A WAYNE GREEN PUBLICATION
October 1983 USA $2.95

HOT CoCo

T.M.

THE MAGAZINE FOR TRS-80 COLOR COMPUTER,® TDP-100,™ AND DRAGON™ USERS

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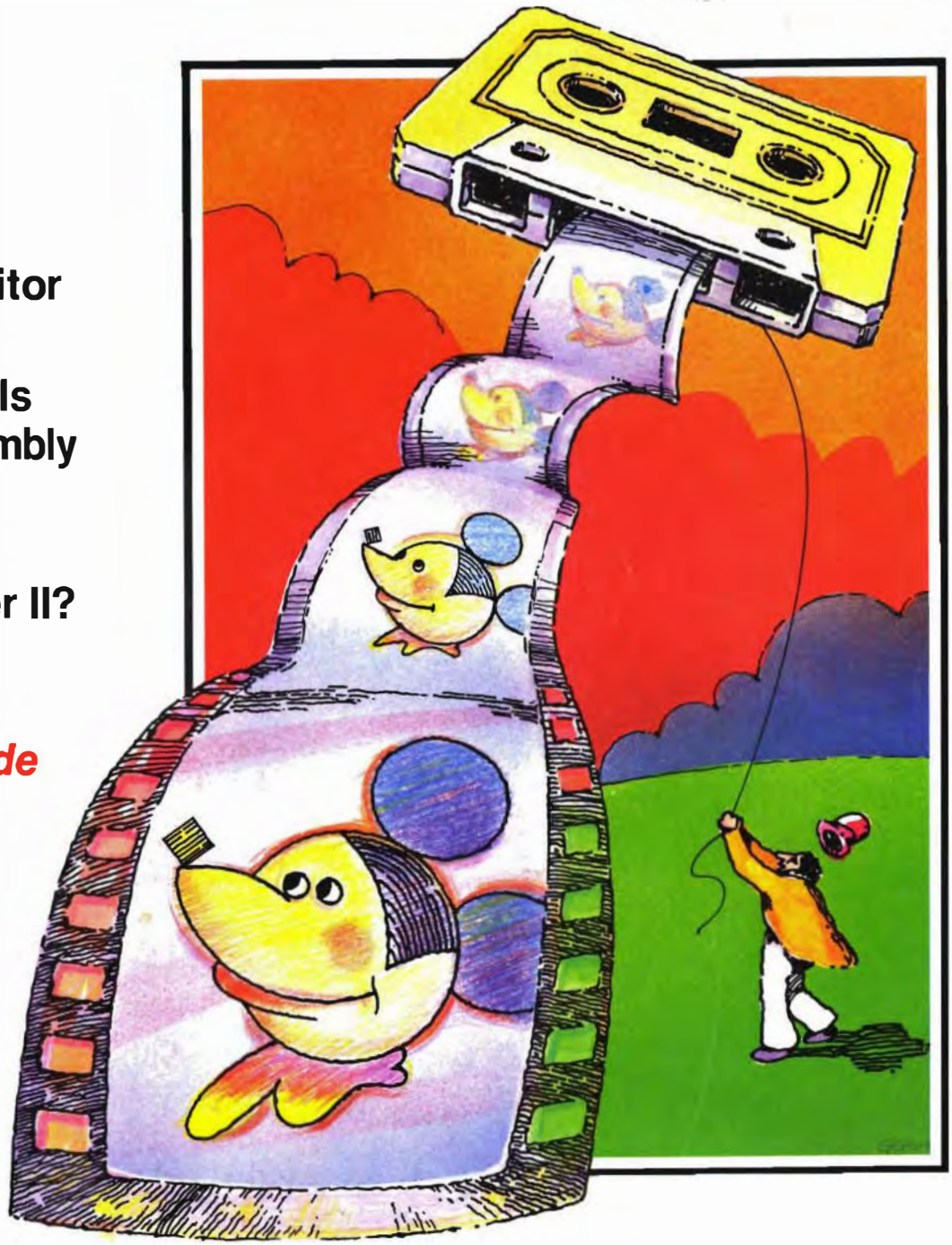

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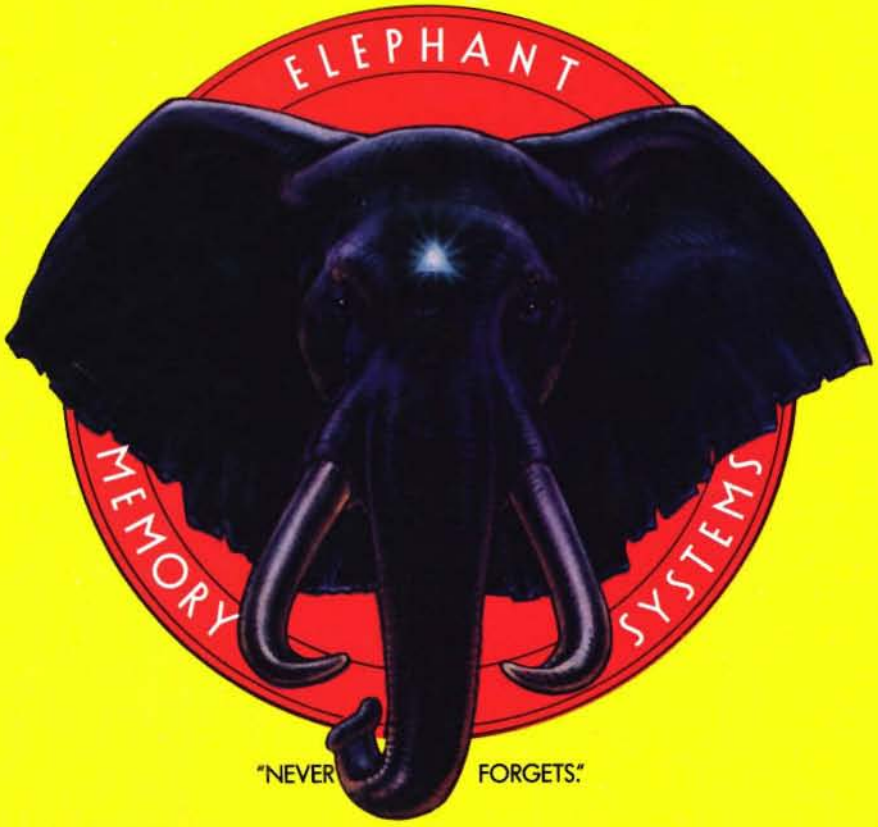
REMEMBER:



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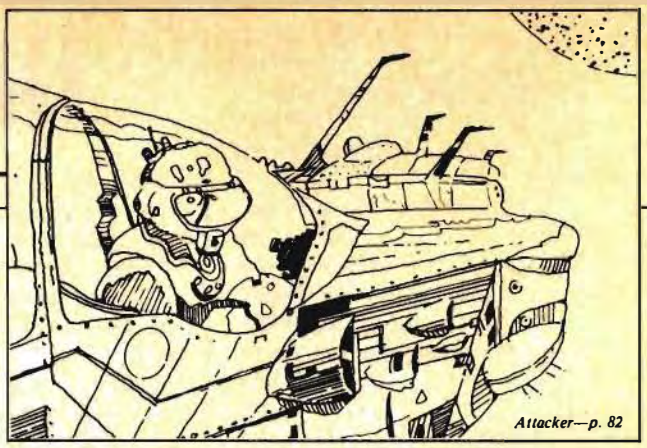
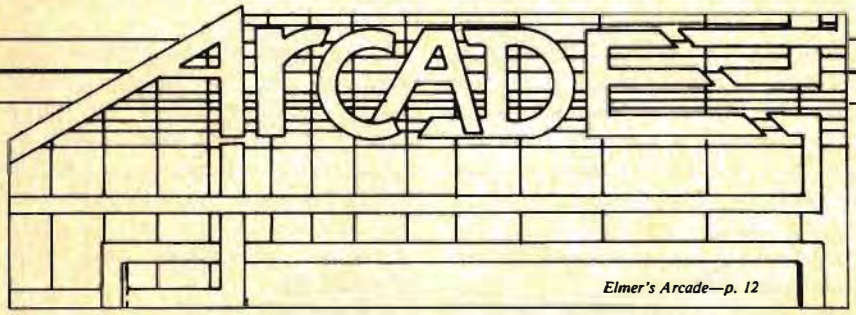
HOT CoCo



ARTICLES

Cover art by Phil Geraci.



DEPARTMENTS

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DIGRESSIONS

TEACH YOUR COLOR COMPUTER A FEW NEW TRICKS

Not everyone is a programmer, so it's hard to put together a Programming Techniques issue that all CoCo users will enjoy. But we think we've achieved a good balance this month for programmers and non-programmers alike.

Most of the articles labeled "Programming Technique" in this issue are more than just that. Henry Grace's "Expansion with a Twist," p. 112, is not only a good demonstration of reorganizing a program during run time, it is also a nice home-finance program.

Our two animation features, "Animate," by Richard Ramella (p. 66) and "Knight Rider," by LeRoy Gross (p. 72), make nice screen displays, as well. If you like computer art, type in the programs in Ken Anderson's "Introduction to Multicolor Graphics—Part III," p. 52. The programmers among you will find his techniques illuminating.

Rodrigue Dugal's "The Game of Towers," p. 92, is a real test of your mental skills, yet it's also a wonderful lesson in recursive programming.

If you are just beginning to learn programming, turn to p. 102 and read James Wood's "Reuse Those Routines." His tutorial should stimulate some programming ideas of your own.

For the advanced programmer we offer Mark Goodwin's "Speedy Assembly Graphics," p. 96. Mark is an Assembly wiz; in fact, this month he also begins a many-part series on disassembling the Color Basic ROM, which should be a treat for anyone who uses or is learning Assembly language.

Instant CoCo

No, this isn't something you drink in front of a roaring fire in January—it's our new tape loader.

Beginning with our January issue, we will offer selected programs from each issue on a monthly tape loader, called Instant CoCo. The programs will be chosen on the basis of length, usefulness, and their overall appeal to CoCo users.

These tapes will be professionally produced with the highest possible quality. We did not come out with a loader with our first issue because we did not think we were prepared at that time to bring you the kind of product you deserved. Check ads in *HOT CoCo* for subscription and price information.

We will also produce a loader for 1983. This will be a "best of" tape featuring the most popular listings from the June to December 1983 issues of *HOT CoCo*.

New Stuff

Many of you have probably seen the new Radio Shack Multi-pak Interface. This device allows four ROM packs to be on-line at once, selectable by either hardware or software. Tandy is a little late in coming out with this device, as there have been several similar units available from third-party

sources for some time. However, it's good to see that Tandy recognized the need for such a product and filled it. Tandy's marketing clout will undoubtedly allow this device to reach a large percentage of CoCo owners, even at its $179.95 price tag.

By the time you read this, the much-rumored-about CoCo II should be available. Without mentioning specifics that we can't confirm, we think this machine will be a well-designed upgrade of the old CoCo we all know and love. All indications point to more memory, a sleeker case, and perhaps a better keyboard.

The introduction of this new CoCo coincides with the announcement of the Dragon-32 being sold and produced in the United States. Dragon Data LTD. of South Wales, United Kingdom, has licensed their work-alike Dragon-32 to the Tano Corp. of New Orleans, LA. The Dragon by Tano, as it's called, will be a 64K machine with features very similar to the Color Computer's, due primarily to its 6809E microprocessor.

The Dragon by Tano is expected to retail for under $400, and it will be carried by department stores and computer outlets. Tano plans to have units ready "for the back-to-school and Christmas buying season."

Most Basic programs for the CoCo will run on the Dragon, provided they do not use incompatible USR calls, so the introduction of the Dragon here should prove a real boon to CoCo users. Although the Dragon will compete with the CoCo II, it will also expand the user base and encourage software companies to come out with more products for the two machines.

The Color Computer looks like it's going to be around for a while; it's even got compatible rivals, much like Apple and the Franklin, or the TRS-80 Model I and the LNW, PMC, and MAX-80. The more units in the marketplace that are software compatible, the better the support will be from the computer industry at large.

New Faces

You might have noticed some new names on our masthead this month. We are growing, and we have been lucky in finding some talented people to fill our needs.

Cynthia Smith is our new Product News editor. Each month she will select which press releases appear in *HOT CoCo*. She is responsible for bringing you the most pertinent and up-to-date information on what's new for the CoCo.

Guy Wright joins us as a technical editor. Guy is the author of the *Help* reference book for the CoCo, and learned Basic at Dartmouth on the computer on which the language was invented. He's also a knowledgeable Assembly programmer. Guy joins Peter Paplaskas on our tech staff. Between Peter's knack for finding bugs in submissions and Guy's knowledge and experience, *HOT CoCo* should be one of the most error-free and technically solid journals available.

Next Month

November is our first-ever Games Issue, and we have a little surprise planned. We can't tell you what it is yet, so you'll have to wait.

But next month's *HOT CoCo* would be a treat without any surprises. If you like simulations, William Bonnell's is a good one. William was a weapons officer on a nuclear submarine, and he now makes his living writing simulation programs. In November his program will put you in charge of a nuclear submarine under attack.

In the world of arcade games, Breakout is a classic. In this game, you knock out sections of multicolored walls by hitting a moving pixel and bouncing it upward. Mark Goodwin has one of the best Color Computer versions we've seen. After playing Smashout, you might be tempted to put a quarter in your disk drive for another play.

