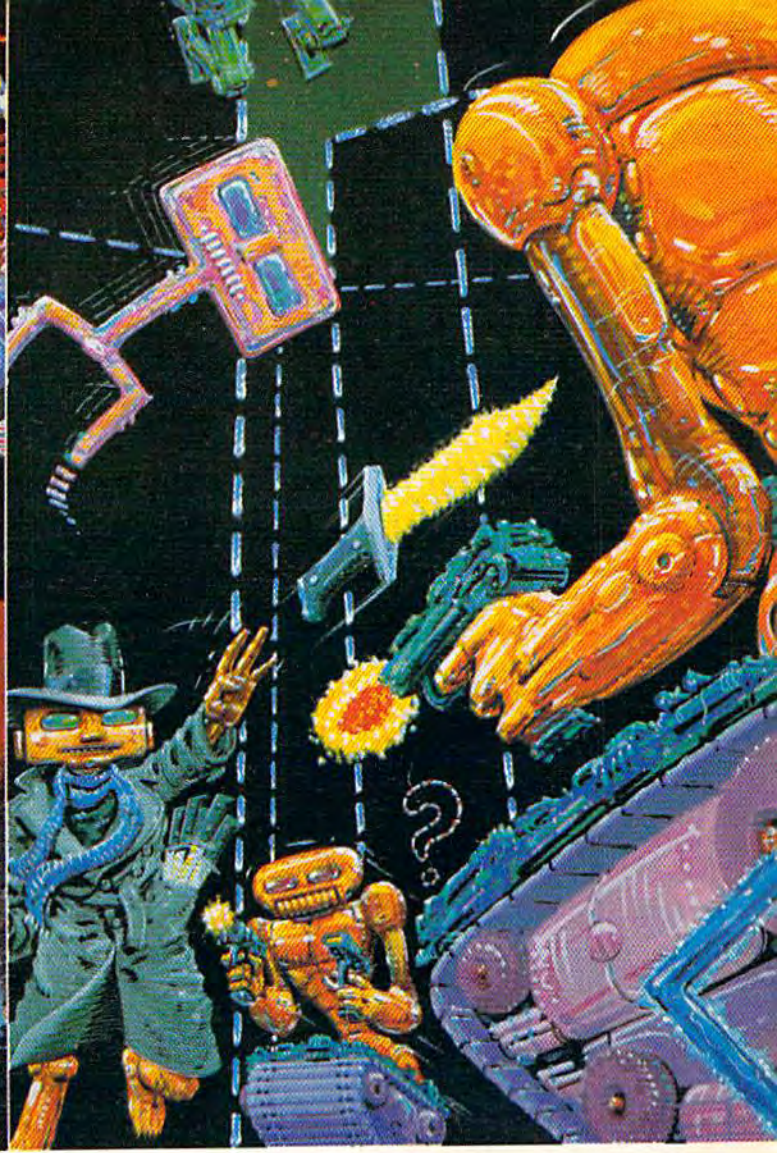
Most disks have 40 tracks, and each track usually has the same number of sectors. An average single density disk can hold roughly 100K (100,000 bytes). This varies according to how many sectors are stored per track. Double density disks squeeze in more sectors per track. This requires a better grade of disk and requires greater reliability.



Inside look at a 1540/1541 disk drive. The small white square bisected by a horizontal line is the read/write head; poised above it is the felt pressure pad. A disk is partially inserted.

Commodore has taken a clever approach to density. The 1540/1541 disk can hold 170K with single density storage. It does it by using a varying number of sectors per track (while using only 35 tracks). The outside tracks of a disk are larger and can proportionally hold more sectors than the inner tracks (see Figure 2). This also solves the problem some drives have when they try to read or write to the inner tracks, where the sectors are crammed together.

Incidentally, this is a good time to distinguish between *soft* and *hard sectoring*. Hard-sectored disk drives require disks with a series of holes that are read through a timing hole (see Figure 1). The holes tell these drives where each sector is. Soft-sectored drives, however, find each sector by timing how long it takes for the disk to revolve. This also can vary from 300 rpm according to how loosely or tightly the disk fits in the jacket. With this system, the single timing hole suffices (some drives — those for Atari computers, for instance — disregard the timing hole altogether). Drives that use hard sectoring (multiple holes) cannot



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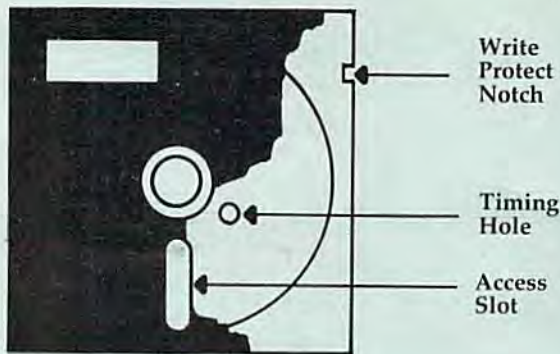
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use soft-sector disks, but you can use both types on your soft-sectored 1540/1541 drive.

Fortunately, you don't have to remember all this when using the drive, since the disk drive's internal Disk Operating System (DOS, pronounced "doss") takes care of managing sectors. All you do is tell the computer whether you want to read or write information and the name of the file involved.

Many application programs do this for you, too. In BASIC, you just give the SAVE or LOAD commands (more on this later). A word processor just asks you for the filename and takes it from there. But you'll still be responsible for keeping track of your disks and following necessary care and maintenance rules.

Figure 1: Cutaway View



You should be careful to protect your disk drive investment. Keep the disks within a reasonable temperature range. To paraphrase one disk manufacturer, "If it's comfortable for you, it's more than comfortable for your disk." Keep your disks away from extreme cold (like your freezer, or a mishap in the winter) and extreme heat (your glove box in the summer, or a heat source such as a radiator or a ventilation slot).

Handle floppy disks carefully. Although disks can sometimes bear being bent in half and still function (if you're lucky), don't take the term "floppy" too literally. Any stress can flake off the magnetic coating and cause read errors.

One more warning is especially important — since disks store information magnetically, keep them away from magnetic fields and radiation. The most common — and hazardous — source of strong magnetic fields and radiation in a home computer system is the TV or monitor. Never rest disks on top of a display device, and don't store or use them within two feet of one.

Magnetism is very sneaky. It's hiding under the case of many appliances in the form of a

transformer. Don't store disks near power supplies, refrigerators, printers, etc. Keep all magnets miles away from your equipment. And don't place disks near a telephone. Every time a phone rings, it sends out waves of magnetism. A disk resting under a telephone (besides being uncomfortably compressed) is a sitting duck for a friendly phone call.

Manufacturers tell us to treat disks as if they were eggs. In fact, disks are very resilient to abuse. Data processing people delight in relating favorite horror stories about how an apparently unrecoverable disk was salvaged. Here's my favorite:

I was preparing to load a very useful BASIC utility program when I noticed someone had spilled a soft drink all over this prized, uncopyable disk. The gooey mess had jelled, like glue, and the disk wouldn't even turn inside the jacket. My heart sank, as I realized the disk was irretrievably lost.

My boss came in response to my cries and appraised the situation. He cradled the mangled disk in his hands and declared: "This disk can be saved." I shook my head in knowing disbelief and surrendered the magnetic victim.

I watched my boss as he undertook what I figured was a mission of folly. First, he took a good, working, but blank diskette. He carefully slit the edge of the jacket (see Figure 1) and removed the blank disk from the envelope.

He then did the same with the damaged disk and carefully placed the syrup-covered victim on some paper towels. Discarding the previously removed blank disk, he brought the hopeless disk to the sink. To my surprise, he held it under a stream of water, and washed it with detergent! After carefully rinsing off the suds, he left it to dry on the paper towels.

To make a long story short, he inserted the newly cleaned disk inside the envelope he had earlier readied. A piece of tape sealed the slit.

You guessed it — the disk worked! I inserted it into the disk drive and it loaded perfectly. I was amazed!

To be fair, though, I would have to say we were very lucky.

Why was the recovery of the disk so important? The reason is that you've banked a lot of information on a disk. A disk can hold 170K, so you have a lot to lose if that disk crashes (fails).

This is a real threat to a small business. Insurance will pay for loss of equipment caused by fire or theft, but the information stored on the destroyed disk is worth hundreds of times the cost

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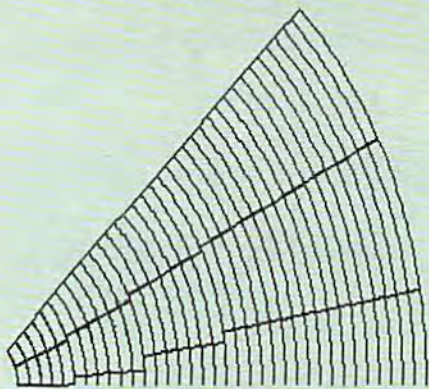
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Figure 2:
Track/Sector Layout — 1/8 Surface



(Sectors are subdivisions of concentric tracks.)


of the disk. Not only do you lose your investment in expensive commercial software, but you lose the countless person-hours it takes to restore the lost information. Some data processing facilities have had to reenter tens of thousands of questionnaires.

Even if a home computer user loses only his or her games, that's still a catastrophe when you

figure that disk-based games can cost at least \$30 each. There are some insurance policies that pay claims for lost data, but some disks are irreplaceable (manufacturer out of business, discontinued software, etc.).

With so much potentially priceless information on a disk, we should, indeed, treat it like fragile china.

Luckily, there's one thing you can do to save yourself in case you lose your disk library: make backup copies of all your important disks. Most computer systems have some way of duplicating a disk. If it is your own programming, you can just SAVE the program to several disks. To be really secure, you should store the backups in a different location, perhaps even in a fireproof safe. Many a programmer has breathed a heavy sigh of relief upon discovering that there was indeed a backup copy of that irretrievable program.

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HOTWARE

A Look At This Month's Best Sellers And The Software Industry

Kathy Yakal, Editorial Assistant

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Commodore 64 Entertainment		VIC-20 Entertainment	
1 <i>Jumpman</i> (Epyx)	1	1 <i>Gridrunner</i> (HesWare)	3
2 <i>Frogger</i> (Sierra On-Line)	3	2 <i>Amok</i> (UMI)	—
3 <i>Gridrunner</i> (HesWare)	7	3 <i>Escape MCP</i> (Commdata)	—
4 <i>Fert Apocalypse</i> (Synapse)	—	4 <i>VIC Men</i> (Star Tech)	—
5 <i>Temple of Apshai</i> (Epyx)	4	5 <i>Ape Craze</i> (Commdata)	—
6 <i>Sword of Fargoal</i> (Epyx)	—	6 <i>Choplifter</i> (Creative Software)	1
7 <i>Telengard</i> (Avalon Hill)	—	7 <i>Apple Panic</i> (Creative Software)	—
8 <i>Supercuda</i> (Commdata)	—		
9 <i>Pegasus Odyssey</i> (Commdata)	—		
10 <i>Pakacuda</i> (Commdata)	—		
Commodore 64 Home/Business/Utility		VIC-20 Home/Business/Utility	
1 <i>WordPro 3 Plus/64</i> (Professional)	1	1 <i>Quick Brown Fox</i> (Quick Brown Fox)	8
2 <i>Turtle Graphics</i> (HesWare)	—	2 <i>HES Writer</i> (HesWare)	2
3 <i>Quick Brown Fox</i> (Quick Brown Fox)	—	3 <i>HES Mon</i> (HesWare)	3
4 <i>Inventory Management</i> (Timeworks)	—	4 <i>TOTL Label</i> (TOTL)	6
5 <i>Money Manager</i> (Timeworks)	4	5 <i>Household Finance</i> (Creative Software)	1
6 <i>TOTL Text</i> (TOTL)	10	6 <i>TOTL Time Manager</i> (TOTL)	—
7 <i>Household Finance</i> (Creative Software)	8		
8 <i>HES Writer</i> (HesWare)	7		
Commodore 64 Educational		VIC-20 Educational	
1 <i>Facemaker</i> (Spinnaker)	2	1 <i>Primary Math Tutor</i> (Commdata)	—
2 <i>Kids On Keys</i> (Spinnaker)	—	2 <i>Touch Typing Tutor</i> (Taylormade)	2
3 <i>Word Race</i> (Don't Ask)	—	3 <i>Square Pairs</i> (Scholastic)	—
4 <i>Dungeons of the Algebra Dragons</i> (Timeworks)	—	4 <i>English Invaders</i> (Commdata)	—

Continued on page 56.

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As Commodore hardware prices continue to drop, the software market spreads out even more. New owners are discovering old favorites that had begun to lose their positions on our HOTWARE list. This month, we see a resurgence in popularity for some of these programs, and some surprise debuts by others.

Commodore 64 HOTWARE

Epyx continues to maintain its presence in the entertainment category. *Jumpman* claims the No. 1 position for the third month in a row; *Temple of Apshai* and *Sword of Fargoal* take fifth and sixth. Though it did not make the list, *Upper Reaches of Apshai* sales reportedly picked up again. HesWare's *Gridrunner*, after falling off the list two months ago, is back up in the No. 3 spot. And Commdata returns with three games in positions eight, nine, and ten: *Supercuda*, *Pegasus Odyssey*, and *Pakacuda*.

Appearing for the first time are Avalon Hill's *Telengard*, a multilevel adventure game, and *Fort Apocalypse*, by Synapse, an underground helicopter rescue adventure.

Four of the eight best sellers in the home/business/utility category are word processors. Holding the No. 1 position for the third month in a row is Professional Software's *WordPro 3 Plus/64*. *Quick Brown Fox* has appeared on the list before in the VIC-20 business category, but appears this month for the first time in the No. 3 position for the Commodore 64. *TOTL.Text* and *HES Writer* continue to fare well.

Turtle Graphics, which came in third on the September list and dropped off last month, is back again — this time in the No. 2 spot.

Spinnaker again claims the top two positions in educational software with *Facemaker*, last month's second-place finisher, and a new entry, *Kids On Keys*. Debuting in third and fourth place are *Word Race*, by Don't Ask Software, and *Dungeons of the Algebra Dragons*, from Timeworks.

The educational software market is beginning to spread out as lots of new programs are being introduced and tested by consumers. It's difficult to dominate in a situation like this. It will be interesting to see if the leaders can continue to hold their positions.

VIC-20 HOTWARE

Creative Software's *Choplifter*, which has held the No. 1 position in the entertainment category for the last three months, has finally been knocked out of first place by HesWare's *Gridrunner*, which has also been on the list since HOTWARE premiered in August. Commdata, which made a comeback on the Commodore 64 list, takes third and fifth place with *Escape MCP* and *Ape Craze*. Star Tech debuts with *VIC Men*; *Amok*, by UMI,

and *Apple Panic*, by Creative Software, make return appearances.

Quick Brown Fox regains its No. 1 spot in the home/business/utility category after disappearing from September's list. The remaining positions, with the exception of Creative Software's *Household Finance* in fifth, belong to HesWare and TOTL Software. TOTL's *Time Manager* appears for the first time.

Commdata and Scholastic are fast becoming contenders in the VIC-20 educational category. Commdata takes first and fourth positions with *Primary Math Tutor* and *English Invaders*. Scholastic debuts with *Square Pairs* in third, and Taylor-made's *Touch Typing Tutor* moves up a notch to claim second.

Honorable Mention: Terminal Software

We don't have a specific program to rank in this area, but telecommunications is fast becoming a common use for home computers. Several sources mentioned to us this month that terminal software packages are very popular. None has taken the lead so far.

The Changing Marketplace

Our HOTWARE sources are valuable to us in two ways. First, the figures. In order to produce a credible, balanced list, we get monthly unit sales figures that range from ten units a month to thousands. Of course, the greater the monthly volume, the more weight they carry in our calculations.

But this is not to say that our sources who do not move a great deal of software every month are not as important. What we learn from them is how consumers feel about what is going on. Distributors generally do not spend a lot of time talking to individual users. But owners of small computer retail stores do — they know what frustrates, aggravates, and delights their customers. And they must respond to their customers' needs quickly in this market.

Our sources who manage small computer retail stores are responding to the changing demands in several different ways. Some have retreated from the software business entirely in the face of discount competition from mass merchandisers. Some have dropped only their lower-end hardware and software, and returned to concentrating on business and higher-end personal systems. One source moved her business to another part of the country to see if the market was any more receptive there. And one source in the Midwest, who got the jump on the low-end market in her area, is moving into larger quarters and offering both sales and service. ☐

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Dale Disharoon & Jim Bach

The Programmers Behind *Hey Diddle Diddle*

Kathy Yakal, Editorial Assistant

Microcomputers have enormous potential as educational tools. Some schools have been using them for years; home computer owners are beginning to explore the educational possibilities of their machines, too. Here's a look at a very popular educational program – Spinnaker Software's *Hey Diddle Diddle* – and the programmers behind it.



Jim Bach (left) and Dale Disharoon jamming in the backyard.

Up to now, the toughest competition for commercial software has been in the area of games and business programs.

Up to now, that is. In the last few months, companies that had previously ignored the educational market are vying for positions in the educational categories of best-seller lists, and new companies are starting up to fill the gaps in the market.

A good example of the latter is Spinnaker Software Corporation, recently organized to

publish entertaining educational software for home use. Spinnaker currently has several programs that are being hailed by many retailers, distributors, and users as the best they've seen yet. Two programmers are responsible for one of Spinnaker's biggest successes, *Hey Diddle Diddle*: Dale Disharoon, 27, and Jim Bach, 17.

Tired Of Teaching

Disharoon's involvement with educational software began about three years ago when he was teaching a

combined class of kindergarten, first, and second grade at a small school in Manchester, California. The school had bought an Atari 800 for the students to use; Disharoon bought an Atari 400 to learn programming on his own.