Charles Levinski has another simulation: Dragrace. This game takes coordination and good reflexes. It's you against the clock. Can you beat your best time without blowing your engine or jumping the gun?

If gambling's your game, Gabriel Weaver's Jackpot Slots turns your CoCo into a one-armed bandit. It's the next best thing to Reno or Vegas—and you play with the computer's money.

Hockey fans will like Charles Boulanger's Hockey One-on-One. This is a two-player game with a goalie and a shooter. Who can outsmart whom?

November will be something special for game fans, so get out your joysticks and practice—you'll need it.—*M.N.* ■

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The left bracket, [, replaces the up arrow used by Radio Shack to indicate exponentiation on our printouts. When entering programs published in *HOT CoCo*, you should make this change.

HOT CoCo formats its program listings to run 64 characters wide. This accounts for the occasional wrap-around you will notice in our program listings. Don't let it throw you, particularly when entering Assembly listings.

Article submissions from our readers are welcomed and encouraged. Inquiries should be addressed to: *HOT CoCo* Submissions Editor, 80 Pine Street, Peterborough, NH 03458. Include an SASE for a copy of our writer's guidelines. Payment for accepted articles is made at a rate of approximately $50 per printed page; all rights are purchased. Authors of reviews should contact the *HOT CoCo* Review Editor, 80 Pine Street, Peterborough, NH 03458.

Feedback

Re: Re:FLEX

Fantastic! Congratulations on *HOT CoCo*. One of the more interesting departments for me is Re:FLEX by David Wasler. Articles like this are invaluable when it comes to selecting software. My thanks to David, and may he keep it up!

Bud Gilmore
4207 Riverdale
Anaheim, CA 92807

CLEAR for Cavehunt

I've received several letters from readers who have had difficulty running my program, "Cavehunt," which appeared in the June *HOT CoCo* (p. 44).

Those with Extended Color Basic machines get an OM error in line 10. You must clear the high-resolution graphics pages on an Extended Color Basic machine in order to run any Basic program over 8.5K.

I assumed this was common knowledge, because it's explained on page 26 of *Going Ahead with Extended Color Basic*. To solve the problem with "Cavehunt," type PMODEØ: PCLEAR1 before you load and run the program.

I regret any difficulty that has arisen because I didn't point this out in the article.

Charles B. Levinski
10 Southside Ave.
South River, NJ 08882

In Defense of Homebase DBM

I'm not a programmer or a computer whiz under any circumstances, but I have been successful in using the CoCo for home and business applications. As far as data-base managers go, I have probably used about 80 percent of those programs that have come with any positive recommendation.

Many of the programs I've used are good enough for small applications but are too limited in their capacity or else do not handle calculations or amount fields—one feature that I find absolutely necessary.

One program getting a lot of hot press now is Dennis Derringer's Pro-Color-File. It's an outstanding program, but it is quite difficult to learn.

Dennis told me himself that the program will not do file-wide calculations. It will perform the math for a specific record, but it won't perform a specific calculation and have it affect every record in the file.

Homebase, the DBM by Ben Stokes from Homebase Computer Systems, although it has often been regarded as unsatisfactory, is the one program with which I am completely satisfied.

Its documentation is the finest I've seen for any similar program; it's clear and complete. You also get demo files and a step-by-step simulated walk through file manipulations. I'm also impressed with Mr. Stokes' willingness to help with any difficulties that I've found.

I don't have any connection with the Homebase company, but after reading the Pro-Color-File review in *HOT CoCo* and the Homebase one in *80 Micro*, I had to write and express my opinion as a Homebase user.

Rush T. Calley
Business Manager
Church of the Assumption
3214 N.E. 62nd St.
Seattle, WA 98115

Machine-Language Number Crunching?

I would like to see some machine-language to speed up number crunching.

Based on my limited knowledge, it appears that machine language handles integers easily, but has much more difficulty with floating-point arithmetic.

Is it possible to access Basic's floating-point machine-language routines to speed up number crunching? If so, I certainly would like to see an article explaining the method.

I'd like to see an article that explains how to use machine-language calculations to speed up the execution of long, number-related Basic programs (such as hour-long Monte Carlo simulations).

HOT CoCo has many useful articles, and I've found it well worth reading. Keep up the good work!

Raymond M. Ingels
1840 Hendron Way
Monterey Park, CA 91754

We have some Assembly tutorials planned. Perhaps you'll find the information you need in them.—Eds.

Hams and CoCo

I purchased my CoCo to use as part of my ham radio station. For its price and its capabilities, it's a great investment.

Now I'd like to see some articles in *HOT CoCo* of interest to hams, and some ads (i.e., Clay Abrams Software and Multimode).

David J. Johnstone WB1COB
19 Margerie St.
Torrington, CT 06790

We get a lot of mail from hams, but what we need are some hams to write articles.—Eds.

New Address And a BBS

We'd like to announce both our new address and our bulletin-board system.

The address is Silicon Rainbow Products, 1111 W.
Suite 109, Sunnyvale, CA 94087.

We also have version 4.0 of our Color-80 BBS on line. You can access it via modem 24 hours a day by dialing 408-733-6809. The system features uploading, downloading, messages, pictures, rumors, jokes, editorials, and more.

Shawn Jipp
Silicon Rainbow Products
Sunnyvale, CA 94087

Any Users In Ontario?

Kudos for a great publication. *HOT CoCo* and *Rainbow* have become the most widely read magazines in my household. Both of my teenage boys and I are learning more from these two publications than from anything available from Radio Shack.

I would appreciate hearing from any CoCo users in my area who are interested in a user's club. They can contact me at 519-776-7538.

Brian C. Cassidy
118 Laird Ave.
Essex, Ontario N8M 1S3

Meet Me In Phoenix

The Phoenix Color Computer Club is now eight months old and has grown to 78 members. We meet at 7 p.m. on the first Tuesday and third Wednesday of each month at the American Legion Post #1 in Phoenix. Anyone wishing more information can contact me at 602-939-5666.

Phoenix Color Computer Club
Mike Huffman, Secretary
6619 W. Palo Verde Ave.
Glendale, AZ 85302

Meet Me In Philly

The Color Computer User's Group, a section of the Philadelphia Area Computer Society, meets the third Saturday of each month at 10 a.m. in the Science Building of LaSalle College. For further information, contact A. Arnold Weiss, Apt. 1626 Kennedy

Philadelphia, PA 19103.

W
publish an annual list of computer clubs as a source of information for prospective members, and so that nearby groups can plan events.

Carol A. Kueppers,
Corresponding Secretary
108 Lee Circle
Bryn Mawr, PA 19010

See page 120.—Eds

Meet Me in The Tri-Cities

I would like to meet anyone interested in a Color Computer club in the Tri-Cities, WA, area. Reach me at 586-4840.

Thell Rooney
1301 W. John Day Ave.
Kennewick, WA 99336

Meet Me In Halifax

The Halifax-Dartmouth Color Computer User's Group has a new address: P.O.
Nova Scotia, B2Y 3Y9.

We meet on the third Monday of each month in the Dartmouth Regional Library Auditorium at the rear of the building. Meetings are from 7–11 p.m., and our club project is to set up a bulletin-board system.

So far, we have about 20 families who attend.

Bob Hamilton
Dartmouth, N.S.

Meet Me In Columbia

I was very impressed with the premiere issue of *HOT CoCo*. I would especially like to compliment William Clements on his outstanding article on the speech synthesizer ("Speech for the Color Computer," p. 66).

I'd also like to announce the Midlands 80 Computer Club in Columbia, SC. We currently have about 100 members, about 60 of whom are CoCo users.

Anyone who's interested should address correspondence to: President, Midlands 80 Computer Club, P.O. Box 7594, Columbia, SC 29202.

Jerry Kilpatrick
Columbia, SC 29202

Where's Color Basic Programs?

I was happy with the first issue of *HOT CoCo* because it carried articles for Color Basic machines. The second and third issues, however, contained only Extended Color Basic programs, except The Basic Beat.

I hope you'll be carrying more Color Basic articles in the future.

Wm. DeWalt Smith
833 E. Seventh St.
Englewood, FL 33533

Color Basic article submissions are scarce, but we will be including a number of them in upcoming issues. Also, we plan to publish programs for the new MC-10, most of which will be compatible with Color Basic.—Eds.

Contour Graphics On 32K Disk

Thanks for the excellent article on Contour Graphics ("3-D Graphics," June, p. 94). I had a lot of fun with it.

Since I have a 32K disk system, I adapted the programs. Generally, the POKEs for speed-up do weird things to my disk system, so I deleted lines 105 and 165 and changed line 4040 to send control to line 175.

I changed the save prompt in line 200 to read "disk" instead of "tape," and also altered the following lines:

```
4000 CLS:INPUT"FILENAME";FI$:
PRINT"INSERT DISK & PRESS ENTER"
4430 LOADM FI$
5000 CLS:INPUT"FILENAME";FI$:
PRINT"INSERT DISK & PRESS ENTER"
5030 SAVEM FI$, 3584, 9727,0
```

These changes apply to Listings 2, 3, and 4.

Jerry L. Touchton
1517-B Willow St.
Alexandria, LA 71301

Betcha Can't Do It Again

The August *HOT CoCo* was one of the most informative single magazine issues that I've ever read, and I subscribe to the "big four." I don't think you'll be able to do it every time, but the articles on multicolor and the talking calculator are going to be very helpful to me.

Britt Monk, CDP
GALAK Software
925 Dalton Drive
Morristown, TN 37814

Wanted: CoCo

I'm looking for a "previously owned" Color Computer—4K is fine. I don't need any software or peripherals.

Thank you and keep up the good work with *HOT CoCo*.

John Gribbel
Box 425
North Conway, NH 03860

Looks Like I Did The Right Thing

I just wanted to let you know how much your magazine is appreciated here in California. With all the micros on the market, I was beginning to have second thoughts about my CoCo, but now I'm proud of my choice.

With FLEX and OS-9, I have the choice of such computer languages as Pascal, Cobol, Forth, and C, along with the Microsoft Basic. Now I can look Apple owners in the eye and tell them that I own a powerful computer.

Steve Secord
6600 Warner #54
Huntington Beach, CA 92647

Galaxy Trek Errata

In the listing for "Galaxy Trek" (Aug., p. 68), there is an error in line 27: The checksum value at the end of the statement should be 1569 instead of 1659. The statement is otherwise printed correctly, as are all other checksum values in the listing. Thanks to Earl Kamber of Columbia, SC, for catching the transposition.

In addition, disregard lines 63500–63520; the listing should end with line 63070.

Howard F. Batie
12002 Cheviot Drive
Herndon, VA 22070

Disk Modifications

I'm very pleased with the first edition of *HOT CoCo*. It's all a CoCo owner could ask for. But I've found that many machine-language and partial machine-language programs won't work when I have my disk ROM in.

Wouldn't it be helpful if you included a box entitled "Disk Modifications" for those programs that require them? Or, if you really wanted to go all out, you could put in an entire separate listing. This, in my opinion, would make *HOT CoCo* the hottest.

David Van de Vate
820 Ridgefields Road
Kingsport, TN 37660

We'll consider your suggestion; it certainly would help disk owners.—Eds.

More on the SP-1

Thanks for the great review of our SP-1 Serial Interface Board (July, p. 16). Needless to say, we feel the same about our product.

We'd like to add that the SP-1 works equally well on the Epson FX-80, MX-80, and MX-100 printers, although we didn't say so in our original instruction sheets.

C. Navarrete
CNR Engineering
P.O. Box 492
Piscataway, NJ 08854

Looking for MC-10 Users

I've just purchased the new MC-10 Micro Color Computer and would like to start a user's group.

Any interested readers who send me an SASE will receive the group's first newsletter and a member survey inviting them to join.

Bob Kantor
36 Prospect Ave.
Ossining, NY 10562

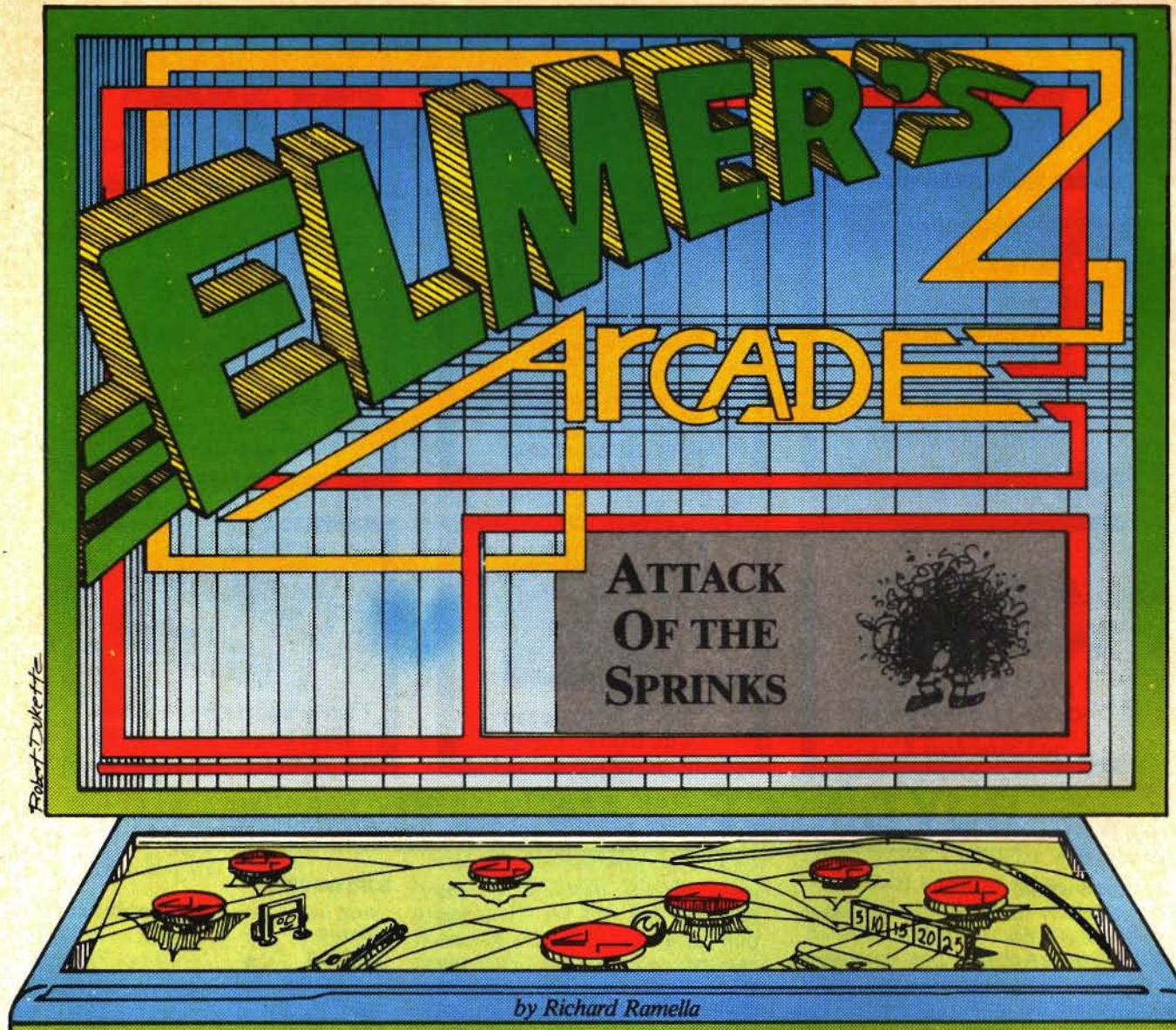
Swapper's Club

Several CoCo owners and I have formed a club called "Color Swap," in which we trade Color Computer machine-language programs that we've written or copied from magazines. Anyone who's interested should contact me.

Timothy Wehner
12541 Norman Road
Yale, MI 48097

Send your letters to Feedback, HOT CoCo, *Pine St., Peterborough, NH 03458.*

↙See List of Advertisers on page 130



by Richard Ramella

When I visit Elmer's Arcade I usually take along a computer magazine, hoping my Cro-Magnon friend will be inspired by all the great game software and put a few video games in his joint. But it doesn't seem to work.

"Oh, this is great," Elmer said, slapping a page of my magazine. "Attack of the Sprinks? You've got to be kidding!"

"It's a very good game," I said defensively. "Give me some nickels so I can play the baseball machine."

"Sure!" Elmer laughed, ignoring me. He read the description of the game: "Help, the world is being attacked by Sprinks, lint-like creatures from another dimension. In this exciting real-time game, it's your task to roam 12 battle sectors in search of Sprinks,
runs out." He could read no more, for he had fallen off his stool in laughter.

"It's too easy to be critical," I said, "now give me those nickels!"

"Have you ever heard anything so stupid?" he said.

I grimaced. "Look at the bottom of the page, Elmer. Notice who wrote that program."

"Yeah," he chortled, "I wonder what kind of bozo would..." He stopped and looked at me with an expression of mild horror. "Oh, you wrote it..."

"I'm the bozo," I said.

"Hey look, I'll bet Sprinks isn't that bad after all. I'm sure if you wrote it..."

"It's a fine program," I said, "a hundred times better than any of the time-worn junk around here. I think I'll keep my quarter and go home for a few exciting games of Sprinks!"

Elmer's sorrowful voice trailed after me as I stomped out the door. It was at least a day and a half before I went back to that dump!

Sprinks

So you be the judge. Would a bozo write a fine game like Sprinks? It's 74 lines of Color Basic that will work on any TRS-80 Color Computer.

In reality, Sprinks is a light chase game, but to inject a certain blood lust

System Requirements

4K RAM
Color Basic

Telewriter-64™

the Color Computer Word Processor

- **3 display formats: 51/64/85 columns × 24 lines**
- **True lower case characters**
- **User-friendly full-screen editor**
- **Right justification**
- **Easy hyphenation**
- **Drives any printer**
- **Embedded format and control codes**
- **Runs in 16K, 32K, or 64K**
- **Menu-driven disk and cassette I/O**
- **No hardware modifications required**

THE ORIGINAL

Simply stated, Telewriter is the most powerful word processor you can buy for the TRS-80 Color Computer. The original Telewriter has received rave reviews in every major Color Computer and TRS-80 magazine, as well as enthusiastic praise from thousands of satisfied owners. And rightly so.

The standard Color Computer display of 32 characters by 16 lines without lower case is simply inadequate for serious word processing. The checkerboard letters and tiny lines give you no feel for how your writing looks or reads. Telewriter gives the Color Computer a 51 column by 24 line screen display with *true lower case characters.* So a Telewriter screen looks like a printed page, with a good chunk of text on screen at one time. In fact, more on screen text than you'd get with Apple II, Atari, TI, Vic or TRS-80 Model III.

On top of that, the sophisticated Telewriter full-screen editor is so simple to use, it makes writing fun. With single-letter mnemonic commands, and menu-driven I/O and formatting, Telewriter surpasses all others for user friendliness and pure power.

Telewriter's chain printing feature means that the size of your text is never limited by the amount of memory you have, and Telewriter's advanced cassette handler gives you a powerful word processor without the major additional cost of a disk.

...one of the best programs for the Color Computer I have seen...
— Color Computer News, Jan. 1982

TELEWRITER-64

But now we've added more power to Telewriter. Not just bells and whistles, but major features that give you total control over your writing. We call this new supercharged version Telewriter-64. For two reasons.

64K COMPATIBLE

Telewriter-64 runs fully in any Color Computer — 16K, 32K, or 64K, with or without Extended Basic, with disk or cassette or both. It automatically configures itself to take optimum advantage of all available memory. That means that when you upgrade your memory, the Telewriter-64 text buffer grows accordingly. In a 64K cassette based system, for example, you get about 40K of memory to store text. So you don't need disk or FLEX to put all your 64K to work immediately.

64 COLUMNS (AND 85!)

Besides the original 51 column screen, Telewriter-64 now gives you 2 additional high-density displays: 64 × 24 and 85 × 24!! Both high density modes provide all the standard Telewriter editing capabilities, and you can switch instantly to any of the 3 formats with a single control key command.

The 51 × 24 display is clear and crisp on the screen. The two high density modes are more crowded and less easily readable, but they are perfect for showing you the exact layout of your printed page, *all on the screen at one time.* Compare this with cumbersome "windows" that show you only fragments at a time and don't even allow editing.

RIGHT JUSTIFICATION & HYPHENATION

One outstanding advantage of the full-width screen display is that you can now set the screen width to match the width of your printed page, so that "what you see is what you get." This makes exact alignment of columns possible and it makes hyphenation simple.

Since short lines are the reason for the large spaces often found in standard right justified text, and since hyphenation is the most effective way to eliminate short lines, Telewriter-64 can now promise you some of the best looking right justification you can get on the Color Computer.

FEATURES & SPECIFICATIONS:

Printing and formatting: Drives any printer (LPVII/VIII, DMP-100/200, Epson, Okidata, Centronics, NEC, C. Itoh, Smith-Corona, Terminet, etc).

Embedded control codes give full dynamic access to intelligent printer features like: underlining, subscript, superscript, variable font and type size, dot-graphics, etc.

Dynamic (embedded) format controls for: top, bottom, and left margins; line length, lines per page, line spacing, new page, change page numbering, conditional new page, enable/disable justification.

Menu-driven control of these parameters, as well as: pause at page bottom, page numbering, baud rate (so you can run your printer at top speed), and Epson font. "Typewriter" feature sends typed lines directly to your printer, and Direct mode sends control codes right from the keyboard. Special Epson driver simplifies use with MX-80.

Supports single and multi-line headers and automatic centering. Print or save all or any section of the text buffer. Chain print any number of files from cassette or disk.

File and I/O Features: ASCII format files — create and edit BASIC, Assembly, Pascal, and C programs, Smart Terminal files (for uploading or downloading), even text files from other word processors. Compatible with spelling checkers (like Spell 'n Fix).

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— The RAINBOW, Jan. 1982

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weeks for personal checks. Send self-addressed stamped envelope for Telewriter reviews from CCN, RAINBOW, 80-Micro, 80-U.S. Telewriter owners: send SASE or call for information on upgrading to Telewriter-64. Telewriter-compatible spelling checker (Spell 'n Fix) and Smart Terminal program (Colorcom/E) also available. Call or write for more information.)

into the proceedings, I fantasized that the playing field, a white-bordered area of 12 connected cells, is actually a dozen battle sectors. The orange dot that first appears near the middle of the field is you. You maneuver throughout the grid by holding down any of the four directional arrow keys.

Sprinks are the magenta dots that appear one at a time randomly throughout the rectangle.

The object of the game is to race to the Sprink and cover its position, in that way eliminating it. That scores a point for you. If you don't reach the Sprink in time, that chalks up one for the invaders. A running score appears at the top of the screen. The score is most useful for keeping track of the rounds you've played and the Sprinks that have escaped. When the Sprinks score five times, the game ends.

More important is the Megascore at the bottom of the screen. It's based on how long it takes you to reach a Sprink during a round. If you don't reach the Sprink, you add nothing to the Megascore and lose the round besides. In each succeeding round there's less time to reach the Sprink.

If you get a Megascore of 5 million or more, you're doing well. A score of 6 million means you're definite material for the military. And 7 million? You already know sleight-of-hand magic. I'd say a score of 8 million or more is impossible, but then I also once said Donky Kong was not going to last more than two months.

```
100 REM * SPRINKS * TRS-80 COLOR
 BASIC 4K *
110 REM * ELMER'S ARCADE #4 * OC
T. '83 * RICHARD RAMELLA
120 CLS(0)
130 V=500
140 FOR A=1 TO 32
150 M$=M$+CHR$(128)
160 NEXT A
170 FOR A=1 TO 32
180 A$=A$+CHR$(207)
190 NEXT A
200 B$=CHR$(207)
210 C$=CHR$(128)
220 FOR A=32 TO 416 STEP 128
230 PRINT @ A,A$;
240 NEXT A
250 FOR A=32 TO 416 STEP 32
260 FOR B=0 TO 31 STEP 8
270 PRINT @ A+B,B$;
280 NEXT B
290 PRINT @ A+31,B$;
300 NEXT A
310 FOR A=4 TO 28 STEP 8
320 PRINT @ 160+A,C$;
330 PRINT @ 288+A,C$;
340 NEXT A
350 PRINT @ 232,LEFT$(M$,17);
360 A=32
370 B=14
380 RESET(X,Y)
390 SET(A,B,8)
400 X=RND(60)+2
410 Y=RND(23)+2
420 IF X=A AND Y=B THEN 400
430 IF POINT(X,Y)<>5 THEN SET(X,
Y,7) ELSE 400
440 TIMER=0
450 IF TIMER=>V THEN 670
460 SET(A,B,8)
470 IF A=X AND B=Y THEN 540
480 M=A
490 N=B
500 IF(PEEK(341)AND8)=0ANDPOINT(
A,B-1)<>5THENB=B-1ELSEIF(PEEK(34
2)AND8)=0ANDPOINT(A,B+1)<>5THENB
=B+1ELSEIF(PEEK(343)AND8)=0ANDPO
INT(A-1,B)<>5THENA=A-1ELSEIF(PEE
K(344)AND8)=0ANDPOINT(A+1,B)<>5T
HENA=A+1
510 RESET(M,N)
520 GOTO 450
530 REM
540 PRINT @ 0,M$;
550 PRINT @ 0,"YOU GOT IT !";
560 J=J+(V-TIMER)
570 PRINT @ 480,"MEGASCORE:";STR
$(J)+"000";
580 FOR T=1 TO 2
590 SOUND 218,1
600 SOUND 213,1
610 SOUND 204,2
620 SOUND 193,2
630 SOUND 176,4
640 NEXT T
650 P=P+1
660 GOTO 770
670 PRINT @ 0,"TIME'S UP. THE SP
RINK ESCAPES";
680 S=S+1
690 FOR T=1 TO 5
700 SOUND 204,1
710 FOR G=1 TO 100
720 NEXT G
730 SOUND 32,1
740 FOR G=1 TO 100
750 NEXT G
760 NEXT T
770 PRINT @ 0,M$;
780 V=V-5
790 PRINT @ 0,"SCORE: YOU-";P;"
SPRINKS-";S
800 FOR T=1 TO 1000
810 NEXT T
820 IF S=5 THEN PRINT @ 0,M$;: P
RINT @ 0,"SPRINKS PREVAIL...";:
PRINT@ 480,"BUT NICE MEGASCORE:"
;STR$(J)+"000";: SOUND RND(13)*8
,1: GOTO 820 ELSE 380
830 END
```

Program Listing. Sprinks

Programming Notes

Be careful typing in line 500; to speed the program execution, I've run everything together at a place where a lot of decisions have to be made quickly. This line allows you to move the orange dot by holding down an arrow key. Without this feature the game has no speed.