Soon, he started writing computer programs that replaced some of the more repetitive lessons he had to teach every year. To Disharoon, the process of creating a lesson was valuable, but he

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grew tired of teaching some of the same lessons time after time.

Disharoon realized he had a knack for creating good educational programs due to his background in teaching and his newly acquired programming skills. He began to sell his creations, first to the Atari Program Exchange (an Atari-managed collection of user-written programs), then to The Learning Company, and, finally, to Spinnaker Software.

Tired Of Teachers

Enter Jim Bach, a teenager from upstate New York who was pretty discouraged with the traditional educational system. So discouraged, in fact, that he dropped out of high school, and then was asked to move out of the house by a father who couldn't understand his son's passion for computers and lack of interest in traditional schooling. Ironically, it was Jim's father who had sparked his interest in computers by buying him an Apple three years before. "Everything I've done has been inspired by my father," says Bach.

Bach's father, incidentally, is Richard Bach, author of the best-selling book *Jonathan Livingston Seagull*.

Jim Bach and Disharoon met when Bach was working for an office supply store in Iowa, writing and reviewing programs. Disharoon had been looking for someone to translate his programs, and Bach was looking to get into the commercial software business.

"I'm in training right now," explains Bach. Disharoon creates the concept and initially programs a new educational game on his Atari, then Bach translates the program for Commodore computers.

"When I was learning about Commodore, I got a Toronto phone book and called every Butterfield in the book until I found [Commodore expert] Jim Butterfield," says Bach. "He was extremely helpful in my learning process."

Recalling A Childhood Game

Disharoon got the idea for *Hey Diddle Diddle* from a school game he had played as a child. Someone would write a familiar poem on a large piece of paper and cut it up so each line was separated. Students would queue up in front of the class, each holding one line of the poem, and the class would rearrange them so the poem was restored to the right order.

"The game actually helped students in three different areas of understanding: reading, logic, and poetry," says Disharoon.

In Disharoon's version, *Hey Diddle Diddle* contains 30 eight-line poems that the player has to rearrange. A line lights up on the screen, and the player uses a joystick to move it to the correct



A screen from *Hey Diddle Diddle* on the Commodore 64.

place. When the verses are finally rearranged, a picture illustrating the poem (drawn by Santa Barbara artist Robin Bush) appears on the screen and a song plays.

Computers As Teachers

Disharoon's most recent project for Spinnaker was *Alphabet Zoo*, introduced at the Summer Consumer Electronics Show held in Chicago in June. "Basically, it helps accomplish what kindergarten and first-grade teachers spend a whole year doing: teaching the alphabet and how to read," says Disharoon.

Yet he does not believe that computers can or should replace human teachers. "When I was teaching, I liked to sing and dance with the kids and help them get to know each other," he says. "There are very important social aspects of education that computers cannot handle."

Bach agrees that computers may be capable of taking over many of the repetitive tasks now performed by teachers. "Before that happens, though, computers have to be a lot less technical and foreign," he says. "They will have to contain a tremendous amount of knowledge and actually be able to teach. Most educational programs that are available now, with the exception of CAI [Computer-Aided Instruction], don't actually teach – they just let you practice something you already know."

Bach says he might have stayed in school longer if educational computer technology was more sophisticated, and if he had been allowed more freedom to learn by using computers.

What's Educational?

Three elements are necessary to make an educational program, according to Disharoon: it must

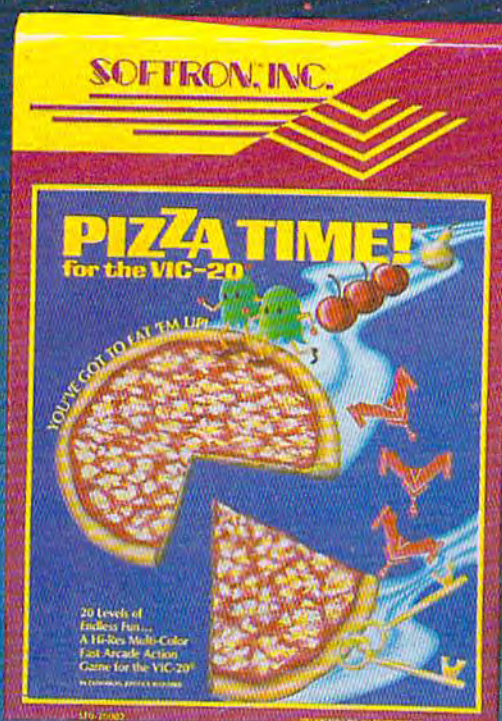
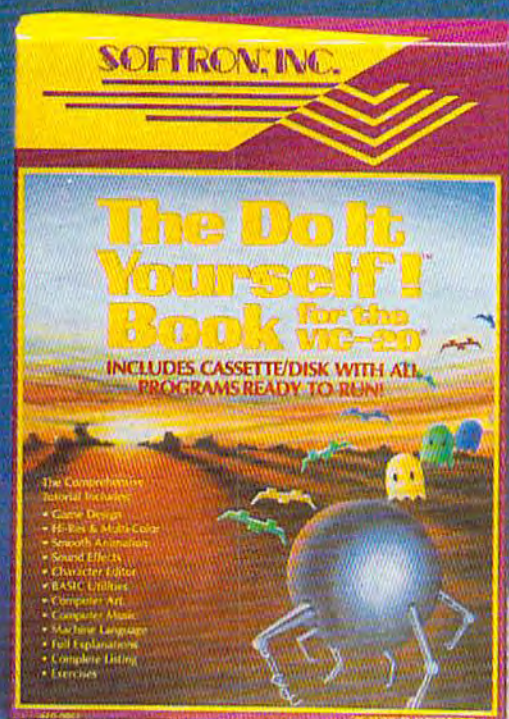
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teach, be fun, and be easy to use. "Some educational software is too game-like and not educational enough. And some is just like a book on a computer — all text." Disharoon tries to achieve a happy medium.

He also tries to write games for children that he himself likes to play. "After you've written a program, you end up playing it hundreds of times while you're refining it," he says.

Disharoon's next project is an adventure game in which the player can program the actual environment of the game. It will use a combination of text and graphics; all the rooms, creatures and other variables can be created and edited by the player. The game will be suitable for ages 12 and up.

Does Disharoon consider this an entertainment or educational game?

"The act of anything where a child creates is educational," he says. ■

Programmers

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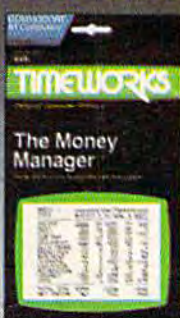
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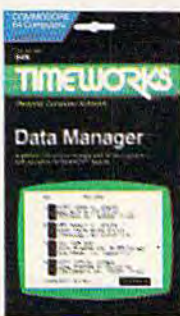
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Chicken Little

Jeff Wolverton



"Chicken Little" is an action game for the unexpanded VIC-20 and Commodore 64. The author, who is 15, wrote the original program for the VIC. VIC users should be sure to read the section headed, "Special Instructions."

Probably everyone is familiar with the childhood tale of Chicken Little. It is, of course, about the little chicken who was hit on the head by an acorn and then jumped to the conclusion that the sky was falling. (Though that reaction may seem a bit neurotic, the story caught on.)

The game "Chicken Little" is a simulation of the tale. But in this re-creation, the sky really is falling. Your goal is to keep too many fragments from tumbling to the ground. You'll have to be nimble on your feet and adept at hurling stones to survive unscathed.

How To Play

In the VIC-20 version, you control Chicken Little with four keys: I=Up, M=Down, J=Left, and K=Right. Because the program scans the keyboard with the PEEK statement instead of GET A\$, you can hold down a key for continuous movement.

The Commodore 64 version uses a joystick plugged into port one instead of the keyboard.

Chicken Little's vertical movement is restricted to the bottom four lines of the screen, and horizontal movement to the screen's width. The top line is reserved for the score and number of chickens left (you start the game with three chickens). The rest of the screen is filled with 30 randomly placed pieces of sky.

Detailed instructions are included in the program, but I'll summarize them here.

Basically, pieces of sky — blown around by wind — fall down at you randomly. To protect yourself (and to save the world), you must hit them with stones. On the VIC, press the space bar to throw a rock; on the 64, press the joystick fire button. You can also heave rocks at stationary pieces of sky before they start falling. If more than eight pieces of sky get by you and hit the ground, the sky has fallen and the game is over.

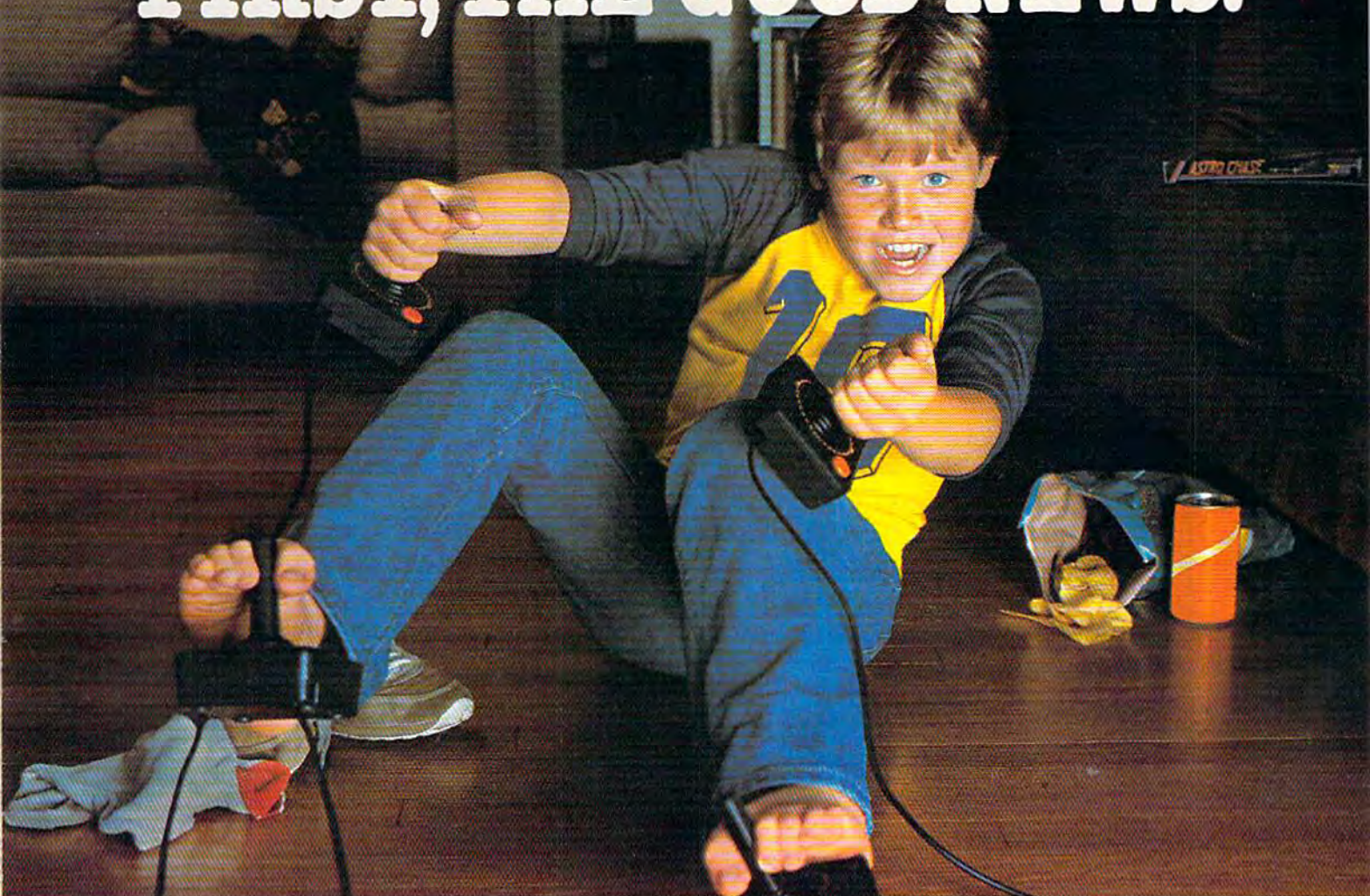
Each time you clear the screen of sky fragments, you advance to the next level and the sky falls faster. Also, with each new level, the number of pieces that can fall before the game ends is decreased by one. On the unexpanded VIC, it's possible — if you're very good — to run up a score so large that you'll overflow the memory. But even if you're that good, it would take a long time.

Special Instructions

The VIC version of Chicken Little is broken into

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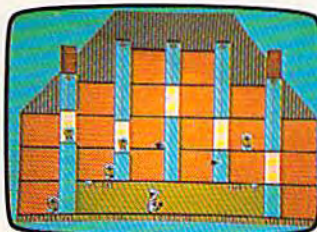
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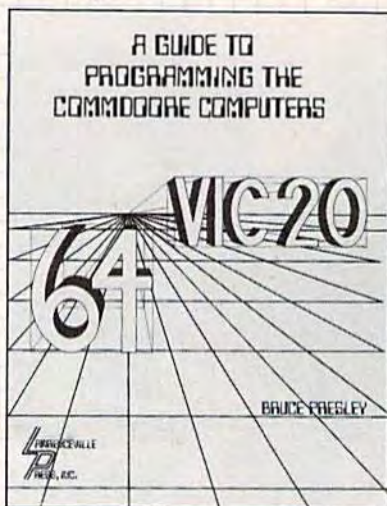
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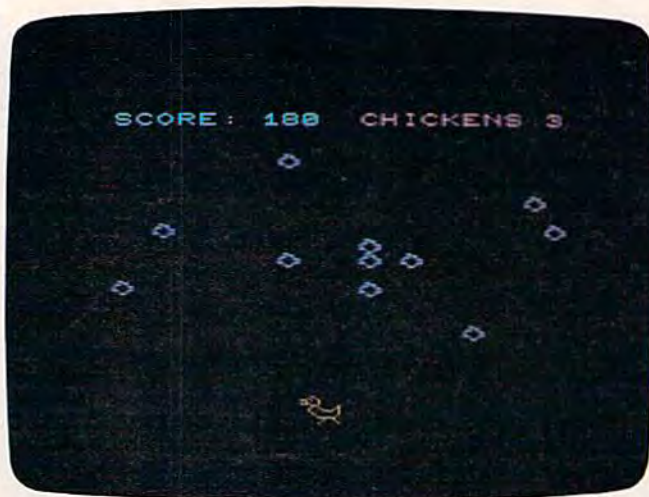
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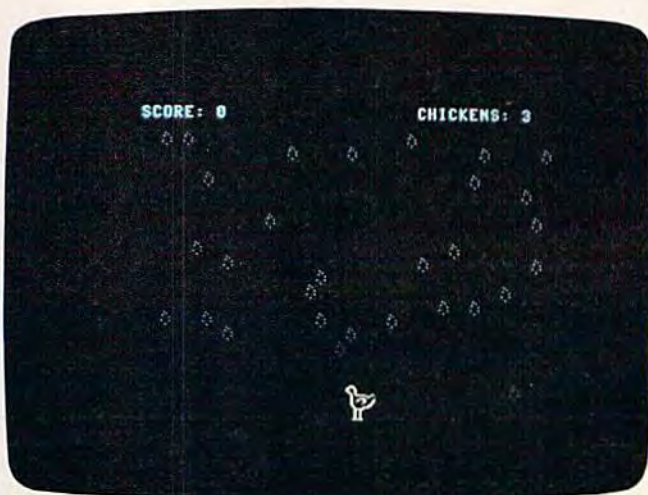
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The sky is falling in large chunks toward Chicken Little (VIC version).



"Chicken Little" on the Commodore 64.

two parts to save memory. The first part (Program 1) prints instructions and loads a custom character set of 12 characters. If you're using tape, it then automatically loads and runs the next part (Program 2), which contains the actual game.

Tape users: Type Program 1 and SAVE it on cassette. Then type NEW, enter Program 2, and SAVE it on the same tape immediately after Program 1.

Disk users: SAVE both programs on the same disk. RUN Program 1. When the screen says, "Press Play On Tape," press RUN/STOP instead (but not RUN/STOP-RESTORE), and LOAD Program 2. Type RUN and the game will start.

Because of the Commodore 64's larger memory, it was possible to combine the 64 version into a single program that requires no special loading.

See program listings on page 182.

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Martian Prisoner

Adventure Game For VIC And 64

Alan Poole

"Martian Prisoner" is a mini-adventure game for the unexpanded VIC-20 and Commodore 64. If you've never played an adventure game before, this is a good introduction. Unlike most computer games, text adventures have no graphics and do not require fast reflexes — instead, they test the player's patience and cunning.

Without warning, the Martians have suddenly started a devastating war against Earth. They have captured you and are holding you prisoner in a cell on a Martian space cruiser headed toward Earth. The cruiser also carries a secret weapon that can neutralize all of Earth's defenses. Your task is to destroy the Martian ship and escape in a lifecraft before the Martians can complete their sinister mission.

Like Radio Dramas

"Martian Prisoner" is a mini-adventure game, about the most that can be squeezed into an unexpanded VIC. Adventure games require you to solve puzzles and explore a simulated world inside the computer. The computer will describe what you see and what happens, and you tell the computer what you want to do. Instead of using screen graphics, adventure games rely on text descriptions and your imagination. It's like the difference between old-time radio dramas and television; despite the visual impact of video, the mind can still imagine a scene more exciting than a camera can picture.

In *Martian Prisoner*, you start off in the prison cell of the Martian space cruiser. Besides the cell, the cruiser contains several other rooms. It's up to you to explore the rooms and find a way to destroy the ship. In each room, the computer will describe your surroundings and list the objects in

WE INTERRUPT THIS AD TO BRING YOU THIS IMPORTANT PROGRAM...