The CoCo's internal timer is helpful in this game. In each round, the timer is set at zero in line 440. In line 130 V = 500, you obtain the starting limit of time for a round. Line 450 says: If the timer has reached or exceeded the value of V, then the player hasn't reached the Sprink in time, so go to the loser routine starting at line 670.

After each round of play, V is reduced by five, so eventually it becomes impossible to reach a Sprink, no matter how good you are. This is a necessary fail-limit required to make the game interesting. It is greatly helped by the internal timer, which assures the timing is the same, no matter what may be happening elsewhere in the program.

To move a SET(X,Y,Z) graphic around the screen, it's necessary to turn on the light, turn it off, and move its position. This can produce a jerky situation, especially when the light must be turned off during the time the program logic is dealing with what to do next, as in line 500. I averted this situation by storing the SET(X,Y,Z) values in a safe-deposit box, then withdrawing them when needed later.

"After each round of play, V is reduced by five, so eventually it becomes impossible to reach a Sprink, no matter how good you are."

Here's how: Line 460 SET(A,B,8) turns on the orange player light. Lines 480 M = A and 490 N = B store the orange dot's value. Line 500 can change the dot's position, but that's okay because you use line 510 RESET(M,N) to turn off the old position, then return to the lines starting at 450 and in line 460 SET(A,B,8) to turn on the new position. Using this routine eliminates any jerky movements by graphics.

And last, I'll help you if you have trouble getting Sprinks to run if you'll send a self-addressed stamped envelope (Canadians 40 cent Canadian and self-addressed envelope) to me: Richard Ramella, 1493 Mt. View Ave., Chico, CA 95926. If you have a printer, send a listing of the program as it exists in your machine. If not, report the error message and where it's occurring, and describe the problem. I cannot advise on any program that has been modified, so save enhancements until you get it running correctly. ■

See List of Advertisers on page 130

The Basic Beat

First Steps To Basic Programming Lesson 5

by James W. Wood

This column has reached the halfway mark. Do you feel like half an expert? How about a midterm exam? Take out your pencil and see how much you can remember.

I'll begin this month's lesson with a discussion of PRINTTAB. Program Listing 1 shows how you can use this command to print titles. The 13 creates enough space for 13 characters in front of the word "Title".

Never leave a space between the word TAB and the left parenthesis. If you do, and if the number in parentheses is less than 11, the computer will print a zero followed by the phrase in quotes. If you leave a space and if the number is greater than 10, you'll probably get a BS error, and you don't even learn about BS until next month.

The number in parentheses can range from 0–255. Whenever the number is larger than 32, the computer will print below the top line. Change the 13 in Listing 1 to 45 or 77. Notice that adding multiples of 32 will move the "TITLE" straight down on the screen.

If you change line 10 to CLS2, PRINTTAB will change all the yellow in front of "title" to green. If you wish to print a word completely surrounded by a different color, you must use PRINT@.

Sometimes a semicolon must follow TAB to produce the proper result. Program Listing 2 prints 5, 15, and 25 on different lines. Change lines 20 and 30 to end with a semicolon, and the three numbers will appear on the same line. Many business-type programs use TAB to produce columns of numbers or other information.

Program Listing 3 is a checkbook checker. It lists deposits to the left, withdrawals in the middle, and balance on the right.

```
10 CLS
20 PRINTTAB(13)"TITLE"
```

Program Listing 1

```
10 CLS
20 PRINTTAB(5)"5"
30 PRINTTAB(15)"15"
40 PRINTTAB(25)"25"
```

Program Listing 2

```
10 CLS
20 INPUT"STARTING BALANCE";B
30 INPUT"DEPOSIT OR WITHDRAWAL (
D/W)";A$
40 INPUT"AMOUNT";A
50 IFA$="D"THEN B=B+A:PRINTTAB(5
)A;TAB(22)B
60 IFA$="W"THENB=B-A:PRINTTAB(12
)A;TAB(22)B
70 GOTO30
```

Program Listing 3

Place the letter preceding the correct explanation within the parentheses in front of the following Basic commands:

( ) 1.	INPUT	A.	turns off smallest graphics block
( ) 2.	GOTO	B.	causes computer to stop and wait for response
( ) 3.	CLS	C.	can be used to increase available string space
( ) 4.	MEM	D.	makes any number positive
( ) 5.	CLOAD	E.	used in IF statement to require two or more conditions to be true
( ) 6.	CLEAR	F.	directs program to a specific line
( ) 7.	RND	G.	prints information at any screen position
( ) 8.	SOUND	H.	determines SET position's color
( ) 9.	SET	I.	can be used to enter information into computer without stopping animation
( ) 10.	POINT	J.	erases printing on screen
( ) 11.	PRINT@	K.	shows program on screen
( ) 12.	INT	L.	random numbers
( ) 13.	RETURN	M.	rounds non-whole number down to next lowest whole number
( ) 14.	AND	N.	determines unused RAM
( ) 15.	INKEY$	O.	erases program
( ) 16.	LIST	P.	part of a FOR loop
( ) 17.	RESET	Q.	transfers program from tape to computer's memory
( ) 18.	ABS	R.	creates musical notes
( ) 19.	NEXT	S.	used with GOSUB
( ) 20.	NEW	T.	turns on smallest graphics block

Midterm

```
10 CLS
20 FORX=1 TO 25
30 PRINTTAB(X)"HURRY"
40 NEXTX
```

Program Listing 4

```
10 CLS
20 POKE1024,72
30 POKE1025,69
40 POKE1026,76
50 POKE1027,80
60 GOTO60
```

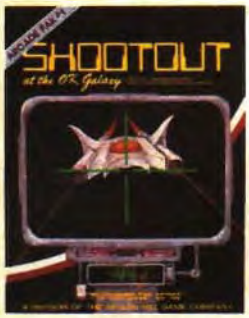
Program Listing 5

System Requirements

4K RAM
Color Basic

eeny meeny miney mo

FIVE HOT GAMES FOR YOUR HOT CoCo



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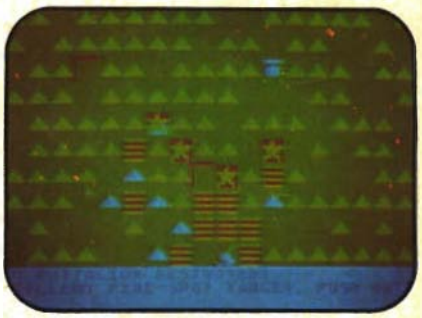

VC Screen

SHOOTOUT (at the OK Galaxy)

0 ALIEN WARSHIPS HAVE ENTERED YOUR PATROL ZONE. OK, hields up?, energy level . . . check, azimuth set? Yup. This may sound ke the latest summer space movie thriller but in fact it's the preparations OU will make when playing Avalon Hill's new **arcade** strategy game HOOTOUT AT THE OK GALAXY. Over 2 years in the making, HOOTOUT is purely graphical combining arcade excitement with just the ight touch of strategy.

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You can use TAB with variables for graphing mathematic curves; however, the limited number of screen positions on the Color Computer text screen make this use of TAB more limited than usual. SET graphics are a more efficient way of creating graphs—perhaps I should use this as a future topic.

Program Listing 4 uses TAB with a variable to create a display that you might work into an adventure game or educational program.

POKE

Give your Color Computer a little POKE. This command stores numbers into computer memory locations. The video memory is the easiest place to see the results of POKE. The contents of the monitor screen are stored here. Video memory ranges from locations 1024–1535. To determine a video POKE location, add 1024 to the PRINT@ position.

Program Listing 5 POKEs values into the first four screen positions. How did the word "help" appear? Line 20 POKEd the number 72 into memory location 1024. This location is the first position of video memory, the upper left corner of the screen.

The computer stores letters as numbers. The number 72 represents the letter H. The alphabet ranges from 65 for A to 90 for Z. These numbers are listed in your owner's manual under the heading, "ASCII Character Codes." You can ask the computer for the ASCII (American Standard Code for Information Interchange) code of any letter. To find the code for A, for example, simply type PRINT ASC("A") and press enter.

There are ASCII codes for graphic characters also. You can't use this method to create any display that you can't create with SET, but it will be faster.

POKEing an ASCII code for a graphic fills a PRINT@ position, each of which is composed of four SET positions. One position cannot have two different colors, but it can have a combination of black and one other color. Use Table 1 to determine ASCII code required for a graphic.

How do you make PRINT@ location 300 yellow in the upper left and lower right corners? Add 300 to 1024 to give the memory location. From Fig. 1 add 144 to 8 and 1, yellow's starting number plus the upper left and lower right numbers. The command, therefore, is POKE1324,153.

Program Listing 6 shows all possible graphic characters.

Run Program Listing 7 for a dem-

Green	128 +
Yellow	144 +
Blue	160 +
Red	176 +
Buff	192 +
Cyan	208 +
Magenta	224 +
Orange	240 +

Table 1. ASCII Codes for POKE and STRING Graphics

```
10 CLS0
20 FORR=1 TO 50
30 A=128+RND(127)
40 B=1296
50 C=RND(7):D=RND(15)
60 POKEB-C*32-D,A
70 POKEB-C*32+D,A
80 POKEB+C*32-D,A
90 POKEB+C*32+D,A
100 NEXTR
110 GOTO10
```

Program Listing 7

8	4
2	1

Fig. 1. ASCII Codes for the Quadrants in a PRINT@ Position

```
10 CLS0
20 POKE1199,67:POKE1200,90
30 POKE1209,255:POKE1300,134
40 PRINTPEEK(1199);PEEK(1200);
50 PRINTPEEK(1209),PEEK(1300)
```

Program Listing 8

```
10 CLS0
20 FORX=128TO255
30 POKE1024+X,X
40 NEXT
50 GOTO50
```

Program Listing 6

```
10 CLS0
20 SET(0,0,8):SET(0,1,8)
30 SET(1,0,8):SET(1,1,8)
40 PRINT@64,PEEK(1024);
50 GOTO50
```

Program Listing 9

The Basic Beat

onstration of some POKE graphics that might inspire you in your next program. In Listing 7, lines 60–90 POKE a graphic pattern into four positions symmetrical to the center of the screen to create an electronic kaleidoscope of sorts. The variable C determines lines above or below the center of the screen, and D determines distance left or right of center. With careful planning, you can use POKE to create many screen displays.

SET graphics use the POINT command to recognize a screen SET position's color. POKE graphics use the PEEK command to tell what was POKEd into a memory location. PEEK returns the ASCII code for the contents of a particular memory location. Program Listing 8 is a short example of PEEK.

But what if SET, and not POKE, has colored the video? Program Listing 9 uses SET to color all four SET positions in the PRINT@0 position orange. PEEKing memory location 1024 (the PRINT@0 position) prints a value of 255. Check Table 1 to see that a solid orange has a value of 255. In other words, it doesn't matter how the upper left corner became orange. The value stored in memory location 1024 is 255 whenever the PRINT@0 position is all orange.

Program Listing 10 POKEs solid colors onto each position of the screen. If you calculate all the values for A in line 30, you will see that the only possibilities are the eight numbers representing solid colors (143,159,175, 191,207,223,239,255). Note that adding 16 to an ASCII code for a graphic results in the same pattern, but the next color.

I would write a program to draw a picture on the screen, but I don't want to step in on your creativity. You can only POKE one position at a time. However, you can use FOR... NEXT loops to fill locations with the same value, thus saving lots of typing.

Program Listing 11 creates a Martian landscape. You can add your own

```
10 CLS0
20 FORW=1024 TO 1535
30 A=127+16*RND(8)
40 POKEW,A
50 NEXT
60 GOTO20
```

Program Listing 10

spaceship, men, or whatever. In line 20, you can add the 1024 to 480 before typing the line. I left it this way to make it easier to find the PRINT@ positions when studying the program. Lines 130–150 create a random star pattern.

You'll find a POKE game in Program Listing 12. At the start, the screen shows a blank green display. A line begins moving from center screen, and you control its direction left and right with the < and > keys (or, the comma and period). The A and Z keys move it up and down, respectively.

Each location changes to yellow as the line passes over it. When the yellow line crosses itself, the location changes to blue. Crossing blue changes it to red, and so on, until the location has turned to orange. Trying to cross an orange location ends the game, and the variable, CT, records and displays the number of moves you scored.

C=C+16 advances one color to the next. Note how lines 20 and 30 allow the INKEY$ to keep a line moving so that you don't have to continuously tap the keyboard. What is the greatest possible number of moves?

READ, DATA, and RESTORE

The READ, DATA, and RESTORE commands store information (numbers or strings) within a Basic program. After reading the data, the program can print it, set it, sound it, or use about any command with it.

One primary use of a DATA line is to store words (or food). Run Program Listing 13. Big deal, right? The first time the READ statement reads APPLE. Next time through the loop, it reads BANANA.

The program keeps track of the data items you've used, and READ statements read the next item. You could replace lines 50–90 in Listing 13 with 50 DATA APPLE, BANANA, CHERRY, DONUT, EGG. This saves memory and typing time. To read string variables (words) use a string variable, N$.

"This method of storing values. . . Takes much less memory than do values stored in DATA lines."