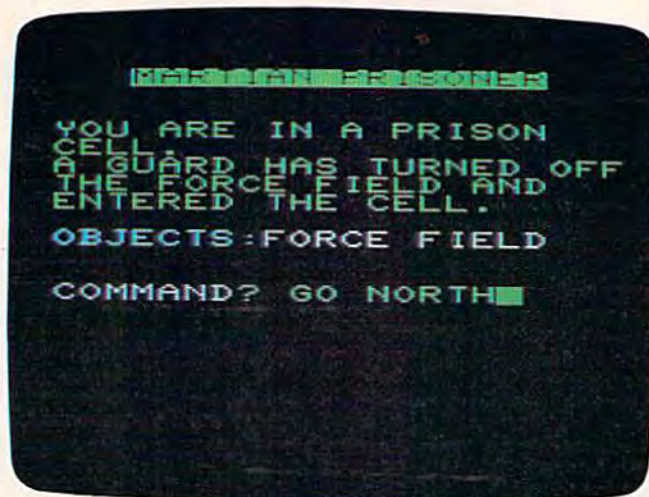
Now you could add **your** program to the rapidly expanding list of MMG Software with MMG's **Write Your Own Program Contest!** Each month a program will be chosen and developed from the entries and suggestions sent in by **you** and best of all, the winners will receive royalties from the sale of their entry. You don't have to be a computer whiz to enter, so see your local retailer who carries ATARI products for details. FINAL FLIGHT is only one of the many exciting and useful programs for the ATARI system now available from MMG Micro Software that are designed with you in mind. At MMG, we believe that people are as important as the programs they use.



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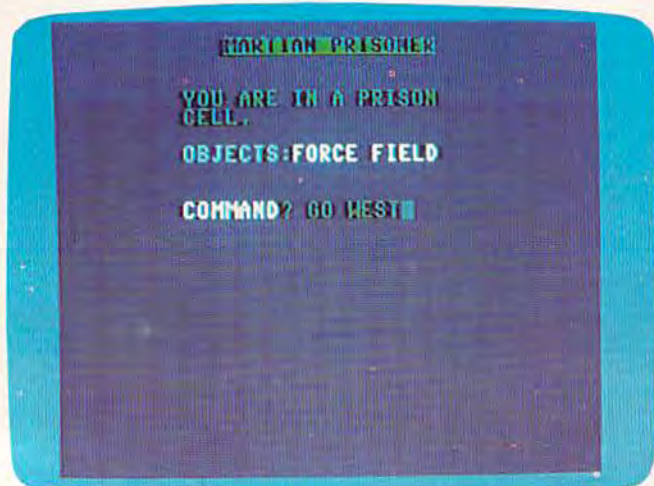
"Martian Prisoner" is a clever text adventure game that fits in an unexpanded VIC-20.

the room. The computer then waits for you to type a command, consisting of one or two words.

For example, you could type GO NORTH to move north. If there is a book in the room, you would type GET BOOK to pick it up. Type INVENTORY at any time to see a list of the objects you are carrying. All commands and nouns can be abbreviated to the first three letters. You can list your INVENTORY by typing INV, for instance.

Although Martian Prisoner is a short adventure game, you must solve several puzzles to win. It's a good way to prepare for the more elaborate adventure games available commercially for Commodore 64s and VIC-20s with expanded memory.

(Editor's Note: If, after hours of play, you're still stumped and desperate for the solution, write to COMPUTE!'s Gazette. Depending on the demand, we may publish a blueprint of the Martian cruiser and the solution to the game in a future issue.)



Starting a game of "Martian Prisoner" on the Commodore 64.

VIC Emulator For 64?


Well, sort of. Program 2 allows one version of Martian Prisoner to work on both the VIC-20 and Commodore 64. To adjust the 64's 40-column screen to simulate a 22-column VIC, 64 users should type in Program 2 in addition to the game listing. VIC users should not use Program 2. Program 2 creates a machine language program which forces the 64 to PRINT within a 22-column format. It will not support any other VIC functions, however. Martian Prisoner will work on the 64 without Program 2, but words will break in strange places and the text will be harder to read.

Be sure to save Program 2 on tape or disk before running it. When you type RUN, the routine activates itself. Should you need to reactivate it at any time, enter SYS 828. (By the way, this program might work on other all-text VIC programs, too.)

Tape Copies

If you would like to save the time of typing in Martian Prisoner, send a blank cassette, self-addressed mailer with postage, and \$3 to:

Alan Poole
4728 King Road
Loomis, CA 95650

See program listings on page 185. 

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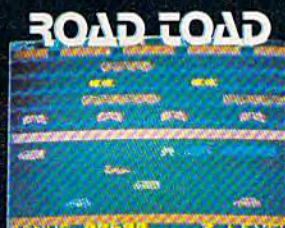


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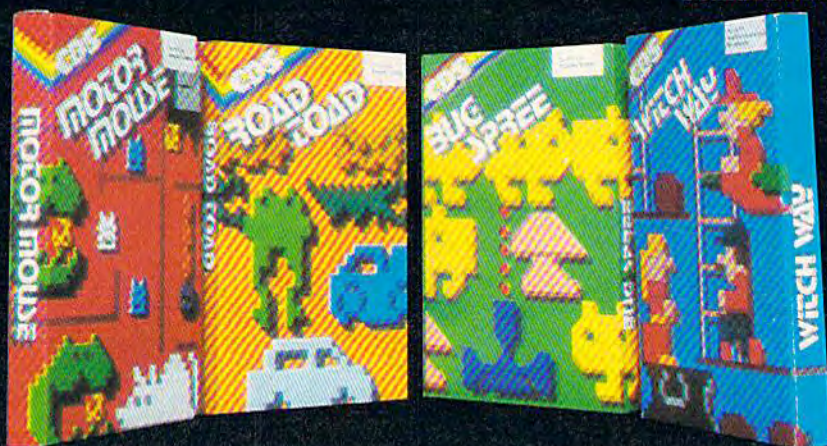


Can our hero make it across the freeway without getting that run-down feeling?

And if he does . . . does he know he can't swim?!?

It's the thrill of victory and watch out for the alligators!

Keep your eyes open — there's a tasty treasure in cheeses just ahead! But . . . there's hungry cats around every corner! One wrong move, and you're hickory dickory dead!



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There's A Creature In My Computer!

The Lobsters Under My Bed

When I was a kid I used to go to sleep at night with my hands pulled up inside the sleeves of my pajamas, and my feet tucked inside two layers of socks and a pair of slippers. I did this to hide my fingers and toes from the lobsters that lived under my bed.

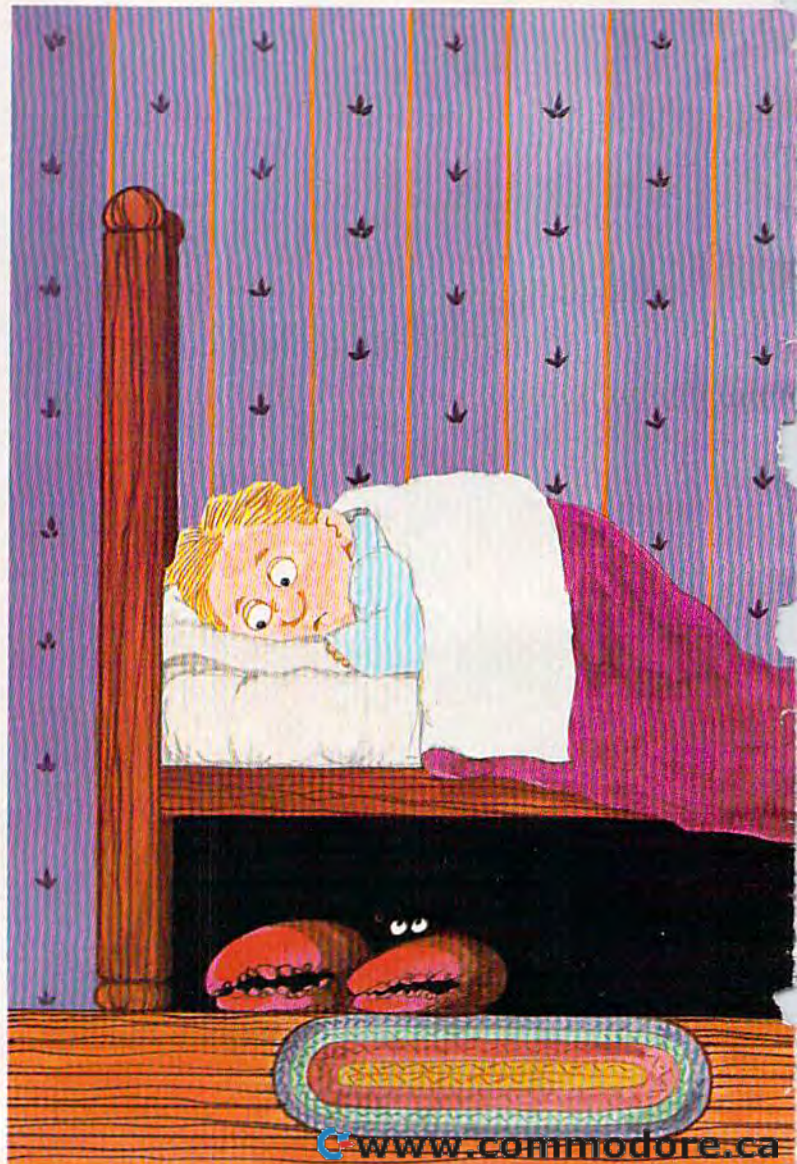
These lobsters weren't just average creatures. First, they didn't need to live in water. Instead, they could somehow survive under my bed — along with lint, dust, dirty clothes, copies of *Mad* magazine, science fiction books, and potato chip crumbs.

Second, if they got hungry, they didn't look for regular lobster food. Instead, they liked to munch on crumpled, smelly socks. (There were lots of those under my bed.) But their favorite food was fingers and toes — *dirty* fingers and *dirty* toes.

I went to bed at night convinced that lobsters really did live under my bed. I was afraid that if I fell asleep and accidentally let my hand or foot slip over the side of the bed, one of the lobsters would leap out, pinch it off, gobble it up, and disappear back under the bed.

The lobsters had never been known to attack clean fingers and clean toes. But I never considered taking a bath. Instead, I bundled up my toes and fingers, and slept in bed all scrunched up like a sunburnt spider. If a lobster wanted to make a meal out of me, it was going to have to work for it.

I shared my bedroom with several lobsters. But we weren't alone. There was also a nightmarish creature who lived underneath my



dresser. He would come out from under the dresser when my mother turned out the hall light. He always hid in the shadows. In fact, he *was* a shadow. Real slithery, dark, and tricky. He was all body. No head.

And then there was the creature that lived in my closet behind my dress shirts and Sunday school pants. I called him the Closet Beast. He was one of those shy creatures. He only came out at night when I wanted nothing to do with him. During the day he probably killed time pretending to look like a bow tie or the pair of brown dress shoes I hated.

Between me and all the creatures, the bedroom was crowded. I wished that some of the bedroom creatures would move out. But if they had they would have bumped into the creatures in the other parts of the house. The worst of these was the Ghoul who lived in the cellar, underneath the stairs.

I hoped and prayed I would never meet the cellar Ghoul. But one night I came very close. It all happened because I was a sleepwalker. I was so bad that my mother had to bolt all the win-

dows each night before she went to bed. She was afraid I might climb out one of them and try to sleepwalk on the two-foot ledge that rimmed the roof.

Thanks to my mother I never did any sleepwalking on the roof. But I did sleepwalk a lot inside the house. And I sometimes ended up in some pretty strange places.

One night I woke up and immediately knew something wasn't right. I had my pillow and was wrapped up in my blanket like a mummy, but I wasn't in my bedroom any longer. I was someplace else, someplace very, very dark. And damp. And moldy smelling.

I rubbed my fingers on something hard underneath me. I realized I wasn't in bed. I was on a dusty concrete floor — the basement floor. And I was right next to the stairs where the Ghoul lived.

As dark as the basement was, the space under the stairs was even darker. I couldn't see anything, but I could sense that I was not alone. Something was there with me. And it was coming closer.

I screamed. I screamed again. And again.

I woke up the whole house with my screaming. Moments later, the basement light came on. My parents came flying down the stairs and found me huddled under my blanket, wailing like a ninny.

When they dug my head out of the covers, I pointed toward the stairs. My parents investigated. They didn't catch the Ghoul. But, they did find, hiding under the stairs, a very scared kitty cat.

There's A Creature In My Computer!

I used to see creatures in every shadow or dark corner of my life. I saw so many creatures because I had a crazy imagination.

How about you? Do you have a crazy imagination like mine? Do you see ghosts in wisps of smoke? Do you see sleeping giants inside craggy mountains? Do you see fang-toothed monsters staring up at you out of gutters and hollow stumps of trees? Have you seen the skinny creature who lives inside your medicine cabinet — the one that feasts on stale toothpaste?

With a little imagination you can see creatures everywhere. And, with a little imagination, you can create a creature inside your computer. The creature (he, she, or it) might even be living there now. You just have to bring it to life.

The Ghosts In The Machine

Your computer is a perfect place for a creature to live. After all, it's already full of ghosts. The ghosts are other people's programs.

Some people think that programs are just abstract lists full of information and commands. These people are wrong. A program is — or can be — much, much more.

Every program that is written has a personality. Most computer programs written in the past had dull personalities. But they don't have to be dull.

Where does a program's personality come from? It comes from its creator, the person who thought it up and typed the commands into the computer.

The program is a reflection of its creator's imagination.

If the person has a dumpy, dull sort of imagination, then the program will be dull. It might have the personality of a stuffed shirt or toad. Most business programs have toady personalities.

On the other hand, if the person's imagination is creative, weird, and funny, then the program will be creative, weird, and funny, too. (Does this remind you of a few game programs



you have played?)

Programs are the ghosts inside your computer. So why not turn them into real ghosts, goblins, ogres, zombies, dragons, and other creatures? You can take the creatures that live inside your imagination and load them into your computer. To create the creatures you just write a program. To bring them to life you just type RUN.

Turn On Your Imagination

Warning: If your imagination is having a bad day, you'd better stop here and wait. The creature we're going to create this month is 99 percent imagination and only 1 percent program. The creature is simple, but it can still seem real — if you use your imagination.

A Simple Creature

Turn on your computer and type:

```
20 PRINT "GRRRR!!!" [Press the RETURN key.]
```

You have just created a creature inside your computer. You don't know what it looks like. You don't know if it wears a ski cap and orange polka-dotted socks, or how many warts are on its nose. But you do know two things: it's there and it's not very friendly.

To see if I'm right, type RUN (and press RETURN). What does the creature do? It says:

GRRRR!!

Not too friendly, is it?

What happens if you add a new line to the creature's program? For example, type:

```
30 GOTO 20
```

Now type RUN. What happens? This time you see:

**GRRRR!!
GRRRR!!
GRRRR!!
GRRRR!!
GRRRR!!
GRRRR!!
GRRRR!!
GRRRR!!**

Now you've created a creature that is *really* unfriendly! (To stop the creature from growling, press the RUN/STOP key.)

So far, the only way to get your creature's attention is to type RUN. But you might want to say something to the creature. To do this you have to teach the creature to *listen*. To make it listen, type:

```
10 INPUT A$
```

Change line 30 to say GOTO 10. Your whole program now looks like this:

```
10 INPUT A$  
20 PRINT "GRRRR!!!"  
30 GOTO 10
```

Type RUN.

The program begins running, and the creature wakes up. He is looking at you. He is waiting for you to say something. (The computer has printed a "?" on the display screen. Imagine that the creature is sprawled in a dungeon inside the computer. He is just waking up. He looks dazed, and has a big "?" over his head.)

This is your first chance to say something to the creature. In fact, he won't make a move until you say something.

But what do you say to a creature?

You can try insulting him by saying something like:

YOUR FEET SMELL!

Or you might try giving him a command like: **DON'T EAT ME!**

Or, you can try to be friendly and ask the creature a question, such as:

DO YOU LIKE PIZZA?

Think up a message, type the message, then type RETURN. What is the creature's answer? He says:

GRRRR!!

He says "GRRRR!!!" because it's the only thing he knows how to say. He's a very dumb creature. No matter what you tell him, he always growls. He's a real grump.

To make him say something else, you have to teach him. What sort of new things can you teach your creature to say? What sort of things can you teach your creature to do?

Next Time: New Creatures

This time we created a very simple creature. Next time we'll see how we can create a creature that surprises you. He'll make scary creature sounds. And he'll have a creature face.

I'll help you build creatures and turn them loose on other members of your family. But I'd really like to see what creature you can come up with on your own.

Write a short program and make a creature. Then, no matter how crazy the creature is, send it to me. Send it to:

Fred D'Ignazio
2117 Carter Road, SW
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Dream up strange, funny, and unusual creatures, then turn them into programs and send them to me. I'll print the best programs in this column.

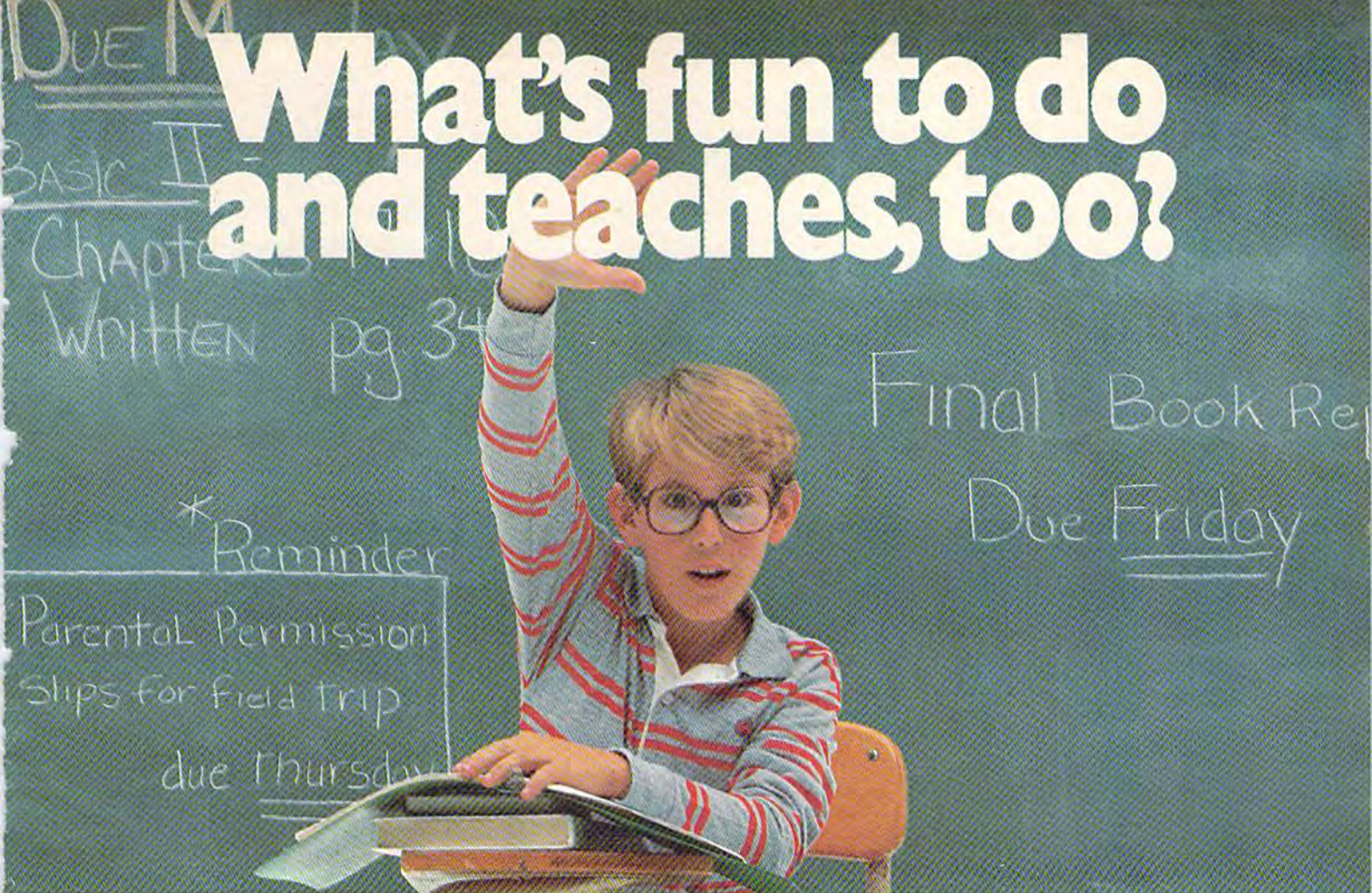
Be like a magician pulling rabbits out of a hat. Pull the creatures out of your imagination. Then pop them in the computer and bring them to life.

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Don't send any lobsters. ☹

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Munchmath

Gerald R. Anderson

"Munchmath" is an above-average math drill program that entertains as it teaches. Because of its multiple difficulty levels, it is suitable for a wide range of ages. There are versions for the unexpanded VIC and Commodore 64.

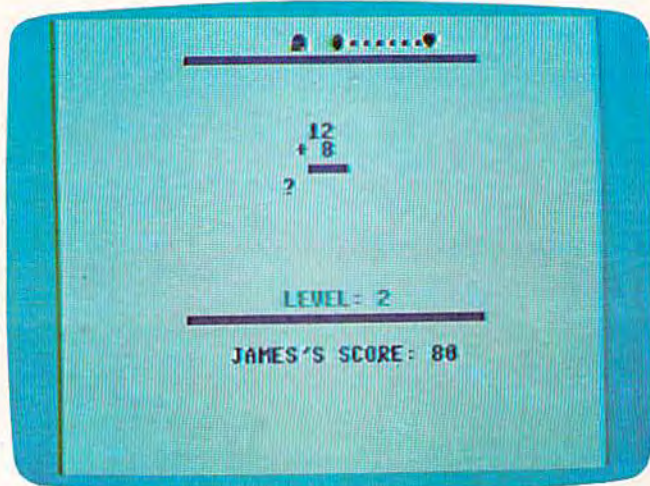
To keep a young person's interest, an educational program has to be fun to play. "Munchmath" presents an arcade-style character that relies on the player's correct answers to math problems to stay ahead of a ghost that is trying to gobble him up.

The program begins by asking for the player's name, the type of problems wanted (addition, subtraction, multiplication, or division), and the starting level of difficulty. Problems are then presented on the screen for the player to answer. Each correct answer scores ten points and moves "Munchie" one step closer to the power prize.

The ghost, however, stays in hot pursuit only three steps behind. After 15 correct responses, Munchie eats the power prize and the tables are turned. Munchie chases the ghost across the screen, eventually catching him and scoring a bonus of 100 points. The difficulty level then advances one notch higher and new problems are presented.

The ghost moves into action when the player gives a wrong answer. First, the correct answer is displayed for the player to study. Then the ghost advances one step closer to Munchie. Three incorrect answers and the ghost catches poor Munchie and gobbles him up. This results in a loss of 50 points and a return to the next lower level of difficulty.

If a Q is typed in response to a problem instead of a number, the game stops. A scoreboard is printed which shows the number of problems the player has been given, the number answered



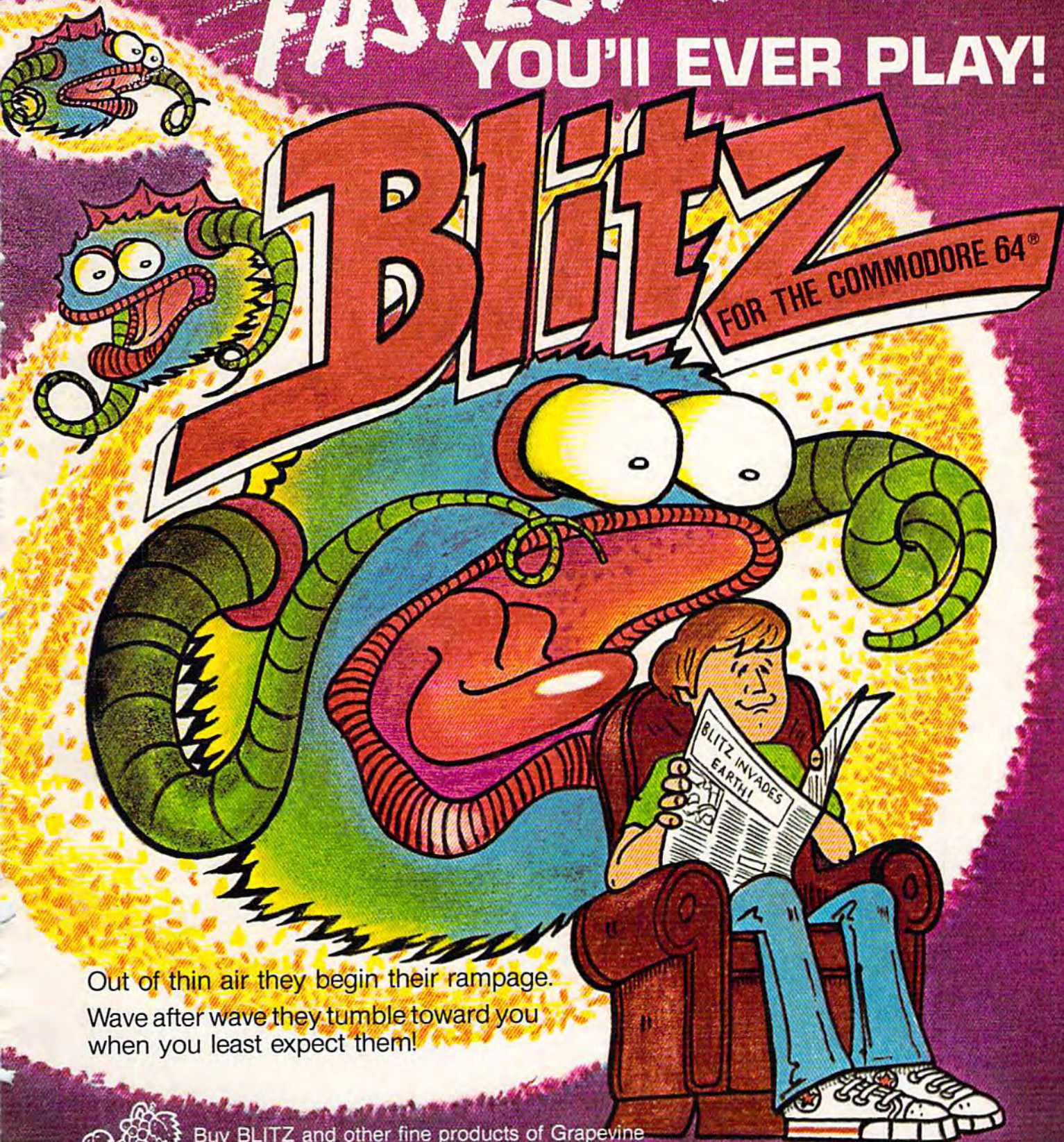
Practicing simple addition with "Munchmath," 64 version.



Practicing easy multiplication with the VIC version of "Munchmath."

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correctly, the number answered incorrectly, and the percentage of correct answers. The player may then choose to resume the game or to end play.

The program has been extensively tested by my six- and eight-year-old daughters, as well as the neighborhood children, and its appeal holds up very nicely.

Munchmath fits neatly into an unexpanded VIC. (There's also a version for the 64.) It uses custom characters, so you should remove any memory expanders you may have on your VIC, unless you know how to rearrange the memory.

If you want to avoid the drudgery of typing in the program (VIC version only), send a blank cassette, a stamped, self-addressed envelope, and \$3 to:

Bob Wallace
6649 Thunderhead Lane
Placerville, CA 95667

(Since I'm in the Navy and frequently gone, my friend Bob Wallace has volunteered to make copies.)

Program Description

Here's a breakdown of the program (VIC version):

Lines 10-35: Initialization and delay subroutines.

Lines 40-50: Answer-checking.

Lines 55-60: Print titles computer-style.

Lines 65-145: Generate problem and print it in proper format.

Lines 150-180: Ghost catches Munchie. Generate sound effects, subtract 50 points, and reduce difficulty level.

Lines 185-235: Munchie reaches the power prize and chases the ghost. Bonus of 100 points, advance to next level.

Lines 240-255: Move Munchie and Ghost.

Lines 260-275: Print level and score. Clear old answer from screen.

Lines 280-300: Print scoreboard at end of game. Restart or end program.

Lines 305-345: Special characters.

Lines 350-385: Titles.

Lines 390-445: Get player's name, choice, and level.

See program listings on page 186. ☐

Young People

COMPUTE!'s Gazette wants to know what today's young people are doing with computers. We want our readers to know, too. If you've written an interesting program for the VIC-20 or Commodore 64, share it with us.

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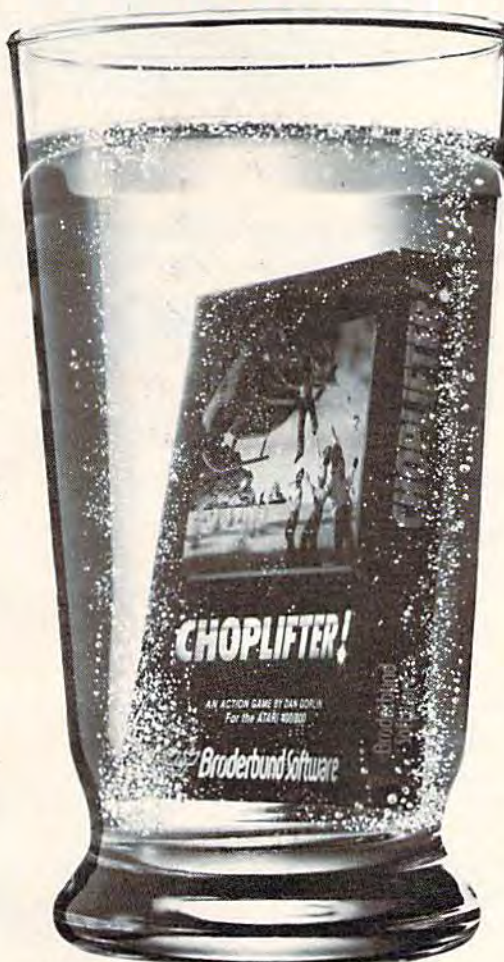
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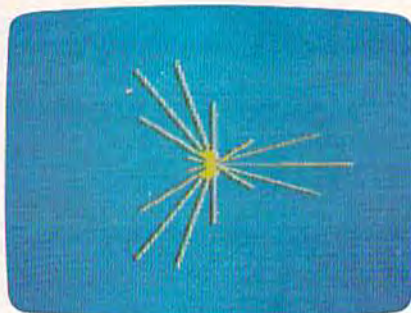
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VIC Super Expander Graphics

Kenneth Knox

Want to see some stunning graphics on your VIC? If you have a Super Expander cartridge, type in this short program and you might be surprised to see what effects are possible.

Here's how you can show off the amazing graphics which can be created with the VIC-20 using the Super Expander cartridge.

Polar figures, in which the points are part of a circular function, may be formed in many ways. In lines 120, 140, and 150 of this program, we see one way to generate unusual point curves. Chords (lines connecting points of a point figure) are drawn using selected points. This program combines these functions in an unusual way. When you type RUN, fascinating patterns are drawn continuously until you press RUN/STOP-RESTORE. Pressing RUN/STOP alone will freeze a pattern on the screen.

How It Works

Lines 40 - 70 — Initialization and graphics setup.

Lines 100 - 170 — Put points (x,y) into memory in an array and plot the points.

Lines 200 - 220 — Draw the patterns as a series of lines with selected points of the point figure.

Lines 230 - 250 — Utility parts of the program.

Several modifications are interesting. Replace line 40 with :

40 B=500:L=0


The new point figures now look much the same but are drawn differently. The line figures vary also.

Another option is to change line 100 to:

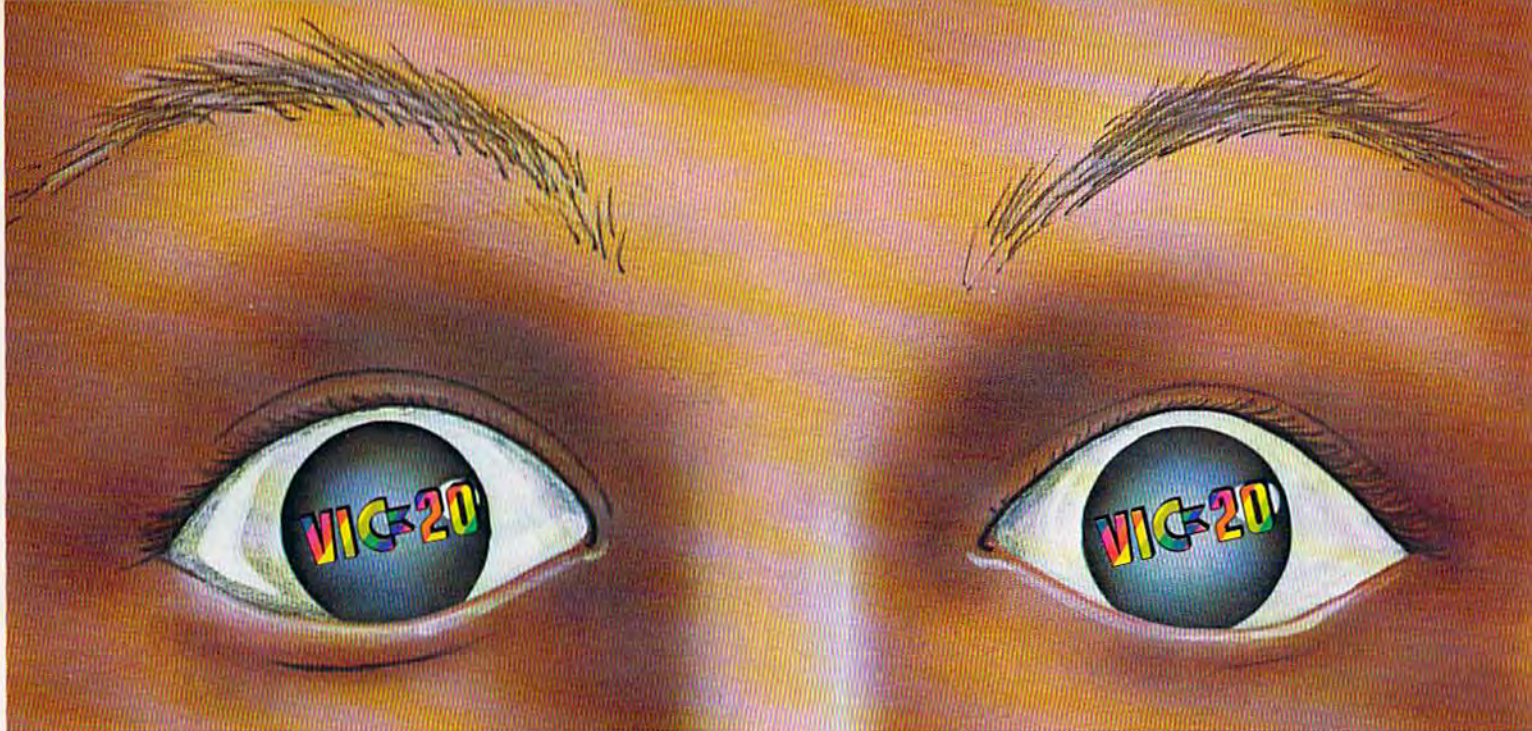
100 FOR Z=12 TO 20

This will create more complex point figures with symmetrical features.