DATA lines can store numbers also. Program Listing 14 reads two values at a time and uses them to program the length and tone in a SOUND statement. If the song plays too fast, make this change: 30 SOUND U,2*V. If your READ statement includes two DATA variables (i.e., U,V), then it will read the next two DATA values, setting U equal to the first and V equal to the second.

Before you NEW Listing 14, rewrite it into Program Listing 15. Run the program; you'll see that it works exactly the same. Now erase lines 10–90 by typing DEL 10–90, and press enter. Run the program again. Amazing, it still works—but how?

Line 10 CLEARed 200 bytes of memory for string storage and reserved memory locations 16350 to top of memory (16383 in 16K). Most Basic commands cannot alter reserved memory, and even NEW will not erase such information. POKE is the only command that can alter the reserved memory.

Line 30 POKEd the values that were in DATA lines into high memory. Lines 100–120 PEEK into memory to find the values for the length and pitch of the tone that line 130 sounds. This method of storing values (POKE into memory, then erasing the DATA lines) takes much less memory than do values stored in DATA lines. If you have a 4K computer, you'll need to change the number 16350 to a number 33 less than the top of a 4K memory.

Program Listing 16 reads the variables three at a time. They represent the X and Y coordinates and the color for a SET command. Notice that I placed the DATA lines first in this program. You can put them at the beginning, middle, or end of the program.

Can you use numbers and strings in one program? Program Listing 17 is

```
10 CLS0
20 FORW=1024+480 TO 1024+511
30 POKEW,191:NEXTW
40 FORW=1024+450 TO 1024+460
50 POKEW,191:NEXTW
60 FORW=1024+470 TO 1024+475
70 POKEW,191:NEXTW
80 POKE1024+469,177
90 POKE1024+476,178
100 POKE1024+449,177
110 FORW=1024+420 TO 1024+426
120 POKEW,191:NEXTW
130 FORW=1024 TO 1120
140 IF RND(10)=1 THEN POKEW,193
150 NEXTW
160 GOTO160
```

Program Listing 11

```
10 CLS1:P=1296:A$="."
20 B$=INKEY$:IFB$=""THENB$=A$
30 A$=B$
40 IF B$="."THEN P=P+1
50 IF B$=","THEN P=P-1
60 IF B$="A"THEN P=P-32
70 IF B$="Z"THEN P=P+32
80 IF P<1024 THEN P=1024
90 IF P>1535 THEN P=1535
100 CT=CT+1
110 C=PEEK(P):IF C=255 THEN CLS:
PRINT@200,CT;"MOVES":END
120 C=C+16:POKEP,C:GOTO20
```

Program Listing 12

```
10 CLS:FORA=1TO5
20 READ N$
30 PRINT N$
40 NEXT
50 DATA APPLE
60 DATA BANANA
70 DATA CHERRY
80 DATA DONUT
90 DATA EGG
```

Program Listing 13

```
10 FOR A=1 TO 17
20 READ U,V
30 SOUND U,V
40 NEXTA
50 DATA147,3,133,1,125,2
60 DATA108,2,89,2,108,2
70 DATA125,2,89,2,108,1
80 DATA125,1,133,1,108,1
90 DATA125,3,108,1,89,2,78,2,89,
4
```

Program Listing 14

```
10 CLEAR200,16350
20 FOR A=0 TO 33
30 READ D:POKE A+16350,D:NEXT A
50 DATA147,3,133,1,125,2
60 DATA108,2,89,2,108,2
70 DATA125,2,89,2,108,1
80 DATA125,1,133,1,108,1
90 DATA125,3,108,1,89,2,78,2,89,
4
100 FOR A=0 TO 33 STEP 2
110 X=PEEK(16350+A)
120 Y=PEEK(16351+A)
130 SOUND X,Y:NEXT A
```

Program Listing 15

```
10 DATA2,4,3,4,8,5,12,24,2
20 DATA14,18,8,16,12,2,18,18,1
30 DATA22,24,5,26,26,6,28,30,4
40 DATA40,30,4
50 CLS0
60 FOR A=1 TO 10
70 READ X,Y,Z
80 SET(X,Y,Z)
90 NEXT A
100 GOTO100
```

Program Listing 16

my black-book program. You can substitute male names if that would be more appropriate to your gender. The DATA lines store names, hair and eye color, height, and weight. You can add more DATA lines as long as line 500 is the last one. You can choose to search your list by hair or eye color (sounds like the basis for a lasting relationship).

```
10 CLS
20 PRINT"CHEAP GENERIC BLACK BOO
K"
30 INPUT"CHOOSE HAIR OR EYE COLO
R (H/E)";A$
40 IF A$="H" THEN 50 ELSE IF A$=
"E" THEN 60 ELSE 30
50 INPUT"COLOR OF HAIR DESIRED";
HD$:GOTO70
60 INPUT"COLOR OF EYES DESIRED";
ED$
70 PRINT"NAME, HAIR, EYES, HEIGH
T, WEIGHT"
80 READ N$,H$,E$,H,W
90 IF A$="H" AND H$=HD$ OR A$="E
" AND E$=ED$ THEN PRINT N$;" ";H
$;" ";E$;" ";H;" ";W
100 IF N$="END" THEN PRINT "NO M
ORE":RESTORE:GOTO30
110 GOTO80
200 DATA BRENDA,BROWN,BROWN,62,1
03
210 DATA SONYA,BLACK,BROWN,62,10
5
220 DATA SIGI,BLOND,BROWN,68,115
230 DATA DEANNA,BROWN,BLUE,65,13
5
240 DATA TONYA,BLOND,GREEN,70,13
0
500 DATA END,END,END,0,0
```

Program Listing 17

Line 80 reads the variables from the DATA lines. Line 90 compares what you asked for with what is available. Line 90 says that if it finds the hair or eye color for which you're searching, it will print out all the data for that person. Line 110 sends the program to line 80 to read more data, unless line 100 stops the process.

If the CoCo reads an END from the DATA line, the data is restored. This command resets the DATA statements so that READ will again start with the first DATA item. If RESTORE was not a command, you would have to restart the program with RUN each time you did another search.

1B, 2F, 3J, 4N, 5Q, 6C, 7L, 8R,
9T, 10H, 11G, 12M, 13S, 14E,
15I, 16K, 17A, 18D, 19P, 20O

Answers to Midterm

Phone numbers could be added to Program Listing 17. For this it would be best to use a string variable (i.e., PN$), because this allows you to type the phone numbers in the three-digit-dash-four-digit form (i.e., 555-1212). You can store any number in data as strings.

It's best to store large numbers, such as serial numbers, as strings. Otherwise, the computer might convert them into scientific notation. If you're going to use a number in a mathematical operation (+, −, *, /, etc.) or in a command such as SET or POKE, then it would be easier to read it as a number than as a string.

No applause, but lets have an ARRAY for next month. ■

Write to James Wood c/o HOT CoCo, *80 Pine St., Peterborough, NH 03458.*

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REVIEWS

CONTENTS

edited by Janet Fiderio

DynaCalc
Computer Systems Center
13461 Olive Blvd.
Chesterfield, MO 63017
64K, FLEX
$200

by Scott L. Norman

DynaCalc is a FLEX-based spreadsheet that lets CoCo owners enjoy all the advantages of the highly touted visiclones and calcalikes that run on CP/M systems. I do mean all of the advantages; this is a potent, full-featured package.

A spreadsheet is an array of rows and columns whose intersections, or cells, can be filled with data. Formulas relating the values in certain cells to the values in others are embedded in the structure. The great contribution of computerized spreadsheets is that they accept a change in one variable and immediately recalculate all values that depend on it. This provides the business user with a chance to examine alternatives. A few keystrokes are enough to generate the answers to a host of "what if" questions.

Although this instant recalculation capability is the hallmark of the electronic spreadsheet, most serious programs of this type offer quite a bit more: built-in mathematical and statistical functions, file handling, and flexible report formatting. Based on my experience with Sorcim's SuperCalc, I can say that DynaCalc is comparable with the best of the mainstream packages.

It isn't practical to go through a complete tabulation of DynaCalc's features in a short review; after all, there are 15 major commands, 58 subcommands, and 26 predefined functions. What follows, then, is my subjective tour of the high points.

Setting Up

Although you can use a single-drive system, DynaCalc is easier to use if two drives are available. I keep my FLEX system disk in drive 0 and use drive 1 for a working disk holding DynaCalc's four files and the spreadsheets I am working on. This means that I have to make copies of DynaCalc from time to time, but there is a reason for doing things this way: DynaCalc has no printer-driver routine of its own. Therefore, you must use the FLEX driver to avoid a "No Driver!" message.

This is easily done if the system disk resides in one drive while DynaCalc is in another. To give DynaCalc the name of the driver (I use P, the stock routine), I merely call the spreadsheet with P 1.DYNACALC at the beginning of a session. In a single-drive system, I would add the P.CMD file to the work disk. It would be difficult to fit DynaCalc onto the system disk; the necessary files take 138 sectors.

DynaCalc's first display is of the upper left position of the spreadsheet and two lines of system information. These location and status lines carry data such as the present location of the cursor, the amount of memory remaining, and subcommands available when a command is entered.

A third edit line appears when you begin to enter data; this echoes keyboard entries before the enter key sends them to the cell where the cursor is located.

DynaCalc follows the established spreadsheet convention of labeling rows by numbers and columns by letters. The column is given first when specifying a location in the matrix.

An empty DynaCalc spreadsheet contains 256 rows and 256 columns, for a total of 64K cells. In practice, the 29K or so of memory available to a fresh worksheet suffices for roughly 3,000 cells of numerical data. You can free up another 6.5K by deleting the program's "Help" screens.

The Commands

You can fill the spreadsheet's cells with numbers, formulas, or labels. The arrow keys move the cursor one cell at a time. There is no auto-repeat function, but there is a shortcut for long-distance moves. Unfortunately, it is far from obvious; you must hold down three keys—shift, up arrow, period—just to generate a GOTO prompt on the edit line. Then you can specify the destination cell and proceed to fill it. In contrast, the SuperCalc equivalent uses the equal key followed by the destination.

DynaCalc provides a quick way of returning to the home position (cell A1) from any point on a spreadsheet: just press the greater-than sign.

How does the system know how to interpret a given cell entry? An entry beginning with a numeral is considered to be a number, one beginning with a single quote is a label, and one beginning with a mathematical operation symbol is a formula. The leading quotes and operators do not appear on the spreadsheet itself.

You can use scientific notation for large and small numbers: 3e25, 7e−16, and so on. You can specify column widths (the default is nine positions), and labels can extend over many columns.

To set up column specifications you indicate a command with the slash key

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DYNACALC will let your computer do just about anything you can imagine. Ask your friends who have VisiCalc, or a similar program, just how useful an electronic spread-sheet program can be for all types of household, business, engineering, and scientific applications.

DYNACALC is designed to be used by non-programmers, but even a Ph.D. in Computer Science can understand it. Built-in HELP messages are provided for quick reference to operating instructions.

DYNACALC has a beautifully simple method of reading and writing FLEX data files, so you can communicate both ways with other programs on your system, such as the Text Editor, Text Processor, Sort/Merge, RMS data base system, or other programs written in BASIC, C, PASCAL, FORTRAN, and so on.

Except for a few seldom-used commands, DYNACALC is memory-resident, so there is little disk I/O to slow things down. The whole data array (worksheet) is in memory, so access to any point is instantaneous. DYNACALC is 100% 6809 machine code for blistering speed.

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followed by a single letter, which stands for the command itself. A single-line menu will remind you of the command initials, while the back cover of the DynaCalc manual provides a vital guide to their identities. Many commands have their own options, indicated by the same type of menu. Typing a question mark when a subcommand is expected brings up a Help screen.

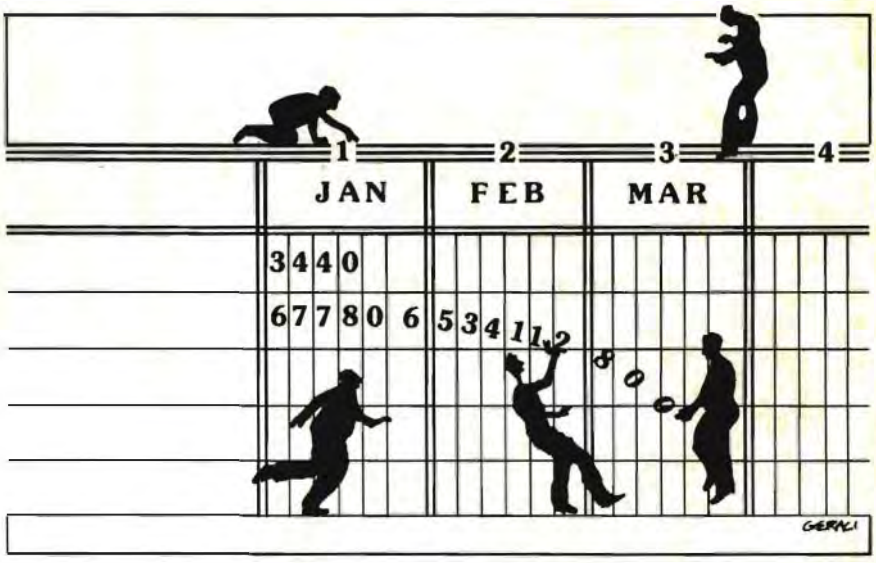
Column widths can be changed by the attribute command, /A, a catch-all that controls 12 print and video display properties. The C (for column) option brings up a typical subcommand menu: C W ?