There are no unusual techniques here, so it should be easy to recreate these figures on any computer with high-resolution graphics.

See program listing on page 195. 





"YOU WON'T BELIEVE YOUR EYES"



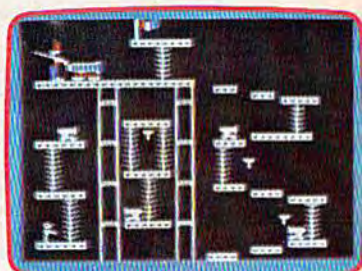
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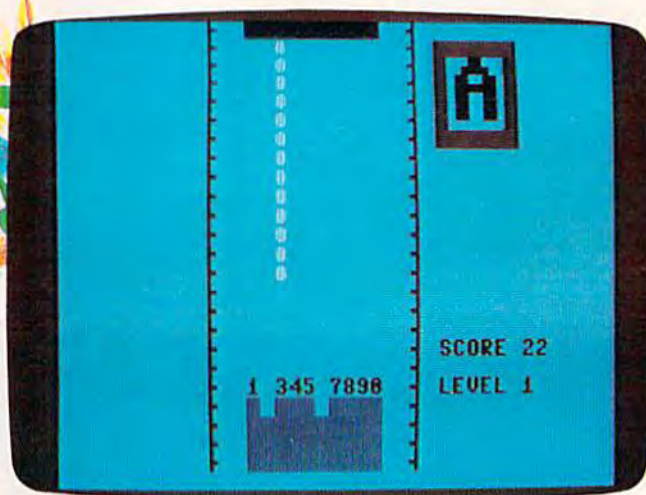
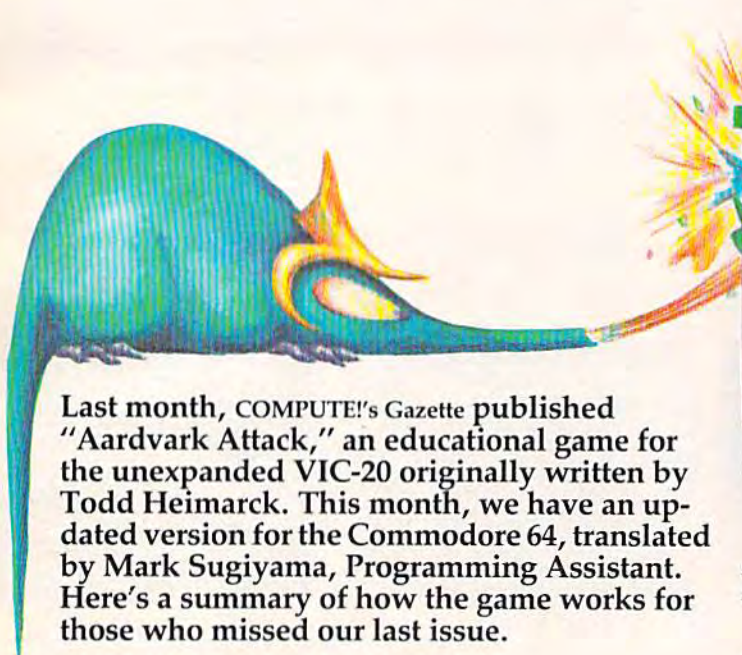


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64 Aardvark Attack



An "A-bomb" drops toward city number 3 in "Aardvark Attack" for the Commodore 64.

Last month, COMPUTE!'s Gazette published "Aardvark Attack," an educational game for the unexpanded VIC-20 originally written by Todd Heimarck. This month, we have an updated version for the Commodore 64, translated by Mark Sugiyama, Programming Assistant. Here's a summary of how the game works for those who missed our last issue.

Mutant aardvarks from Andromeda are attacking Earth with unique weapons — alphanumeric bombs. There are 26 types of bombs, and each requires a different defense on your part. Typing the letter M, for example, sets up the defense against M bombs. The same tactic applies to the other 25 letters of the alphabet.

The aardvarks are attacking Earth's ten largest cities, numbered 0 through 9. Once you set up the defense, you have to decide which city is being attacked.

Keyboard Practice

"Aardvark Attack" isn't designed to teach touch-typing, but it will give you practice on the keyboard if you're just learning to type. For youngsters, it can teach letter and number recognition.

Experienced typists should enjoy Aardvark

Attack, too. It uses the entire keyboard and includes variable speeds that will challenge anyone.

Rules Of Play

Your job is to type the correct letter, and then the correct number. The letter of the bomb about to drop appears in a "radar window" in the upper-right corner of the screen. When it appears, type it. If you miss, try again. When you get the right letter, the falling bomb reverses colors. Then you must look at the row of numbers representing cities at the bottom of the screen and type the matching number to destroy the bomb.

The selectable speeds range from easy to nearly impossible. The faster games award more points.

Parents or teachers can do the typing for very young children who are just learning their letters and numbers. The child can call out the letter or number for them to type.

See program listing on page 191. @



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64 Timepiece

Joe DiNicola

In the premier issue of *COMPUTE!'s Gazette* (July 1983) we published "VIC Timepiece," a clock program originally written for the unexpanded VIC-20 by Joseph D. Wright. A reader, Joe DiNicola, has translated the program to work on the Commodore 64. Following is an adaptation of the original article.

Here's something for your computer to do so it won't get bored when you're not using it. The program is patterned after the plastic rolling-ball clocks often sold in department stores and gift shops.

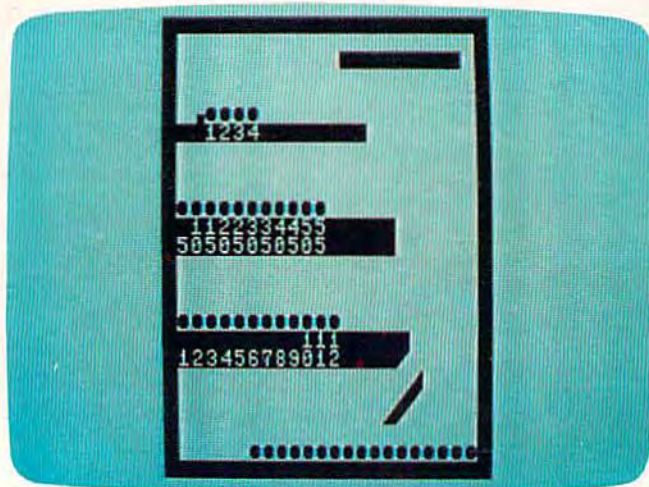
Unlike usual clocks, "64 Timepiece" keeps time by stacking balls on racks representing hours and minutes. Every minute, a ball from the bottom of the screen is carried to the top of the screen and rolled off the ramp. The ball falls onto the top

rack, where it represents one minute. When the rack accumulates five balls, four of them return to the bottom of the screen and one rolls onto the middle rack.

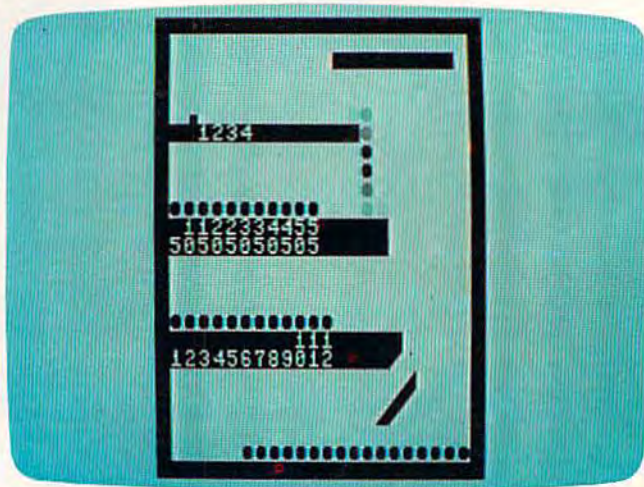
Each ball on the middle rack represents five minutes. When this rack fills up with 11 balls – and when the top rack overflows again – all balls but one return again to the bottom of the screen. The remaining ball rolls to the lower rack, where each ball represents one hour.

When the hour rack fills up with 12 balls – and when the two upper racks overflow – a chain reaction is triggered as all the racks empty into the bottom of the screen, leaving only one ball in the hour rack. This is the changeover from 12:59 to 1:00 (see photos).

To read the clock, you start with the lower rack and work your way up. Six balls on the lower rack mean it is at least 6:00. Then add up the balls



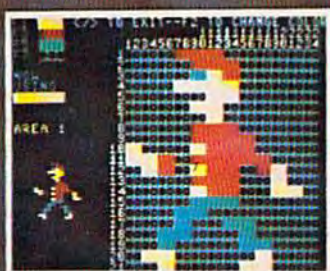
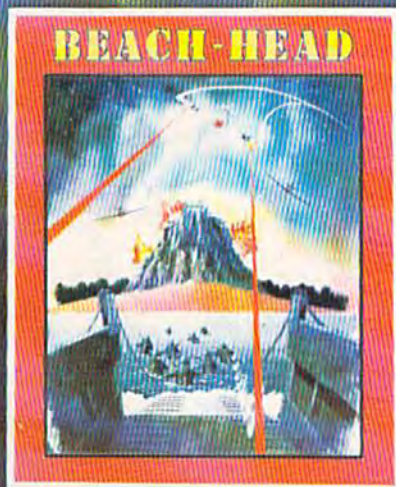
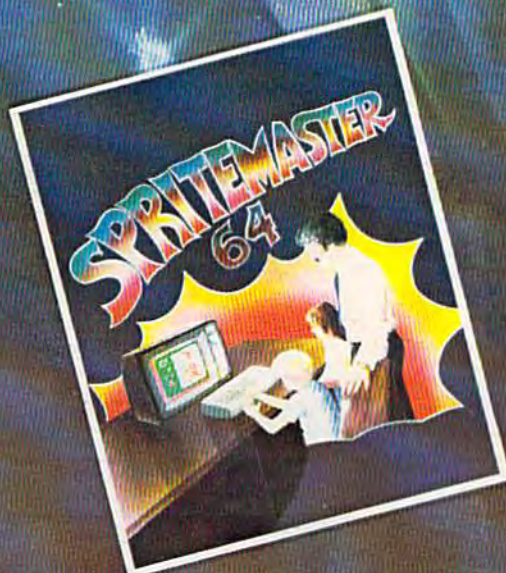
It's 12:59 – all the racks are filled with balls.



Balls from the top rack start tumbling down, triggering chain reactions on the lower racks...

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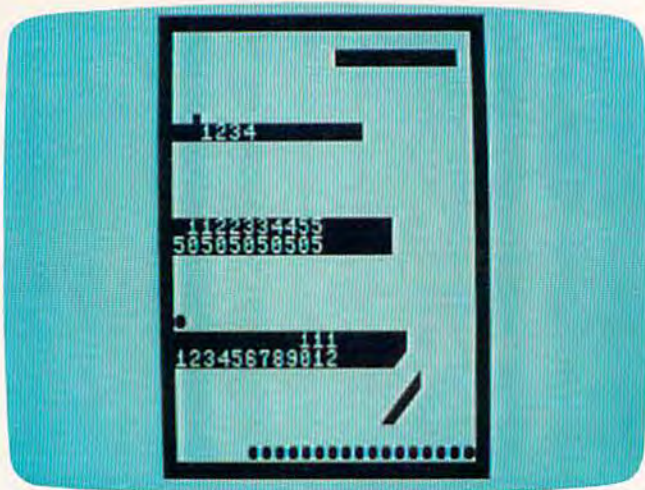
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...until all the racks are emptied, except for one ball on the hour rack - indicating 1:00.

on the two minute racks. If the middle rack is full, and if there are three balls on the upper rack, it is 6:58 ($55 + 3 = 58$).

When you first run 64 Timepiece, it asks you to set the time. Just follow the instructions and enter the correct time as a three- or four-digit number *without a colon*, such as 658 for 6:58.

See program listing on page 189. 

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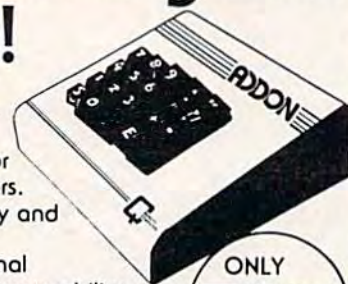
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Connect The Dots

Janet Arnold

"Connect The Dots" is an entertaining graphics program for young children who can locate numbers and letters on the keyboard. Originally written for the unexpanded VIC, we've added a version for the Commodore 64.

As teachers at a small private school, my husband and I saw the children anxious to get their hands on our VIC-20 computer whenever we brought it to class. Unlike many adults, who are hesitant to use it or even refuse to touch it altogether, the children jockeyed for their turn at even the duller programs we loaded.

I wrote "Connect The Dots" to provide my own children and my preschool/kindergarten students with a "game" that could entertain while reinforcing their skills at the same time.

Making Dots Into Pictures

Here's how it works. The child is given a four-item menu from which to choose the picture he or she wishes to draw. The greater the number of dots, the longer it takes to complete the picture.

A grid appears on the screen. Some of the squares contain markings. Tell the child to look for the solid dot, because that's what must be matched with the coordinates. When the prompt "Number?" appears at the top, show the child how to press the correct number coordinate and hit RETURN. Answering the next prompt, "Letter?", will probably take longer unless the child is familiar with the keyboard.

A wrong number-letter combination is answered with a low "uh-oh" sound and the words, "Try again."

After a correct answer, the computer draws a line connecting the dots and plays an amusing sound effect. A short timing loop delays this just long enough for the child to look from the keyboard back to the screen to enjoy this reward.

The finished drawing is accompanied by a

short tune and the remark, "Good job! Draw again?" Hitting a Y calls up the menu again. An N ends the program.

Working With The Child

When introducing this activity to a child, a few additional explanations may be necessary. Be sure to explain the difference between the number 0 — point out the slash — and the letters O and Q.

A tot whose visual discrimination is immature might reverse letters. Connect The Dots can give that child enjoyable practice in overcoming this. If you notice a child confusing 7 and L, for instance, ask, "Is that line walking on the ceiling or on the floor?"

Of course, preschoolers and some kindergartners who are still learning their numbers and letters will enjoy naming them aloud to you.

Children with short attention spans should try the pictures with fewer dots. Even then, be prepared to help them along or to complete it for them. This isn't all bad, because the time spent with children at the computer can enrich your relationship and will tell them that their activities are important to you.

There's no time limit in Connect The Dots, so don't rush the child. This will be a welcome relief to the child who equates computers with tense, timed, shoot-or-be-shot action.

If some children's eyes have trouble following the grid from the dot to the coordinates, show the children how to trace with their fingers directly on the screen.

Details Of The Program — VIC Version

It is important to type this program exactly as shown. Too many extra spaces might cause VIC users to run out of memory.

The fourth selection on the menu is a heart inscribed with my children's names. Substitute your own message by changing line 650.

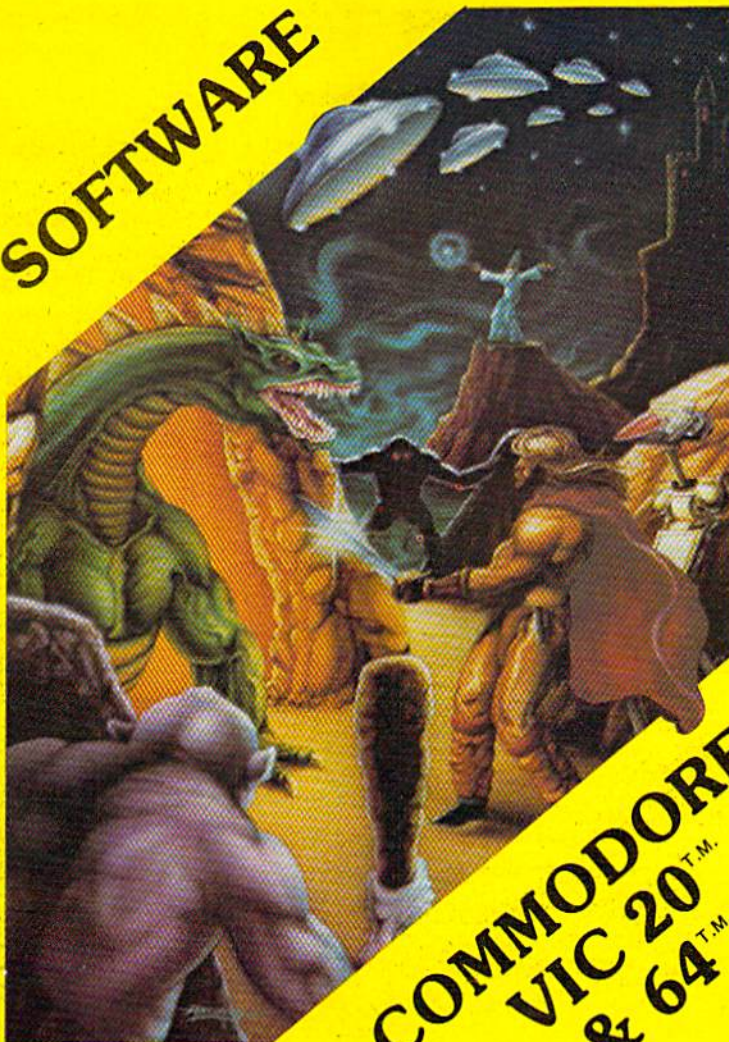


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• VIC 20™

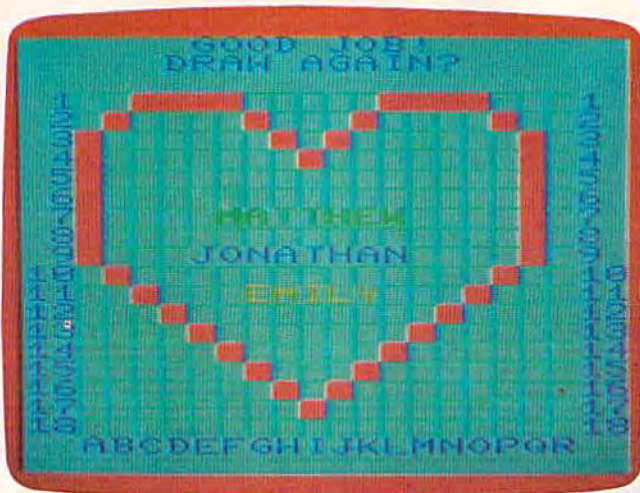
* Both



Arcade Style Games are High Res Full Machine Code.

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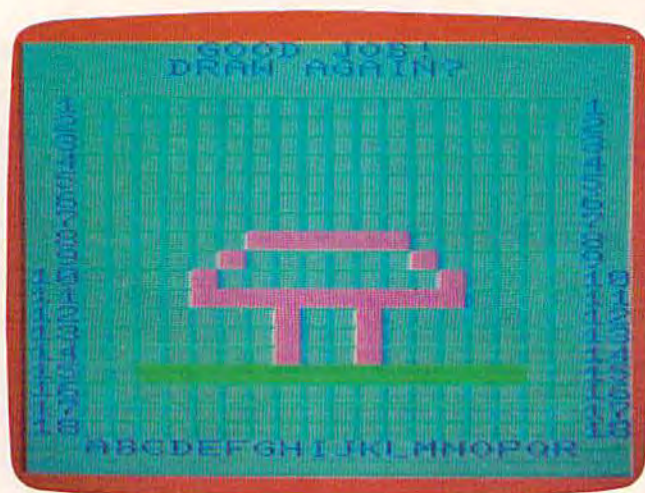
Connecting the dots to draw a heart on the VIC-20. (You can modify the program to substitute any names in the heart.)

Following is a line-by-line program description for the VIC version, giving the starting line number of each section:

- 1 — Title and instructions.
- 10 — Menu.
- 20 — Draw grid.
- 90 — Search DATA for starting point of chosen picture.
- 100 — Read 4 pieces of DATA per dot and POKE dot.
- 110 — Ask for dot's coordinates.
- 140 — Response for wrong answer.
- 200 — Response for right answer.
- 500 — Set up butterfly.
- 550 — Set up mushroom.
- 600 — Set up dog.
- 650 — Set up heart.
- 900 — Response for completed picture.
- 1000 — DATA for butterfly.

Figure 1: Grid For Designing Pictures On The VIC

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
7748																			1
7770																			2
7792																			3
7814																			4
7836																			5
7858																			6
7880																			7
7902																			8
7924																			9
7946																			10
7968																			11
7990																			12
8012																			13
8034																			14
8056																			15
8078																			16
8100																			17
8122																			18
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	



A completed mushroom, one of four pictures included with "Connect The Dots" (VIC-20 version).

- 1500 — DATA for mushroom.
- 2000 — DATA for dog.
- 2500 — DATA for heart.

Designing Your Own Pictures

Part of the fun of this program is designing your own pictures. My five-year-old, Jonathan, contributed the mushroom found in Connect The Dots by coloring in squares of graph paper.

To substitute a picture of your own, design one using the accompanying grids. They correspond to the square grids in the VIC and 64 versions of the program. Remember that most of your design should consist of a continuous line as in dot-to-dot pictures. Anything else must be POKED in when the picture is first set up.

For the purposes of this article, let us assume that you have a VIC and have drawn a clown to

Figure 2: Grid For Designing Pictures On The 64.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1155																			1
1195																			2
1235																			3
1275																			4
1315																			5
1355																			6
1395																			7
1435																			8
1475																			9
1515																			10
1555																			11
1595																			12
1635																			13
1675																			14
1715																			15
1755																			16
1795																			17
1835																			18
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	

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replace the dog in the listed program. Substitute the title "CLOWN" for "DOG" in line 11. This changes the menu to read "C=CLOWN".

Lines 600-610 POKE in the dog's tail and a starting square (SQ). Use these lines to POKE in your clown's nose, for example. (Hint: Since children are always asked the coordinates of a solid dot, use an open O or you will confuse them.)

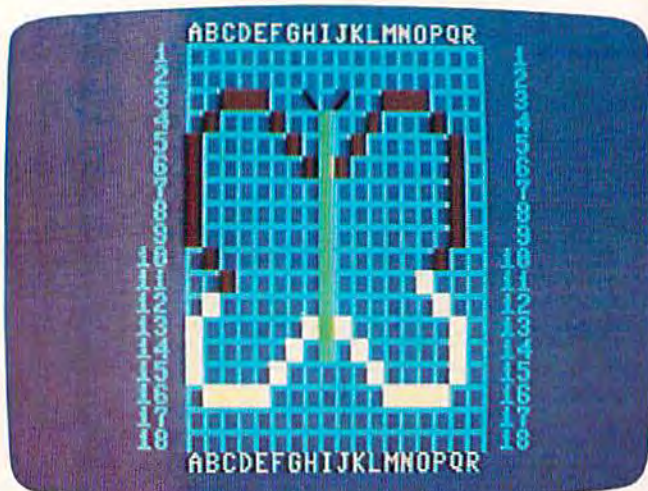
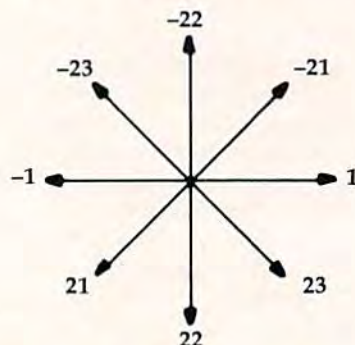
To compute the screen memory location of the nose, add the four-digit row number to the left of the grid to the column number above the grid. This same number + CD is your color memory location.

POKE in your starting square — use code #160, a reversed space — and assign SQ the value of the screen memory location of that starting square.

Now just figure your DATA. The computer

STEP value is 1. From right to left, the line moves backwards one space at a time, making its STEP value -1. A line traveling diagonally up to the left has a STEP value of -23 on the VIC (or -41 on the Commodore 64), since the computer skips back 23 (or 41) spaces before POKEing the next square.

Use this diagram to figure STEP values for the VIC:



A finished butterfly — Commodore 64 version.



A horse — 64 version.

reads four pieces of data per dot: screen memory location (A), color of the line to be drawn (B), number-letter coordinates of the dot (E\$), and the direction that the line will travel to reach the dot (S). Figure each as follows:

First, compute the screen memory location of the dot as explained earlier.

The second number is the color code of the line to be drawn. The color code is always the number of the color's computer key minus 1 (e.g., black=0, red=1, etc.).

Third, look at your grid to find the number-letter coordinates of the dot. The number comes first and is found on the right side of the grid. Follow this with the letter. Do not separate the number and letter with a space.

The last number is a STEP value. This number tells the computer in which direction the line should be drawn. For instance, a line moving from left to right travels one space at a time, so its

Use this diagram to figure STEP values for the 64:

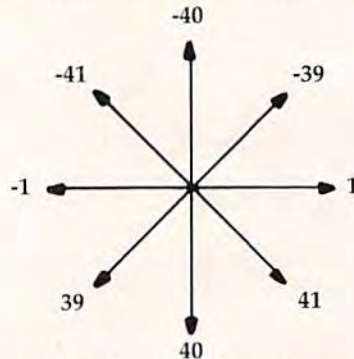


Figure each dot's DATA in the same manner. Separate each piece of DATA with a comma. You must insert your new DATA into the proper line numbers, so check the program explanation listed earlier. Since you are replacing the dog with your clown, your DATA will go in lines 2000-2030. Be sure to leave the first piece of DATA — C — in line

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2000. This is the DATA that the computer searches for to set the DATA pointer.

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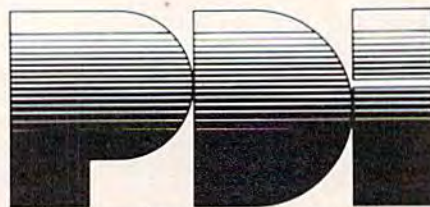
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REVIEWS

Colorcraft Graphics Animator For VIC And 64

Shelby Goldstein

ColorCraft for the VIC-20 and Commodore 64 computers is an entertaining, educational graphics program that is ideal for the computer novice or young student. (We reviewed the VIC-20 version.) The emphasis is on graphics and animation, but *ColorCraft* provides an excellent introduction to the computer in general. It covers topics from setting up the computer and loading tapes to using a screen editor.

The first-time user will quickly become familiar with the computer's graphics keys, function keys, and the CONTROL key. *ColorCraft* also teaches about the computer's special editing features, including the CLR/HOME, INST/DEL, and cursor movement keys. In addition, the concepts of screen wrapping, repeat keys, screen centering, memory, and mass storage are introduced.

Graphics Commands

Animation is created with *ColorCraft* by designing different pictures or text displays on several different screens (pages) and then flipping through them quickly. Text and pictures are created and animated with *ColorCraft* using five commands: Form, Edit, Run, Save, and Load. A sixth command, Copy, is available on VIC-20s with memory expansion and on the 64. Commands are executed by pressing the appropriate letter on a com-

mand line displayed along the top of the screen.

The first option, Form, allows you to change the page size to various dimensions. As the page size decreases, the number of available pages increases. Memory expansion, of course, allows VIC users to have more pages of any size. For example, an unexpanded VIC will hold up to five pages of the smallest page size, 5 x 10 (5 lines by 10 characters), while 16K will increase that number to 50 pages of the 5 x 10 size, or 12 pages of the largest size, 21 x 22. Animation requires several pages, so smaller-sized pages would be the most common choice, especially on an unexpanded VIC.

In addition to controlling page dimensions, the Form command lets you select the border color. This is done simply by pressing the f3 special function key. There are eight colors from which to choose: black, white, red, cyan, purple, green, blue, and yellow.

Most work with *ColorCraft* is done in the Edit mode. The editor is entered by pressing E while the command line is on the screen. In the Edit mode, you can choose the cursor color, change the character set, and turn reverse printing on and off. You can write text or create graphics with the graphics keys.

One particularly nice characteristic of the editor is the advanced drawing command called Direction. This option allows you to set the direction that the



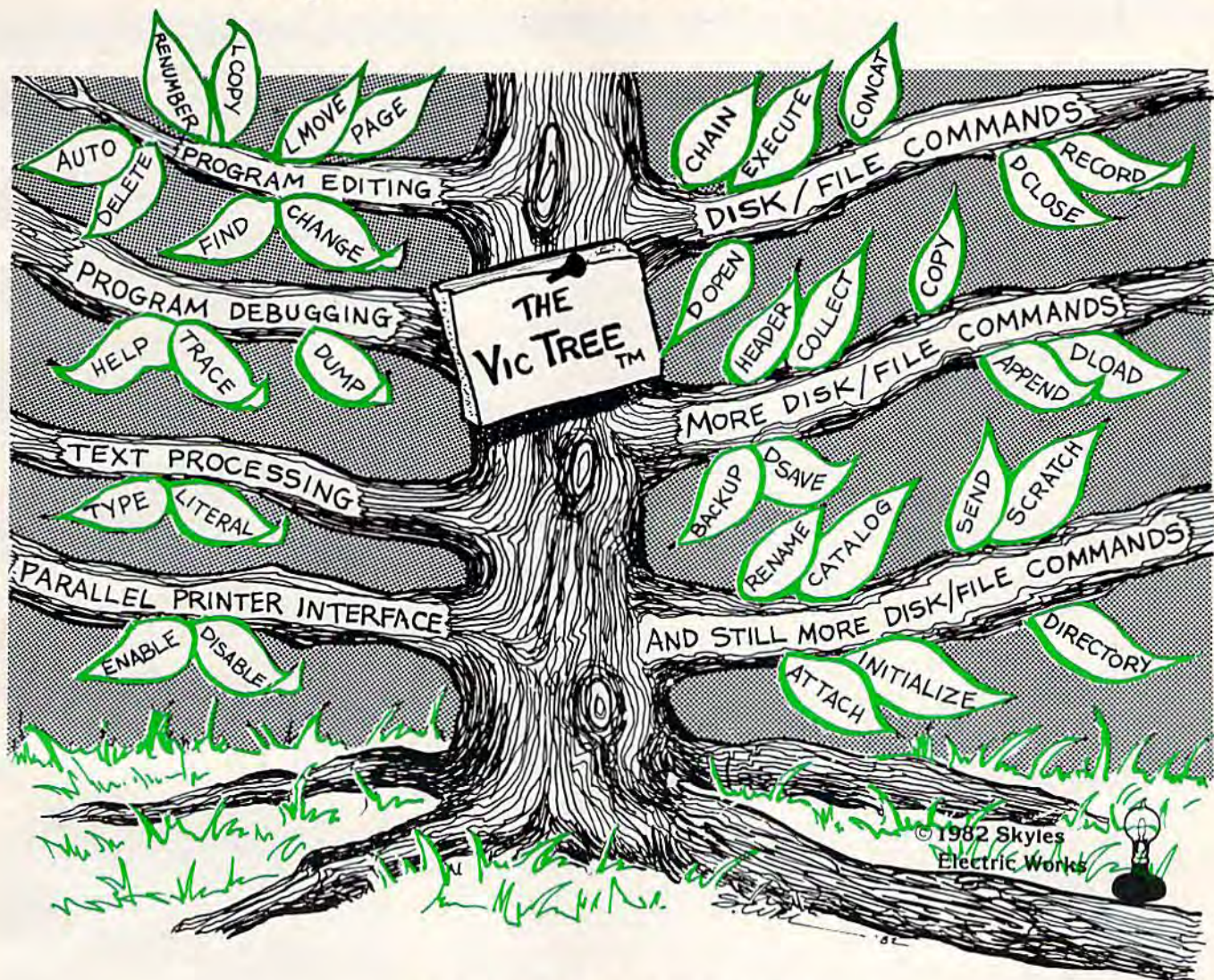
Two examples of graphics screens created with the Commodore 64 version of *ColorCraft*.

cursor will move. For example, Direction 7 is down; it commands the cursor to move downward with each subsequent character typed instead of moving in the normal direction (to the right). Eight directions, including diagonals, are possible. This feature is particularly useful for drawing shapes requiring straight lines.

Editing Graphics

Revisions are easy with the editing keys. Characters or spaces are added or erased with the INST/DEL key. The CLR/HOME key can be used to erase an entire line or the entire screen. On VIC-20s with memory expansion, you can also delete or insert lines by pressing CTRL-D or CTRL-I, and you can center lines with CTRL-C.

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While in the editor, you choose the screen color by pressing the f3 function key. There are 16 colors available. These include the eight colors mentioned above plus orange, light orange, pink, light cyan, light purple, light green, light blue, and light yellow.

One of the most important features of the editor in creating animation is the timing selection. The Timer determines how long each page is displayed. Your pictures or text can move very slowly or very quickly, and each page can stay on the screen a different length of time. The time is set for each page with the f5 function key. The larger the timing number, the slower the page-flipping. The Timer works with the Timing Interval, which is the constant that determines the overall speed of your *ColorCraft* program. The two can be combined to set as much as 45 seconds display time per screen.

The final feature of the editor uses the f1 function key to move to the next or previous page. This is especially helpful for editing the various pages of your sequence, and for previewing your animation by flipping through the pages. This also is enormously helpful if you have memory expansion, because the f1 and C keys can duplicate an entire page as many times as you wish. This makes animation much easier – you can duplicate one screen several times and then make just slight changes to each screen.

Easy Animation

After you've created your pages and finished editing them, you can sit back and view your

accomplishments with the Run command.

Several features can be executed while the sequence is running: f7 turns on the windows that display your page numbers, line numbers, position numbers, direction, timing and color; f3 slows down the screen displays, and SHIFT-f3 speeds them up; f5 runs your program in reverse. The space bar freezes the display and starts it moving again.

Your work can be saved on tape or disk. A print program is included in the *ColorCraft* manual that allows you to access your *ColorCraft* files from BASIC. This program is written for the Commodore printer only, but if you know a fair amount of programming, you can get it to work on other printers.

The flip side of the program tape contains samples created with *ColorCraft*. These are helpful in illustrating some of the possibilities of the program. In addition, the accompanying manual is one of the most lucid manuals I have ever seen. It is written in an easy-to-read style with many detailed explanations and examples. Chapter VII takes you step by step through a sample program that uses all of *ColorCraft*'s editing features and illustrates simple animation. The manual even includes a ten-page glossary of terms used in the program, as well as many common computer terms.

ColorCraft is an excellent program for a first-time computer user or as an introduction to computer graphics. It is not intended for creating advanced graphics. There is a limit to the sophistication you can achieve

when restricted to the VIC and 64 graphics characters. Also, the program is very limited on an unexpanded VIC.

But as with many graphics programs, the weakest link is the user, not the program. If you can't draw on paper, you probably can't create great works of art on a computer. You can, however, learn a great deal from this program and have a lot of fun, too.