The three options are to change just one column, change all columns in the current video window, or call for help. The first two options get you information about the current column width and a request for the new setting. The maximum width is 47 spaces.

The most interesting options available under the attributes command are

- D—toggles a degrees/radians switch for the arguments of trigonometric functions.
- G—lets you select a graphing character. DynaCalc can replace a column of figures with a horizontal-format bar graph to help you visualize trends in the data.
- L—a subcommand that lets labels extend across as many cells as needed, regardless of the cells' individual widths. This is extremely useful for setting up headings for related columns and for an entire worksheet. It is best to set the column widths first, though; otherwise gaps might appear in neatly formatted labels when underlying columns were changed.
- P—a printer/textfile subcommand used to specify whether printed spreadsheets will have row and column coordinates, and to set the number of lines per page, the line length, the pagination, and multiple line feeds.
- S—reports the highest row and column number being used on a spreadsheet (a necessary specification for printing and merging operations).
- R—is an automatic recalculation toggle. Even though automatic updating is what you buy spreadsheets for, there are times when it is not wanted. For example, you might want to make several changes in a sheet that has a lot of calculations, but might not want to run through the recalculations until all the changes were entered. The manual command "!" can force a recalculation at any time.

These are just a few of the options available under one command. DynaCalc also has the expected commands for editing the data in cells, and for formatting a spreadsheet. These are very complete, indeed.



You can work on the format of the current cell with the /F command, or set up every cell in the current window with /WF. (A DynaCalc sheet can be split into two windows, so that you can view widely separated regions at one time.)

Numerical entries are displayed as integers, floating-point numbers, or fixed-point numbers with two decimal places. You can select the default justification rules (labels to the left, numbers to the right) or specify left- or right-justification for everything in a cell.

One peculiarity: Trailing zeros are dropped from fixed-point numbers, which can make a column of dollars-and-cents items look a little ragged.

Report borders and separation lines are generated through the "continuous format" option. This option repeats any entry across the width of the current cell.

You can clear individual cells of data, and delete or move complete rows and columns. The move command also has options for performing ascending or descending sorts on any specified row or column. Choose one, and you are prompted for the range of cells to be sorted. You respond with the first address, the separator character (a period), and the last address.

The spreadsheet is promptly sorted, and all formulas are automatically adjusted to keep pace with the new arrangement of data. There is a sorting hierarchy—alphabetic characters, then numerals stored as labels, then numerical data—but it can be overridden.

As you might expect, sorts can be performed in sequence. This, together with the ability to print out selected portions of the spreadsheet, gives DynaCalc a simple file-management capability.

The printed page is not DynaCalc's only output medium. You can easily direct the output to disk in standard FLEX text-file format. The command is /O, and all you have to do is specify a file name and the range of cells to be included.

CSC contends that DynaCalc files can be manipulated by other FLEX programs, although I did not attempt to do so for this review. Of particular interest is the possibility of two-way file passing between DynaCalc and one of the FLEX data-base management systems. That should be possible, and would certainly represent a desirable degree of software integration.

Spreadsheets (including format commands) can also be saved to disk in a format suitable for reloading into DynaCalc. The system command, /S, is used. Loading a stored worksheet does not first clear RAM, so it is possible to merge sheets. Be careful to avoid conflicting requirements for

particular cells.

There is also an Execute option, /SX, that lets you temporarily exit to FLEX and return without disturbing the worksheet. Some FLEX commands (COPY, NEWDISK, EDIT, and others) use low memory and can conflict with DynaCalc; avoid these. Among the useful safe commands are CAT, LIST, RENAME, and PROT.

Replication—the ability to automatically generate formulas for a range of cells, each referring to the proper locations for input data—is central to the concept of the modern spreadsheet program. DynaCalc handles the task in a typically neat manner, using the /R command.

Entering /R brings up prompts for a range of source cells and destinations. If the source is a single cell containing a formula, a copy appears on the prompt line and you are asked "(S)ame or (R)elative" for each cell address in the formula. A one-stroke command would be easier to control for long calculations.

I rarely use more than four or five cell references in a single expression, and don't find this much of a burden at all. A potential benefit is the ability to keep certain references the same in all formulas, so you can store constants in a few locations and use them in many formulas.

The split-screen feature is very useful for monitoring the results of recalculations in a remote area of the spreadsheet. It can also be helpful when you are entering data.

The windows can be defined by horizontal or vertical separation lines, and scrolling in the direction parallel to the division can be synchronized or unsynchronized.

Functions

DynaCalc has a number of built-in mathematical and statistical functions that can be helpful. They are used merely by being named in the appropriate cell; the @ prefix is usually required to avoid confusion with labels.

To take the average of the entries in cells D1 through D15, for instance, you merely move the cursor to a convenient spot and enter @AVERAGE (D1...D15). You need only enter a single dot as a separator in the range specification; the program supplies the other dots on the command line.

Other features include the standard trigonometric and logarithmic functions, functions for finding the maximum or minimum value in a specified range of cells, and others for computing the standard deviation and net present value of the contents of such a range.

"The DynaCalc manual is condensed, but adequate."

There are also a number of functions that perform operations similar to the ON N GOTO statement in Basic. Thus CHOOSE(n,x...y) evaluates n (which can be a number or an expression involving the value stored at some address) and returns the value of the nth entry in the list (x...y). This list itself can consist of a mixture of cell addresses and constants.

The INDEX and LOOKUP functions compare a user-supplied value n with items in a list (x...y). INDEX looks for an exact match, while LOOKUP is satisfied by a greater-than condition. Both return values associated with whichever item in the list bears the designated relation to n.

CHOOSE, ROUND (the value-rounding function), STDDEV (the standard deviation function), and one or two others appear to be unique to DynaCalc. Compared with SuperCalc, the program lacks the Boolean functions AND, OR, IF, and NOT. INDEX and LOOKUP partially compensate for this, although it does take a little effort to get used to their logic.

In Summary

DynaCalc is a first-class, professional-caliber program.

The DynaCalc manual is condensed, but adequate. To their credit, author Scott Schaeferle and his colleagues at CSC recognize the need for reference material and recommend several VisiCalc books as back-ups.

My review copy of DynaCalc was intended to run under the Frank Hogg Laboratory version of FLEX. CSC is currently shipping a product that will work with Data-Comp's version of the operating system. Owners of Spectral Associates' DOS may want to contact CSC for advice about compatibility. ■

Super Color Writer II, version 3.0

Nelson Software Systems
9072 Lyndale Ave. S.
Minneapolis, MN 55420
$69.95, cassette
$89.95, ROM pack
$99.95, disk

by James Perotti

Word processing with Super Color Writer (SCW) II, version 3.0, is like driving a high-performance vehicle. This Ferarri of a package is not mastered overnight, but once learned it gives you more word-processing power than ever.

This package has more features than Telewriter, Easywriter, or Applewriter, but this has its drawbacks. SCW lacks the command menus these brands have, and so it is initially harder to learn.

Using Color Writer

A good word processor should let you quickly enter text and make rapid alterations to it if needed. A line-oriented editor fails on both counts. SCW is a screen-oriented editor, meaning that by moving your cursor with the arrow keys you can access a complete screen of text easily. It is also written in Assembly language so it permits the rapid entry of text. I'm not the fastest typist, but SCW keeps up with me.

The arrow keys, clear-arrow, and shift-arrow move the cursor. A clear-right or clear-left arrow moves the cursor to the front or to the back of the line being executed. Clear-up or clear-down arrows let you review text. You move the cursor to the top or bottom of the screen with the clear-shift-left arrow (or right arrow), to the top or end of the text with clear-shift-up arrow or down arrow.

You can insert text with either a character-insert or a line-insert approach. To do so, hit clear-I and begin typing. The character or characters you enter will push back the existing text to make room for the new. When you are in the insert mode, the cursor is smaller than usual, providing a visual guide to the mode you are in.

The insert mode is slower than the normal text-entry mode, because it rewrites the screen as you insert a section of text. As you enter the new text, it is possible to enter new characters

before they can be displayed on the screen. It is unnerving to be unable to see what you have just entered. However, a feature named Typeahead saves your input and eventually displays it on the screen. The line-insert is a faster way to add lines of text.

To correct a mistake with SCW, place your cursor before your error and retype it. This minimizes the need for deleting and reentering text.

Other two-key commands delete a letter, a word to the left of the cursor, a word to the right of the cursor, text from the cursor to the beginning of a line, text to the end of a line, or a whole line. You can delete a paragraph by marking it with block markers and pressing clear-V. I would have preferred a single-key zap for single-letter deletions.

Super Color Writer uses repeating keys extensively. This can be a useful feature, but I find the execution to be a bit erratic. I often hold a key down too long only to have it reproduce the character across the page.

The repeating-key feature is also a problem when you input commands. Even after you let up on a key, SCW continues to execute those key presses that were input before the screen function can handle them. It's easy to send 10 commands for a single action before the cursor begins to move.

Screen Functions

Super Color Writer presents text in a number of formats. It offers seven different-sized character sets: 32 by 16, 51 by 24, 51 by 21, 64 by 24, 64 by 21, 85 by 24, and 85 by 21. The high-resolution screens are crisp and clear. The screens I used most often are the 64 by 21 and the 51 by 21; both are easily read.

A 51- or 64-character screen offers a major advantage over the 32-character screen because you can see how the text will look upon completion.

This software also lets you use a line width of up to 132 characters. SCW has a horizontal scrolling feature that displays the rest of the 132-character line that is to the right of the normal screen. This is useful when you prepare a table or chart more than 60 characters in width. I found it disconcerting to use when editing text because the ends of the lines aren't displayed. I set the width at 50 or 60 and use the 51 or 64 character sets.

SCW's Format Window displays the text on the screen exactly as it is printed. (The screen won't, however, display different sized characters.) The Format screen is distinct from the Edit mode; in Edit the text is left-justified and the right margins are ragged; in Format the text is moved over by the amount of the left margin and justified on the right.

The screen displays margins, justification, page breaks, headers, page numbers, centered lines, and so on. Rather than find surprises as the final text is printed out, the Format window permits a quick check to make sure everything came out as expected.

Printer Controls

SCW, as you might have guessed from the ads, does a nice job with printer controls. Like many other word processors, it uses imbedded commands to let you change margins, characters per line, and single or double spacing throughout your text. For example, you can prepare a double-spaced, 60-character-per-line manuscript to include sections that are indented and single spaced.

The parameter menu lets you change the parameters of the text at any time. The parameters are global, meaning they are in effect from the top of the text until they are changed.

There are two ways to deal with the special printer codes that are needed to underline, center, do subscripts and superscripts, print emphasized or double-strike type, give pica or elite type print, and do upper- or lower-case. First, you can imbed printer codes surrounding a word in the text. To underline a word using the FX-80, the p-code marker is entered into the text. The whole thing looks like this: P27-1underlined-word P27-0, where the P stands for the p-code marker.

If the above method looks too difficult, SCW also lets you define programmable printer drivers. One letter can be defined to execute a special printer function; another can turn it off. Ten such programmed keys are available for printer drivers.

The programmed keys are easy to set up and easy to use. With printers like the FX-80, the Okidata-92, or the DMP-200, all kind of tricks are possible because you can change print styles in the middle of a line. SCW lets you control their features.

Additional Features

SCW has even more to offer; there's a search-and-replace feature that locates any string in the text and replaces it with another. Want to edit a Basic program? SCW does it if you have saved it in ASCII. This is the quick way to change all those PRINT statements to PRINT# – 2. The package also lets you move, copy, or delete blocks of text. With Basic, you can move lines or duplicate existing lines further into the program.

Headers, footers, and even additional auxiliary lines are possible with SCW. Put them wherever you want. SCW lets you start printing anywhere in the text by treating previous text as invisible. If you want to print the foreign character sets that the Epson printer provides, there are 10 programmable character codes available for this purpose.

"Super Color Writer II is a great help for Color Computer owners who want a serious word processor..."

SCW has three programmable functions that you can use to create command sets. These are similar to batch programs that execute a series of commands; they can use up to 28 keystrokes.

The manual is excellent. It is well-written and consists of over 100 pages of extensive documentation.

In Conclusion

Super Color Writer II is a great help for Color Computer owners who want a serious word processor for preparing lengthy or complex documents. Again, it has a large number of features that other more expensive packages (for other micros) lack.

It has idiosyncracies, but its biggest flaw, if it can be called that, is the degree of difficulty it takes to master the keystroke commands for insertion, deletion, saving, underlining, and so on. The program's many features, however, explain some of the need for its complexity. ■

Spelling In Context
Louise Markert and Max E. Jerman
Micro School Programs
Bertamax Inc.
101 Nickerson St., Suite 202
Seattle, WA 98109
32K, disk
Level 4 $59.50
Level 5 59.50
Level 6 69.50
Level 7 79.50
Level 8 89.50

by John Steiner

Spelling In Context is a spelling drill and practice routine for grades 1–8. I reviewed levels 4–8 in 32K disk versions. 32K tape versions are also available. This package provides students with drill time needed to become proficient in spelling.

To use the program, the student or teacher selects the level and lesson. The program displays a word for a short period of time, which is selectable. Next, the screen clears, and a sentence is displayed with a blank where the spelling word should be. The student can then type in the word. If the response is correct, the student receives positive reinforcement.

If the word is misspelled, one of several Try Again prompts appears. A second error on the same word causes the computer to display the correct response.