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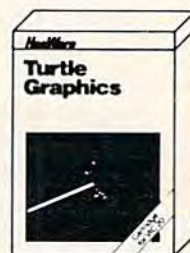
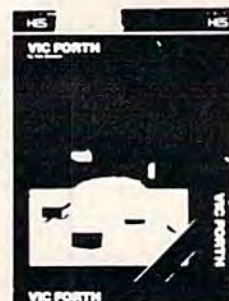
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Preschool Educational Software For VIC-20

Donald Elman

Most commercial programs available for VIC-20 owners are various games designed for children 7 to 70. Very little educational software of any kind has been introduced for the VIC. Even more scarce are programs designed to entertain and educate the *Sesame Street* generation of children under the age of six.

Finally, a handful of commercial programs designed for preschoolers is beginning to hit the market. As more of these become available, parents and teachers should look for certain features that make the programs worthwhile learning tools. I have found four areas of particular significance:

Ease of use. Loading convenience, clarity of documentation, and uncomplicated input/response methods for the child. These are very important for young children, who are easily frustrated and whose ability to solve problems is not likely to be well developed.

Sophistication of graphics, color, and sound. A child's responsiveness is enhanced by an animated screen. A program that uses many of the VIC's special features in this way will promote the child's interest.

Educational features. Matching the program to the child's learning level is essential. How does the program handle positive reinforcement, prompts or corrections following errors, and increasing difficulty as the child masters one level of a problem?

Sustained interest potential.

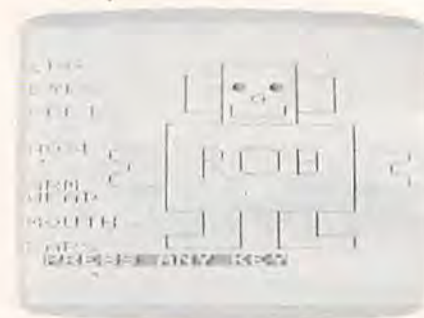
This partly depends on the absence or presence of the three characteristics mentioned above. You need to look for programs that can continue to teach and to hold the child's interest.

Here is a summary of some available software for preschoolers:

Early Games For Young Children, CounterPoint Software (cassette), \$29.95. Documentation: A brochure with loading instructions and brief descriptions of each "game."

There's more packed into this single cassette than nearly any other commercial VIC tape that I have seen. This group of programs was recently adapted from earlier versions for the Apple, Atari, and IBM. They work well on the VIC. On one side of the tape are nine separate programs that can be individually loaded and run on an unexpanded VIC. On the other side of the tape is a huge, single program that incorporates all nine of the shorter programs under one master menu. However, this comprehensive program requires 16K of memory expansion and takes a full five minutes to load from the tape. Once loaded, the long version allows the user to jump around at will among the nine subprograms.

Instead of presenting all the choices on the screen at once, the 16K version's rotating menu displays a symbolic representation of one program at a time, changing to the next one



Rob the robot looks OK now, but he could suddenly redraw himself and be without ears. Players must type in the name of the missing part in My Body.

every two or three seconds. By pressing any key, the user instantly stops the menu and starts the subprogram whose symbol is showing. The menu itself can become a sort of game, as the child learns to anticipate the sequence of symbols and to pounce on a key as soon as a favorite picture is shown. You can return to the menu from any subprogram by pressing one of the function keys.

Numbers. A large block number from one to nine appears on the screen. Below are the instructions "MATCH THIS NUMBER." If the correct key is pressed, a short, random-note tune is played, and a new number appears. If wrong, there is a very brief "uh-uh" sound. No corrections are given, and the child can keep trying different keys until the right one is pressed.

Count. Either one, two, or three blocks appear on the screen. Pressing a number key results in either the correct or incorrect feedback described above. After several correct answers, the level of difficulty automatically increases, with the maximum number of blocks shown going up to six, and

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REVIEWS

eventually to nine.

Add. A simple addition problem is displayed using colored blocks instead of digits. As in *Count*, the level of difficulty gradually increases as the child gives a string of correct answers, with the highest sum being nine. The feedback is the same as described above.

Subtract. This uses the same presentation format as *Add*. The largest operand is five.

Letters. A large letter appears on the screen. Below is the instruction "MATCH THIS LETTER." Correct and incorrect responses receive the same feedback as in *Numbers*.

Alphabet. This is similar to *Letters*, except the child must press the key of the letter that alphabetically follows the one on the screen. After a wrong answer, the child is prompted by a brief display of the entire alphabet.

Names. First a parent or older child must type in a name (or any word). Then the word disappears from the screen, and the young child must retype it correctly.

Draw. In this program, the child can create a low-resolution picture on the screen by pressing various keys. Instead of using a single key for each direction, the keyboard is divided into eight regions. The first character-sized, square dot appears in the center of the screen. Pressing a key in the upper left of the keyboard, such as 1 or 2, will add an adjacent dot above the left of the first one. Pressing a key near the bottom-center of the keyboard, such as B or N, will add a dot directly below the last one, and so on. Pressing the space bar changes the color of the succeeding dots.

Shapes. Four large shapes

appear on the screen, each numbered 1-4. Three of the shapes are identical to each other. The child must press the number of the different one.

Home Babysitter, Commodore (cartridge), \$29.95. Documentation: A two-page, no-nonsense set of "instructions for parents." Commodore's own contribution to this market is a plug-in cartridge with three separate, attractive programs, each instantly accessible by pressing one of the function keys. Except for the overly ambitious title (don't expect this program to feed your child dinner or call the fire department in an emergency), it's a well-designed piece of software that could keep a youngster occupied for quite some time, with minimal supervision.

The first screen is a menu that displays a picture of the F1, F3, and F5 keys, each next to a nonverbal sample of one of the three programs. If no key is pressed immediately, the program repeatedly cycles through a short graphic/sound routine that illustrates each program. Pressing one of the top three function keys begins the corresponding program. You return to the menu by pressing the RESTORE key.

A minor problem with the menu is that the user must wait a few seconds for the computer to cycle through the entire illustration routine before the function keys work. A child might find it difficult to tell when these keys will work and when they won't.

Pressing F1 from the menu leads to *Alphabet Blocks*. The screen clears to white. Pressing any letter from A to Z results in a large picture of a child's block showing that letter in the lower-

right portion of the screen, accompanied by a brief musical tone. At the same time, a smaller version of the letter block appears elsewhere on the screen. Pressing a different letter replaces the large block and adds a small block to the picture. After all the letters have been pressed, the 26 small blocks appear in alphabetical order starting at the upper-left corner of the screen. If a nonletter key is pressed at any point, the screen clears, and each letter block is automatically displayed in order to the tune of the "alphabet song." Once the child has learned the alphabet, he or she could manually play the alphabet song and display the blocks by pressing all the letter keys in order.

The F3 key activates *Learning To Count*. First, another menu appears, which allows the user to choose a maximum number (5, 10, 15, or 20) for the counting exercises by pressing one of the four function keys. Next, a rectangular outline is displayed on the screen, with two "score" columns to the right of it. For each counting problem, a random number of objects appear within the rectangle at the rate of about three per second, each accompanied by a short beep. Then the question "HOW MANY?" is displayed below, along with a large, blinking cursor.

The child must press a number (which shows up on the screen as a large-sized digit), and hit RETURN. If the child's input is correct, a large, smiling face appears, and a small smiling face is permanently added to one of the score columns. If wrong, a large frowning face appears, and the child is given another chance. After two wrong responses, the program counts the objects for

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the child and puts a frowning face in the score column. For variety, different types of objects are displayed with each counting problem, including several standard and custom graphics characters.

The third program, accessed by pressing F5 from the menu, is Face Maker. More creative than educational, this one provides a nice change of pace from the intellectual rigors of the other two programs. Essentially, it is a sort of cartoon version of a police detective's kit for producing composite drawings of a suspect. The outline of a face appears on the screen. By repeatedly pressing various function keys, you can display about six different versions of each of the following: hair, eyes, ears, nose, mouth, and chin. Literally tens of thousands of different shape combinations are possible, and the color of each part can be independently set by pressing one of the color control keys.

This program also has two cute touches. One of the "eyes" is an animated wink, and one of the "mouths" sticks out its tongue; appropriately accompanied by the sound of a "Bronx cheer."

Alphabet. American Peripherals (cassette) \$9.95. Documentation: None.

This is a single-function program that runs on an unexpanded VIC. For each problem, a sequence of six letters appears on the screen in alphabetical order, except that in place of one is a "?". Pressing the correct letter results in an upward-sliding tone, a smiling face, and a message such as "DOING FINE!" or "RIGHT ON!" An incorrect answer results in a downward-sliding tone, a frowning face, and a list of the entire alphabet,

which remains on the screen for four seconds until the problem returns. After about eight correct answers, a brightly colored rocket ship blasts off and slowly rises until it disappears from the screen.

My Body. American Peripherals (cassette), \$11.95. Documentation: None.

This single program can run on an unexpanded VIC. After asking for the user's name, it displays the following instructions: "I'm a robot. My name is Rob. When I show myself, look very carefully and I will play a game with you. We will play ten times, and each time a part of me will be missing. Type in the name of the missing part."

The screen display shows the robot and a list of words for each body part. If the correct word is typed in, the robot is redrawn, but with another part missing. If wrong, the message "LOOK AGAIN" appears. This program uses no color, no sound, and no random variations. If the user replays after all ten words have been entered correctly, the missing parts are presented again in the same order.


Recommendations

Very young children will undoubtedly need some help getting started with any of these programs. However, I've seen three-year-olds who can readily insert a tape, type "LOAD", and (with two hands) press the PLAY button. The 16K version of *Early Games*, which takes five minutes to load, requires both the RAM expansion cartridge and the tape. Then there is the possibility that the child might tire of waiting. The shorter tape programs are simple to load and run, but with the 5K side of the *Early Games*

tape there is the problem of cuing up the programs in the middle of the tape. Once any of these programs is loaded, the child would probably need guidance in using the menu (if any) and understanding the response procedure the first time or two. Of course, an older child may not have any problems with this.

Because of its impressive use of graphics, sound, and color, I'd judge that *Home Babysitter* is the most delightful of these for children. Its well-balanced offering of letters, numbers, and visual creativity are nicely designed for the preschooler. A very close second in enjoyment is *Early Games*, especially the 16K version which allows the child to shift instantly from one game to another. In fact, the variety of *Early Games* might sustain more long-term interest than *Home Babysitter*. Both of these products, however, seem to be effective exercises for a youngster's early letter and number skills – a useful complement to the passive learning mode of *Sesame Street*.

By contrast, the American Peripherals tapes seem to offer less, although their lower price might tempt you to give them a try. Of the two, *Alphabet* is clearly more animated, with color/graphic/sound feedback, prompts, and randomly varying reinforcement messages. Any child would surely enjoy the rising rocket ship. However, once the novelty wears off, there is no variety to sustain interest.

My Body, in the version that I tested, has few redeeming features. Its basic concept is unique, but it could use a lot of "extras." Since it's written in BASIC, perhaps you could use your own programming skills to add color, sound, and other enhancements. 

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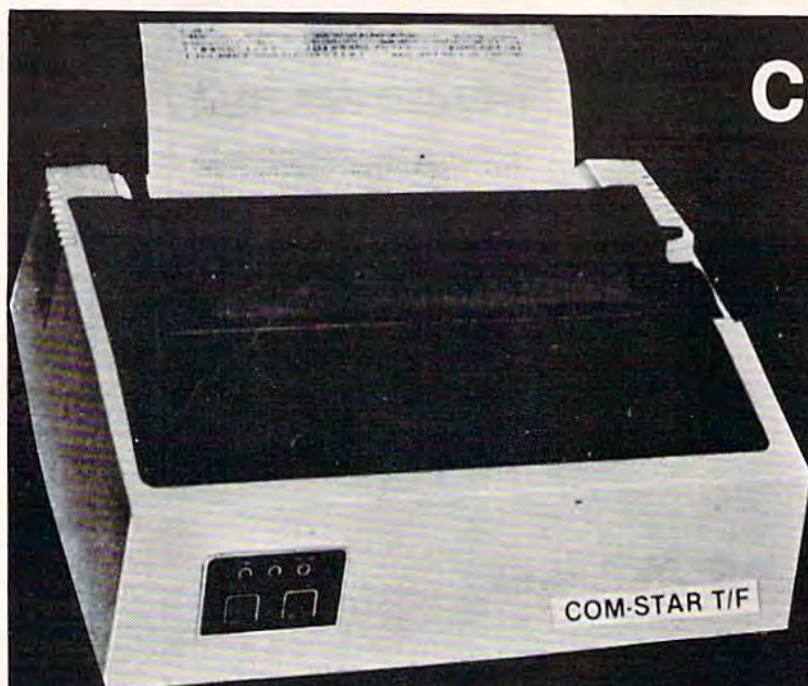
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Four Tronix Games For VIC And 64

Dan Gutman

Have you wiped out any Killerwatts lately? If not, you may want to pick up a copy of *Juice* for your Commodore 64, one of four new games from Tronix, which last year blessed us with *Kid Grid*, the fill-in-the-blanks game for the Atari 400/800. *Juice* (designed by *Kid Grid*'s designer Arti Haroutunian) is the most exciting game in the new batch. It's a good takeoff, but not a rip-off, of the hit arcade game *Q*Bert*. The other new Tronix games are *Deadly Skies*, *Scorpion*, and *Gold Fever*, all for the VIC-20 only.

Juice

In *Juice*, as in *Q*Bert*, you are a helpless but resourceful character who relentlessly hops around a grid trying to change the appearance of all the blocks by landing on them. "Juice" refers to electricity; if you hit all the blocks without getting killed by various nasties, you have completed a circuit board and you move on to the next level.

While *Q*Bert* hops on a pyramid, Edison, *Juice*'s character, leaps about a slanted rectangle. The configuration is slightly different for each of the six levels. If you get into trouble – and you will – you can jump off the grid onto a line which will cause you to materialize elsewhere.

This game is a knockout. The characters are human-looking, not some videogame stick figures. The graphics are top-notch, and the play action is fun for five minutes as well as five months. It is available on disk for the Commodore 64 and for Atari computers with 32K.

The other three new games from Tronix are very different from one another, seemingly intended for specialized audiences. Still they do have one thing in common – simple directions. Just pop that cartridge in and play.

Deadly Skies

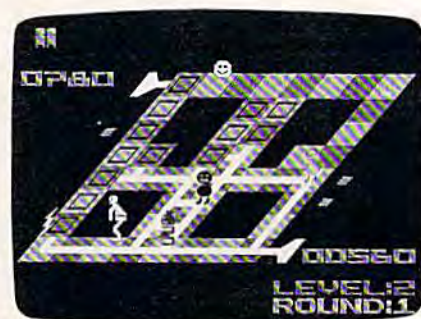
Here's your shoot-em-up. Underneath a protective cloud cover are a missile base, tanks, and missile emplacements set up to destroy your copter. UFOs, smart bombs, and asteroids harass you in the air. You've got to bomb through the cloud cover, then bomb the ground targets which scroll by from left to right. Unfortunately, your copter cannot scroll off the screen with the targets, nor can you wrap around and come out the other side.

The sound effects are quite good, reminiscent of the shooting in *Centipede*. Although you can barely make out the shapes of your enemies, the overall graphics are adequate.

You will be challenged. Around level four there is so much debris in the sky, you feel like you're attacking Mount St. Helens. It is a good test of peripheral vision, though it is bothersome that the enemy missiles suddenly appear a quarter of the way up the screen, which happens to be your ideal bombing altitude.

Scorpion

Scorpion is another fast-action shooting game, but it requires some thinking, not just twitching. You've got eight different things to shoot at (Venus's-flytraps,



In *Juice* for the Commodore 64, the player controls a figure who jumps around a power grid, pursued by "Killerwatts" (artist's rendition of actual screen).

worms, pod babies, etc.), each with a different point value. More importantly, you've got to feed your clan by stunning frogs and bringing them home.

This is the fastest-moving of all the Tronix games, and you should have fun fighting your way through the maze, wreaking havoc, shooting everything in sight. The program makes pretty good use of the VIC's graphics capabilities, and the screen scrolls in four directions.

There is a scanner on the side of the screen that reports your location, but if you glance at it you're probably a goner. It might be an improvement to eliminate the gauges and make the playfield larger.

There are 32 levels and three difficulty settings, so you will be occupied for the next few months. Designer Jimmy Huey has also given us left- and right-handed play, and a freeze option.

The instructions neglect to say where the scorpion "house" is, but I'll tell you – it's that black square in the center of the screen.

Gold Fever

In *Gold Fever*, you are inside an abandoned mine filled with glittering piles of gold. But

REVIEWS



The helicopter (right-center) bombs ground targets in *Deadly Skies* for the VIC-20.



In *Scorpion* for the VIC-20, enemy creatures abound in a four-way scrolling maze.



Your miner (upper-right) must avoid hazards while gathering riches in *Gold Fever* for the VIC-20.

some of the screen objects are difficult to recognize. The gold could just as easily pass for small sleeping rodents. Boxcars are chasing you, and so is an evil Claim Jumper, who looks more like a fire hydrant with a tabletop.

Anyway, after you pick up

all the gold in one mine, you move to another. There are nine difficulty levels, distinguished mainly by the amount of gold and speed of action, and only two alternating scenes.

Of the four new games from Tronix, the standouts are *Juice*, *Deadly Skies*, and *Scorpion*.

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Rat Hotel For VIC-20

Clark L. and Kathryn H. Kidd

Like mold on cheese, *Rat Hotel* tends to grow on you after a while. Our copy of the new hide-and-seek VIC-20 cartridge from Creative Software didn't come with instructions, and without the benefit of a press release we might have had trouble learning how to play. But once you know the rules, *Rat Hotel* is easy enough to entertain even younger players.