The student must spell the word correctly before he can proceed. A score of 90 percent or less causes the computer to redrill the student on previously misspelled words before the session is completed.

The program series does not contain any bugs, with the exception of a quirk regarding words at the beginning of a sentence. If the first word of a sentence is the word to be spelled, the answer must be capitalized or the answer is considered to be incorrect.

Technically, the series is well designed, and comes in attractive packaging. Each level comes with a 30–40-page manual and a program disk. The manual contains recommended learning methods, concepts covered in each lesson, and the word lists.

I contacted several elementary instructors for their opinions on the educational value of the software. Each instructor was given time to sample the manual and run the program.

✓See List of Advertisers on page 130

Most of their reponses were similar. They liked the nicely designed screen display and the ease with which a student could use the program series.

The teachers also liked the idea of presenting the spelling words in context. In addition to assisting in spelling, the program also assists in vocabulary building.

Their complaints were unanimous. It is not possible to enter and use your own vocabulary; you are limited to the words that are included in the software. Bertamax comments, in their manual, that a list of common words is preferred over local or specialized lists. Instructors I talked with didn't feel that way. Another minor complaint was that some had trouble understanding the general-concepts sections of the manuals.

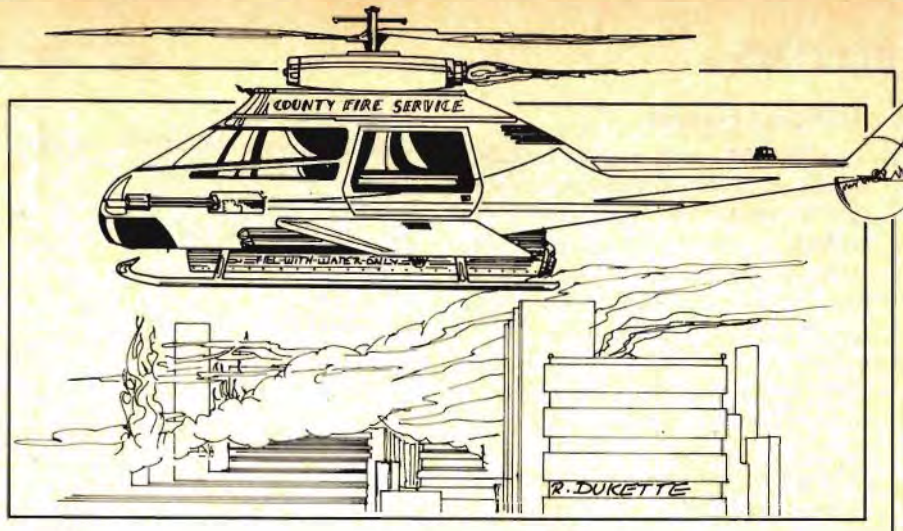
For the home user, the relatively high cost of the software is another disadvantage. My test-site instructors had mixed feelings concerning the software's prices. Those not familiar with computers tended to think it was too expensive. Teachers who were familiar with software pricing thought the price schedules were reasonable.

Overall, as a vocabulary building tool and spelling drill, this program gets a high grade. ■

Sea Dragon
Coniah Software
32K
$34.95, cassette

Fire Copter
David A. Lear
Adventure International
Box 3435
Longwood, FL 32750
16K
$24.95, cassette

by Michael E. Nadeau
***HOT CoCo* staff**



Fire Copter and Sea Dragon are Adventure International's first attempts at breaking into the Color Computer game market. Both are high-quality products that are fun to play.

Sea Dragon

Sea Dragon, originally written for the TRS-80 Model I/III, is an underwater Defender clone. You must destroy mines, battleships, stalactites, and laser weapons on a horizontally scrolling screen, ending with a well-defended "Master Mine." The game's "feel" does give the impression that your sub is under water.

This game has been converted to a number of other machines with mixed success. (The Apple version is terrible.) But AI seems to have hit the nail right on the head with the CoCo version. It is challenging, offering eight skill levels. Its graphics are outstanding, and its sound effects are just amazing.

When you run Sea Dragon, a scoreboard appears with a little sailor figure holding an accordion. A digital voice says, "Welcome aboard, Cap'n," while the little sailor salutes.

The sailor then breaks into a hearty rendition of a well-known sea tune on his accordion. The music sounds just like an accordion's, too, with simultaneous multiple chords (or at least the illusion thereof). It is a nifty effect.

Popeye's theme song plays, accordion style, as each new sub is launched, and a morbid version plays when your sub is destroyed.

Sea Dragon is joystick compatible, but your sub is easier to control from the keyboard. Using the joystick, you fire forward with the fire button, and you fire up with the enter key, a nearly impossible arrangement for one person. The keyboard provides much more efficient game control.

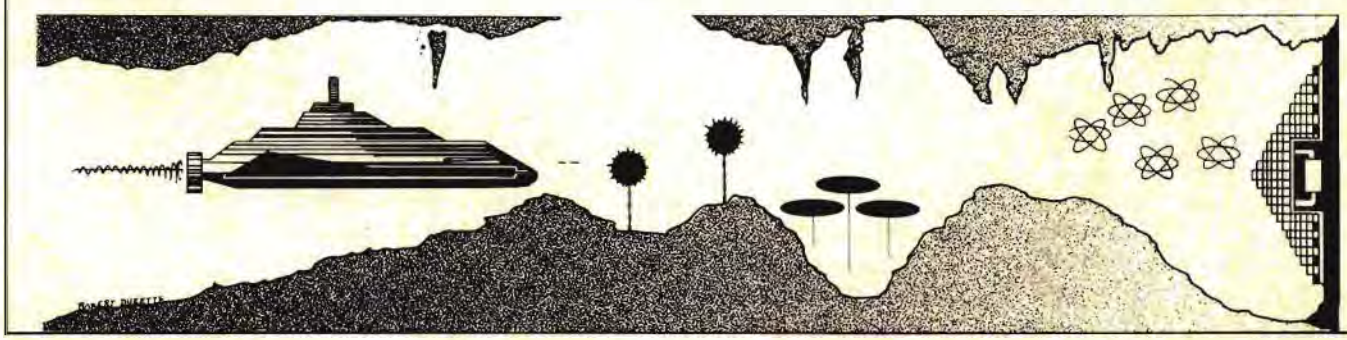
The game offers a practice mode, and I suggest you use it. Sea Dragon takes some getting used to before you can play it competitively. Speeding up and stopping in underwater caverns is especially tricky.

Sea Dragon offers nearly anything one would want in an arcade game—except price. I've seen many great games for the CoCo, but I don't think any of them are worth $35. Sea Dragon ranks with the best of them, but that doesn't justify its price, even with its slick packaging and AI's good reputation.

Fire Copter

Fire Copter is an entertaining break from the usual arcade-game theme. You are the pilot of a souped-up fire-fighting helicopter whose mission is to save a city being burned down by android arsonists.

You have two goals: douse all the flames you find before it's too late and shoot any android you come across before the snipers among them shoot you. Putting out fire takes priority



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over zapping androids, giving this game a different feel from other games.

The game begins with a high-altitude view of the endangered city, which appears more like the geometric shapes on a math teacher's blackboard than a city. You never see your copter. As the bright red flames randomly pop up on each "building," you must hover and use your water cannon to douse the fire.

Dousing takes more time than zapping space invaders—much more if the building is engulfed. You must hold in the fire button on your joystick and maintain the proper position to put out fires. This game takes a soft touch.

You eliminate the androids by tapping the joystick's fire button, activating your lasers. This dual purpose for the fire button causes some problems in the game's play. Many times when I tried to zap an android, I actually doused it with my water cannon, an ineffective act. This might have been the joystick's fault (Radio Shack), but I didn't test other brands. Fire Copter requires joysticks.

"...the game is fun to play, and it's a refreshing break from killing space invaders or running through mazes."

The documentation is brief, adequate, and cleverly written, giving a vivid imaginary scenario. It also has a pleasant surprise: directions on how to back up the tape to disk or another tape. It's good to see a company like AI recognize the fact that game players need back-ups, too.

Fire Copter's graphics are not impressive, and neither is the sound, though it simulates a "chopper" noise quite well. But the game is fun to play, and it's a refreshing break from killing space invaders or running through mazes. ■

Direct File Transfer
Computer Shack
1691 Eason
Pontiac, MI 48054
$24.95, cassette
$29.95, disk

by Debbie Cooper

Direct File Transfer (DFT) is a utility that lets you transmit programs or files from one computer to another. It comes with a 12-page manual.

After loading the program, you are given a menu with six options: chat with another computer user, change duplex mode, change baud rate, transmit a file to another computer, load buffer from tape or disk, or save buffer to tape or disk.

The first option, chat, makes it possible to talk with a friend.

The baud rate and duplex mode can be changed during any phase of program operation, whether on or off line, simply by pressing the shift and clear keys simultaneously. For exam-

ple, to change the baud rate, you select option 4 and then type the number of the baud rate you want to invoke. You are then returned to the main menu.

When you want to download or upload a program, DFT advises you through prompts exactly what to do and when to do it.

To download a file from the host, you answer the prompt "Send or Receive" with an R. The actual transmission will not take place until both computers are ready. When the transmission has finished, the main menu will reappear. You can then save the buffer to tape for later retrieval.

One excellent feature of DFT is its beep option. At the end of downloading or uploading, a beep sounds. This means that you don't have to sit at your computer while transmitting or receiving long files.

Overall, this program is well worth its cost and is extremely easy to use. However, if you are looking for a smart terminal program with many other features, then this one won't be adequate for your needs. ■

Starfire
Intellectronics
22 Churchill Lane
Smithtown, NY 11787
16K
$21.95, cassette

by Ed Hemrick

Starfire is a Defender-like arcade game that is keyboard controlled. The keyboard orientation makes the game harder to learn, but once learned, gives you more positive control than a joystick. The machine-language game is responsive and fast paced.

Starfire starts by listing your opponents and the points you receive for destroying them. The list is a long one: Floogs, Zoids, Gulls, Hornets, Runts, and the killer saucer. Pressing the space bar starts the game, but the game will start on its own if you're too slow.

You begin each game with three ships and three smart bombs. The remaining ships, bombs, and your score are displayed at the top left of the screen. Your radar is at the top right of the screen. Your mission: to destroy all the alien ships that attack the world before they take its inhabitants. It is important to protect the humans because after they have been taken, the aliens attack you.

The aliens come from the top and the bottom of the screen simultaneously. Destroying each wave of ships earns you 100–500 bonus points.

If you successfully complete seven waves, the eighth wave replenishes all your humans. This wave is signaled by a high-pitched siren. Every 40,000 points you are rewarded with a ship and one more bomb.

Tips

Here are a few tips for those who wish to play Starfire long enough to earn 40,000 points.

- Stay in the middle of the screen.
- If you shoot a Hornet do it from a distance, unless you have a very quick finger. (There is no rapid-fire option.) When you do destroy a Hornet it releases its cargo of six Runts (a smaller version of itself). Beware of them.

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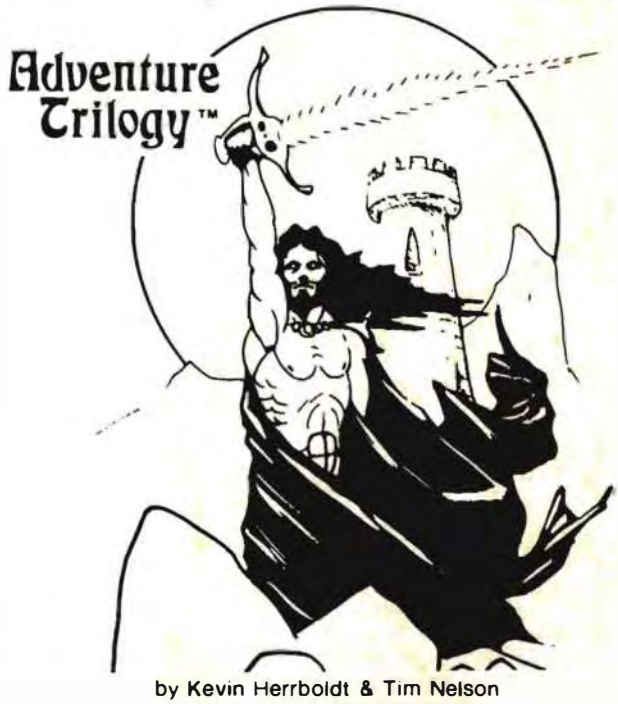

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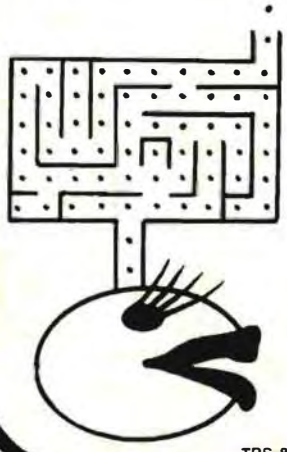

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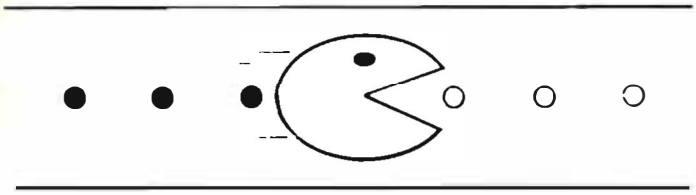

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They will come after you like a swarm of killer bees.