The object is to maneuver Ermine the Rat down six floors of the Hotel Paradisio to consume Le Grand Cheeseball in the basement. Ermine's enemy is Waldo the Maintenance Man. Waldo, armed with a gun, chases Ermine around the hotel.

Rat Hotel is a game of several challenges. One, of course, is Waldo the Maintenance Man. There are also rattraps scattered throughout the hotel, which Ermine must avoid. The third obstacle is time: players have three minutes to guide Ermine from the hotel attic to the cheeseball. If and when the rat consumes Le Grand Cheeseball, the game starts again at a more difficult skill level.

Along the way to the basement, cheese is hidden in various corners. When Ermine consumes this cheese, points are added to your score. The rat must eat all the cheese on each level to move from one floor to another. Occasionally the cheese changes color from yellow to black. When the cheese is black, it paralyzes the rat for a few crucial seconds. During those seconds, Waldo may sneak up and shoot the rat. Never fear, however: a player is allowed three rats per game.

Playing *Rat Hotel*

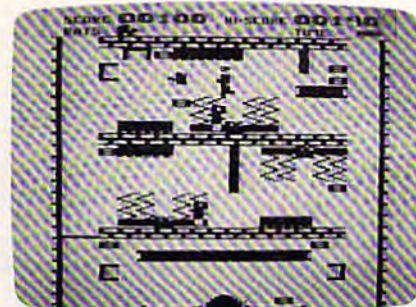
For those who might not learn how to play *Rat Hotel* without printed rules, here they are. *Rat Hotel* is a cartridge game requiring a VIC and a joystick. Plug in the cartridge, turn on the VIC, and jiggle the joystick to center the title screen on your TV. Choose your skill level by pushing the joystick up. Press the fire button to start play.

Once play begins, the top of the screen records your current score as well as the high score of games in the series. Little rats on the upper left side indicate the number of rats left in a game. On the upper right is a black bar showing the amount of time a player has left. Rather than giving the time in minutes and seconds, the black bar shrinks to show the remaining time. This is a clever feature; it's easier to gauge the length of the bar out of the corner of your eye than it is to take your eyes off the game to read a numeric display.

There are five skill levels, and the only significant difference is the speed of the game. Level 5 isn't unreasonably fast unless you've just finished playing a game on Level 1.

Ermine must avoid Waldo by staying ahead of him or by finding places to hide. When the rat has eaten all the cheese on a floor, move him to the extreme right or left of the screen and then push him as far down as possible to await the elevator. As you press the joystick toward the edge of the screen, a beeping sound will call an elevator to take Ermine to the next floor.

While you can move the rat only one floor at a time, Waldo can skip floors. Sometimes you



Waldo the Maintenance Man chases Ermine the Rat in *Rat Hotel*.

think you're well ahead of him, but he'll catch up to you. More rats "bite the cheese" while waiting for the elevator than in any other *Rat Hotel* situation.

Good Features

The idea of having an elevator that makes you wait is ingenious. It adds a little variety to the game. Another good feature of *Rat Hotel* is the sound effects, which are excellent. When the game begins, a Bach tune is played. After a while, though, the song does get a little tedious, especially if you're not a good player and have to keep starting over. There are also little tunes played when you win or lose.

When Waldo shoots the rat there's a popping sound, and when the rat gets caught in a trap there's a definite crunch. There's a beeping noise that calls the elevator. Different sounds are made when the rat eats good or bad cheese. A lot of effort was put into the sound effects, and it makes the game more enjoyable.

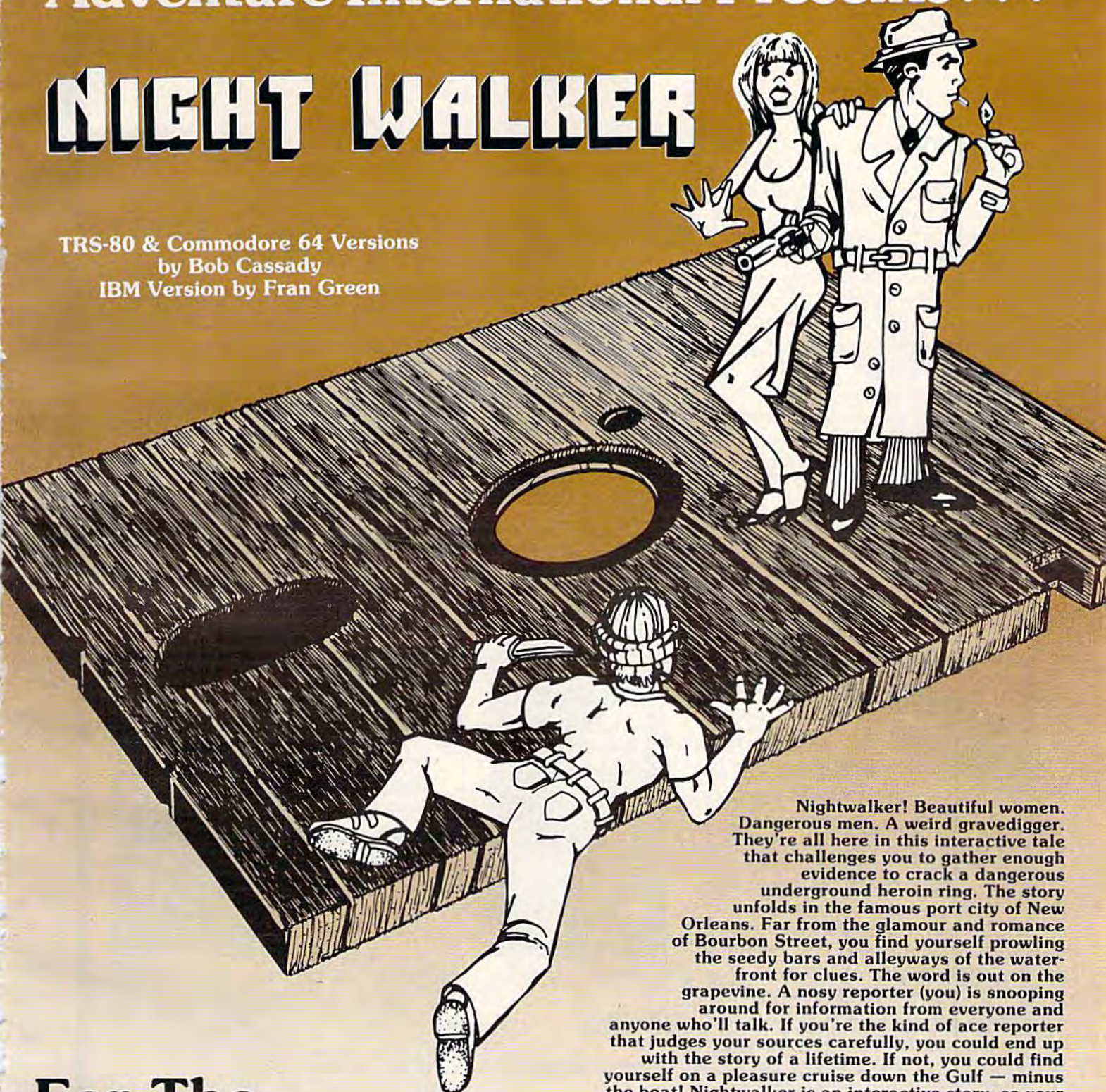
The graphics of *Rat Hotel* are above average, perhaps even excellent. Graphics are not the strong feature of the VIC-20, but the graphics in *Rat Hotel* are good enough to add to the enjoyment of the game.

For all its innovation, however, *Rat Hotel* is a game of few

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REVIEWS

surprises. The rat always starts the game in the same location, cheese and traps are hidden in the same spots every time, and Waldo plods the same basic route each time the game is played. Even the poisonous black cheese shows up only once in most games, and that's at a specific spot in the basement. Thus, all games are basically the same, and after a few dozen rounds the player begins to feel like a rat in a maze. Some randomness introduced into the program would have made *Rat Hotel* an even better game.

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A close-up screen photo showing how ordinary characters (left) are transformed into custom characters (right) for the VIC-20 version of "Chicken Little," a game program elsewhere in this issue. Note the technique of combining one or more characters (A, F, G, J) to form a single, large custom character.

Introduction To Custom Characters For VIC And 64

Tom R. Halfhill, Editor

What are "custom characters"? Why might you want them? Are they hard to program? How do they work? This introduction to the concept of custom characters answers all these questions and more. Two other articles in this issue then show exactly how to program custom characters on either a VIC-20 or Commodore 64.

Perhaps you've admired the screen graphics of a favorite arcade-style game, or the Old English letters of a Gothic text adventure. These kinds of shapes and special characters are not built into the computer itself. Maybe you've wondered how these effects are achieved and if they are difficult to program.

The secret is a technique called *custom characters*, also known as *redefined characters* or *programmable characters*. The terms are almost self-explanatory — with programming, you can design your own shapes and special characters to display on the TV screen. They can be almost any shapes you want: spaceships, aliens, animals, human figures, Old English letters, anything. In

effect, you are *customizing* or *redefining* the characters already built into the computer.

For instance, if you redefine the letter A to look like an alien creature, every time you PRINT A on the screen you'll get the alien instead of the letter. Animation is as easy as erasing the character — by PRINTing over it with a blank space — and then PRINTing it in the next position. When this process is repeated rapidly, the alien seems to move across the screen.

Custom characters are especially useful to game programmers, but also are fun to experiment with for anyone interested in programming.

Character Sets

First, let's clarify exactly what is a *character set*. Briefly, it is the complete set or collection of characters that a particular computer can display on its video screen. *Characters* include letters of the alphabet (both upper- and lowercase), numbers, punctuation marks, symbols, and — on the Commodore 64 and VIC-20 — the 64 special graphics characters that are pictured on the front of the keys. In all, a VIC or 64 has a standard character set of 256 characters. This is the total set of charac-

ters which the computer is capable of displaying.

The character set is built into the computer, permanently stored in Read Only Memory (ROM). ROMs are memory chips that retain important information even when power is turned off between sessions. The character set is stored in ROM as a list of numbers. The numbers describe to the computer how each character is formed from a pattern of tiny dots.

You may be able to see these dots if you look very closely at your computer screen. (The dots might be too small to discern on some ordinary TV sets, but they are much more visible on a monitor.) All the characters in the character set are made up of these dots. The dots for each character are part of an 8-by-8 grid, for a total of 64 dots per grid. This method of forming characters is familiar to anyone who has seen the large time/temperature clocks on banks, or the scoreboards in sports stadiums. A computer displays characters the same way, except instead of light bulbs, the dots are very small pinpoints of glowing phosphor on the TV picture tube. (Figure 1 shows the dot pattern for the letter A on a Commodore 64; the dot pattern is slightly different for the VIC-20, but the principle is the same.)

Figure 1: Dot Pattern For Character A On Commodore 64



The character set is always kept in ROM, ready for the computer to use. Let's say you display a character on the screen — for instance, the uppercase letter A. The computer refers to the character set in ROM to see how it should display the A on the screen, much as you would refer to a dictionary to see how to spell a word. Once it looks up the dot pattern for an A, the computer displays the character. The whole process takes only a few microseconds, and happens every time a character is displayed, either by typing on the keyboard or using a PRINT statement in BASIC.

When the computer's ROM chips are pre-programmed for you at the factory, these dot patterns for each character are permanently burned into the chips so the computer will always display the same character set. Short of replacing the ROM chips themselves, there is nothing you can do to change this preprogramming. Normally,

this would limit you to the built-in character set. Indeed, on some computers there is no alternative.

Fooling The Computer

However, on the VIC and 64 — and on many other home computers — there is a way to modify the character set to suit your own needs. The technique requires fooling the computer.

Here's how it's done. The first obstacle to overcome is the preprogrammed ROM chips. It is not possible to erase or change information in ROM. But remember, there are two types of memory chips in computers: ROM and RAM.

RAM (Random Access Memory) is temporary memory that *can* be erased and changed. Programs loaded from disk or tape, or which you write yourself, are stored in RAM while they run. They can be changed at any time from the keyboard, or even erased altogether by typing NEW or switching off the computer. RAM is the computer's workspace.

So, the first step toward custom characters is to copy the list of numbers representing the character set from ROM into RAM.

This is a relatively simple programming task. You find out exactly where in ROM the character set is stored by looking at a *memory map*, a list of memory addresses inside the computer. (Memory maps are often found in reference or owner's manuals or magazine articles.) Once you know the beginning memory address of the ROM character set, you can write a short routine which reads the list of numbers in ROM and then copies it into RAM. In BASIC, this is done with PEEKs and POKEs within a FOR/NEXT loop. One or two program lines are all it takes.

Now there's a copied image of the ROM character set in RAM. Again using POKEs, you can freely change the list of numbers to customize the characters any way you want (we'll cover this in detail in a moment).

OK so far, but there's one catch. The computer doesn't know you've relocated the character set. It still expects to find the character set where it always has, in ROM. It will continue to refer to ROM and will ignore your customized set in RAM.

That's why you have to "fool" the computer. The VIC and 64 contain a memory location, called a *pointer*, which points to the character set in ROM. Luckily, the pointer itself is in RAM. With a single POKE statement, you can change the number in this location to point to your custom character set in RAM, thereby fooling the computer into referring there for its information instead of ROM. The computer goes through its usual process of looking up the dot pattern for

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each character and displaying it on the screen, except it looks up *your* modified pattern instead of the pattern preprogrammed at the factory.

Clever, eh?

Character Patterns

Basically, if you've made it this far, you've got the picture. But there are still a few details to clean up.

For example, exactly how are characters customized?

Recall that the character set is defined by a list of numbers which describes the dot patterns for each character, and that each character is formed by dots within an 8-by-8 grid. By changing these numbers, you change the shape of the dot pattern, and therefore the shape of the character.

It helps at this point to know something about the binary number system, so you might want to read "The Inner World Of Computers, Part 1: Binary Numbers" elsewhere in this issue. But even if you don't understand binary, look at Figure 2.

The eight numbers running vertically along the right side of Figure 2 are the numbers which define the dot pattern for an A on a Commodore 64 (again, the pattern for A on the VIC is slightly different). These are the same eight numbers which the computer refers to when it looks up A in the character set. They are also the numbers you must change to customize the character. These numbers are decimal versions of the binary dot patterns.

Figure 2: Dot Pattern For A On Commodore 64



Along the top of Figure 2, running horizontally from right to left, are eight more numbers: 1, 2, 4, 8, 16, 32, 64, and 128. Notice that each of the numbers in this series is twice as much as its predecessor. That's how binary works. (If you want to get technical, each number represents a *bit* in a *byte*.)

Now, this is important: to understand how the numbers in the *vertical column* were determined, simply add up the numbers in the *horizontal*

row which correspond to colored dots in the 8-by-8 grid. For example, the top row of the grid has two colored dots which form the peak of the A. (These are the same dots which will be lit up when the letter is displayed on the TV screen.) These two dots fall beneath the 8 and 16 of the top row of numbers. Because $8 + 16 = 24$, the number in the right-hand column for that row is 24.

Likewise, the next number in the right-hand column is 60, because the colored dots in the second row of the grid fall beneath the 4, 8, 16, and 32, which add up to 60. And so on down to the very last row, which has no colored dots. This is represented by a 0 in the right-hand column. When the A is displayed on the screen, no dots will be lit up on this row of the grid. (All patterns for letters and numbers allow a blank line for the last row, and for the extreme right and left-hand columns, in order to keep the characters from running into each other on the screen.)

Figure 3 shows the dot pattern for an A on the VIC-20. Notice how the eight numbers in the vertical column are different from the eight numbers for an A on the Commodore 64. A comparison between the patterns of Figures 2 and 3 shows why: each computer forms its A in a slightly different way. Study these figures until you're sure you know how to add up the dot patterns to arrive at the eight numbers along the right. This is the key to customizing characters.

Figure 3: Dot Pattern For A On VIC-20



Customizing Characters

Once you understand how character patterns work, it's easy to customize them at will.

First, take some graph paper and mark off an 8-by-8 grid, or draw your own grid on a blank sheet. Along the top, write down the horizontal row of numbers as seen in Figures 2 and 3: 1, 2, 4, 8, 16, 32, 64, and 128. *Be sure to list them from right to left.*

Second, design your custom character by coloring in dots on the grid. Figure 4 shows a sample design for a *Space Invaders*-type creature.

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Third, add up the colored dots in each row, starting from the top. Write down each sum in a vertical column along the right, as seen in the figures.

Figure 4: Dot Pattern For A Customized Character (Space Invaders-Type Alien)



You have now designed your own custom character. You can design as many of these as you'll need — up to the limit of 256 characters in the character set (although on the unexpanded VIC, memory limits make it practical to customize only 64 characters).

The only remaining step is to take the new series of eight numbers for each custom character and substitute them for the numbers in the stan-

dard character set. Remember, that's why you relocated the character set from ROM to RAM. Now that the list of numbers spelling out the patterns for the standard character set is in RAM, it can be changed to use your own numbers with POKE statements.

Specific Details

Up to now, this article has had to be fairly general in its explanations. The basic technique for customizing characters is the same for the VIC-20, Commodore 64, Atari, or any computer on which the character set can be relocated and redefined. But the specific details vary for each computer: the character set's memory address in ROM, how to safely copy it to RAM, the memory address of the character set pointer, the order of characters within the character set, and so on.

For these details, as well as example programs and utilities, turn to the article elsewhere in this issue which is appropriate for your computer: "How To Make Custom Characters On The 64" or "How To Make Custom Characters On The VIC."

Besides these articles, from time to time COMPUTE!'s Gazette will offer additional articles and columns on custom characters — one of the most powerful features available on your VIC-20 or Commodore 64. ☺

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