- You can rescue a human after it has been picked up by a Floog by destroying the ship. Once shot, the Floog ship drops its cargo (the humans) allowing you to pick them up in mid-air. You receive 500 points for picking up a human and another 500 for setting it down safely. If you fail to rescue the human and it falls more than an inch, it self-destructs.
- Only Floogs can pick up humans, so eliminating them first is a good idea.
- Avoid shooting the Hornets; it takes a lot of valuable time to eliminate them and their cargo of Runts; while you do so, the Floog will busily steal your humans.
- When a human is picked up on or off screen a distinct click will be heard warning you.

Drawbacks

This program has two minor drawbacks. One is the use of the keyboard. Even though it does give you greater control it is rough on the keyboard as you tend to hit the keys hard. Second, there is no high score kept in the next game.

Starfire is not an easy game to learn and high scores come with practice. However, as you get more proficient you become more addicted to the game's fast play and pace.

The highest score attainable is 1 million at which time the screen disintegrates and you must reload Starfire—a fitting end for an entertaining game. ■

The Battle of Gettysburg
James Woodruff
Softwride
P.O. Box 3504
Austin, TX 78704
16K
$20.95, cassette

by Michael E. Nadeau
***HOT CoCo* staff**

There has been a lack of good strategy-game software for the Color Computer. Now, Softwride has begun to fill this need with The Battle of Gettysburg.

As you might guess from the name, this program simulates the famous Civil War battle. It pits you as the initially outnumbered Union commander against the Confederate forces generalled by your computer. Actually, the game offers one of three Confederate opponents: General Pickett (of Pickett's Charge fame), General Stonewall Jackson, and General Robert E. Lee.

Playing the Game

The program generates a hi-res map representing the actual Gettysburg battleground. Lines indicate roads and magenta areas are high ground. The game begins with your command center in the upper right of the screen and the Confederate troops in the lower left. Your divisions are about 2 inches north of the Confederate forces.

The object of the simulation is to hold off the Confederates from capturing your command center until reinforcements arrive. You do this by strategically placing your divisions (little blue squares) to repel the Confederate divisions (little yellow squares).

You must use a joystick to move your troops. The author recommends a good-quality potentiometer joystick for the best control, and I agree. I used a Radio Shack joystick, and I spent as much time mastering that as I did learning the game.

The Confederates don't use much strategy. They just make a beeline for the command center. You can relocate the command center to manipulate the Southerners' movement. You can also attack a Confederate division by placing one of your divisions on top of it. The program determines the outcome (North or South withdraws or is defeated) according to its built-in algorithm.

High ground is easier to defend, and you can use the roads to transport your forces quickly. The game is not in real time; you get a certain amount of time to make your moves, and the computer moves automatically even if you haven't made yours.

I found the best strategy to be to fall back to high ground and set up as good a line as possible. Until reinforcements arrive, I attack only if it looks like one Confederate division is going to break through; it's best to keep the enemy forces together.

Reinforcements periodically arrive for both sides, though they tend to turn the tide to the Union's favor. It isn't until the second wave of reinforcements that you can seriously go on the offensive—any sooner and you will lose too many divisions and probably the game as well.

Game or Simulation?

The author, James Woodruff, has tried to simulate the historical odds, difficulty of the terrain, and styles of

the Confederate generals as much as possible. For instance, you begin the game with two divisions, while the computer's Confederates start with six. To make matters worse, the program has put the odds in the Confederate's favor in one-on-one skirmishes.

You get varying amounts of time to make your moves (you can make more than one if you are quick enough) depending on which Southern general you chose as an opponent. I usually choose General Jackson because I find the others too slow; Old Stonewall adds excitement by forcing you to make quick decisions, more closely simulating actual battle conditions.

Once troop strength becomes equal via reinforcements, the odds go heavily in the Union's favor. It is difficult to lose if you get to this point, unless you make a key tactical error.

This predictability of the program is its greatest fault, but it is also what places it more in the simulation category. It will take several games to master the correct strategy, but once you do, the challenge diminishes.

To the author's credit, the program is not protected (except for the map-generating section). He encourages people to alter his program. He also gives instructions on how to change the program to make the odds more in the Union's favor in the beginning of the game.

The documentation is very interesting. It gives a good, though brief, historical perspective of the Battle of Gettysburg. The simulation does seem to progress according to historical events. Mr. Woodruff also recommends a couple of books on the Civil War that he urges his customers to read before playing the game. He has taken much effort to educate buyers of his program to the historical perspective of the simulation.

The Battle of Gettysburg is a game because it is fun to play, and a simulation because it reasonably represents the occurrences of the historical event. Anyone who has played an Avalon Hill strategy game will appreciate this program, too, though Softwride's product is not quite as complicated.

Even with the game's predictability, I recommend it. Each session can take some time, perhaps an hour or more. It's better than a good game of solitaire, and much more intellectually stimulating than Space Invaders. ■

Fastape
Spectro Systems
11111 North Kendall Drive
Suite A 108
Miami, FL 33176
16K
$21.95, cassette

by Louis Bybee

Fastape is a Color Basic utility designed to cut the time and amount of tape used during tape input/output (I/O) operations in half. I received Fastape on a C-60 cassette with the program saved three times on one side.

"Fastape is a quality contribution in the lonely field of tape-based utilities. My only complaint is the copy-protection, which limits user flexibility and convenience."

The Fastape documentation consists of four pages of clear, concise instruction. I had the program up and running in less than five minutes.

You enter the commands by preceding them with a down arrow for a control code. Five numeric commands allow any combination of normal- or high-speed POKEs (65,495,0) and the choice of a slow or fast tape-load format.

Twelve alphabetic commands, associated with tape I/O functions, are available for added speed. You also get directions to modify CoCos that won't accept the speed-up POKE. Cassette-recorder maintenance instructions are offered to reduce the possibility of I/O errors related to recorder problems. (See *HOT CoCo*, June, p. 52.)

The documentation makes a number of claims, among them that the utility:

- "Doubles the speed of CSAVE and CLOAD operations." Actually, I found the time spent to be slightly less than half.
- "Basic programs run 30 percent faster." This depends upon the time ratio spent in RAM or ROM by your Basic program.
- "Fastape allows control-key entry of cassette-related commands." This is true of Audio on/off, Motor on/off, CLOAD, CSAVE, SKIPF, RUN, LIST, EDIT, CONT, and EXEC.
- "Fastape is fully compatible with printer operations, all tape formats, and graphics." The auto command adjusts the baud-rate constant present when you load Fastape.
- "Takes up only ½K of memory." A PRINT MEM will not show this as Fastape is in machine language.
- "Fastape is completely transparent to Basic." I could not cause any conflicts to surface.

Fastape Operation

After trying to crash Fastape for a short time the only problem I experienced was in loading an ASCII file saved at high speed while in the low-speed, fast-load format.

I found the real value of this package to be the reduced load and save times that were previously unbearable. While Fastape does not have the flexibility of disk random access, its added speed is of real value to those limited to tape using data files. Although disk compatible, this program auto-executes, and is copy-protected. (Moving the program to disk requires that you first break the copy-protection.)

Using Fastape with a disk dump-to-tape utility I wrote, the time savings was very pronounced. Fastape starts the tape motor with a longer delay before data is sent to ensure the tape is up to speed. This prevents varying data-transfer rates, and the accompanying I/O errors.

Fastape is a quality contribution in the lonely field of tape-based utilities. My only complaint is the copy-protection, which limits user flexibility and convenience. Spectro Systems maintains a high customer-service profile. They can be contacted through the mail or through the CompuServe Information Service. Defective tapes are replaced without charge. I would recommend the purchase of Fastape. It is a real treat for those without disk systems. ■

BY JAMES J. BARBARELLO

REAL-WORLD APPLICATIONS—PART II

In this second part of my series, I'll construct an interface and provide the software that transforms your CoCo into a sophisticated biofeedback monitor. The interface is called the BioBox and is similar to the CMI presented in the previous article. Along with a new Basic program (called Bio), I'll expand the machine-language subroutine I used with the CMI to include screen graphics manipulation.

Biofeedback is a scientific process that uses an electronic device to monitor body variations caused by stress and tension. In practice, you consciously vary your behavior (thoughts, attitude, and so on). The biofeedback monitor then relays to you the effect those conscious variations are having on your level of tension. With this information in hand, you can discriminate between those behavior modifications that help you to calm down and those that do not.

I don't claim that Biofeedback has definite medical benefits, but it can help many people control everyday minor stress. With practice, it might also help you.

Can't seem to relax? Build this biofeedback monitor and learn how to better handle stress.

The BioBox interface is simple and inexpensive to build. It monitors the changes in skin resistance between two adjacent fingers on one hand (a parameter that is directly proportional to your level of tenseness). The BioBox is battery powered for safety, requires no modification of the CoCo or special connectors, and with the appropriate software you can use it on the TRS-80 Model I/III as well.

The Hardware

The BioBox schematic diagram (Fig. 1) is similar to what I used to measure capacitors (the CMI). There are major differences, however. I'll review the circuit's operation.

When the CoCo provides a positive voltage greater than 0.7 volts to J1, transistor Q1 is turned on, shorting R1 to ground. This negative-going voltage change is applied directly to pin 2 of IC1 (a 555 timer IC configured as a monostable multivibrator, or "one-shot"). Pin 3 immediately rises to the supply voltage (9 volts) and C1 begins receiving a charge through R3 and an "effective" resistance called R Bio.

I call R Bio an effective resistance because it is not a physical resistor. Instead, it represents the resistance presented by the current path between two adjacent fingers on one of the subject's hands. Don't be alarmed by the thought of current racing through your fingers. This is a common practice with devices of this sort, and the current level is miniscule (being measured in microamps).

Pin 3 remains high until a time interval approximately equal to R Bio × C1 seconds elapses. At this time, C1 has charged to 2/3 of the supply voltage (6 volts) and triggers IC1 to force pin 3 back to ground potential, so you generate a positive-going pulse with duration equal to (R Bio + R3) × C1, where R3 limits current if the R Bio probes are inadvertently shorted together.

The initial positive-level change is inverted in transistor Q2. The differentiation circuit of C2 and R6 converts this level change into a negative-going pulse, which the CoCo doesn't recognize.

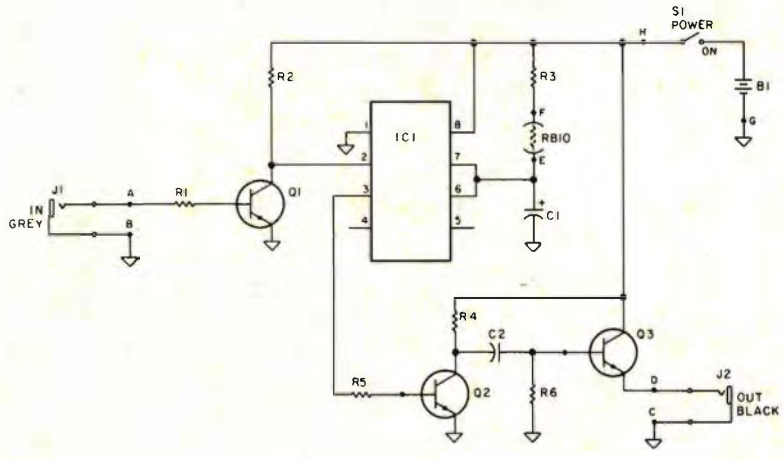

Fig. 1. BioBox Schematic

System Requirements

16K RAM
Extended Color Basic

See List of Advertisers on page 130

However, when the timing cycle is completed and pin 3 returns to ground, this negative-level change is converted to a positive pulse, which the CoCo senses.

So, if you tell the CoCo to count the time between its sending out the trigger pulse to J1 and receiving a response from J2, you can calculate the duration of the timing cycle. Since C1 and R3 remain constant, a decrease in R Bio (as with increased sweating caused by tension) causes the resulting output pulse to be shorter. When R Bio increases (as with increased calm), the output pulse is longer. Thus, the duration of the output pulse is a direct measure of level of calmness (or inverse measure of level of tenseness).

Q3 is commonly called a pass transistor. Its function is to pass current demanded by the low-impedance (100 ohm) load in the computer. It isolates this load from the previous stage and, in doing so, ensures that J2 receives the voltage level it requires. Q3 lets you use the BioBox on the CoCo, the Model I, and the Model III. A 9-volt battery, B1 through power switch S1, provides power for the BioBox.

The BioBox Software

There are two separate elements of software. The first is a machine-language subroutine that controls the operation of the BioBox. The second is a Basic program that uses the information provided by the machine-language subroutine to perform the biofeedback monitor/human interface.

Program Listing 1 shows the machine-language subroutine. You convert this subroutine into DATA values, place them in your Basic program, and POKE them into memory for use with Basic's USR function. If you are not interested in how it works, you can skip to the next section, because what follows is a detailed description of Listing 1.

Lines 100–2100 are identical to that used in Part I for the CMI. Line 100 defines its ORG (or origination) at 3F00H. The next command (ORCC #50H) sets the condition-code register's interrupt-request mask and fast interrupt-request mask bits. In doing this, all interrupt requests are disabled. This must be accomplished before you send out any data. Next, you load the A register with 255 decimal and send that value out to memory location 0FF20H.

Referring to page 7 of the *TRS-80 Color Computer Technical Reference Manual*, you see that memory locations FF20 through FF23 are actually PIA

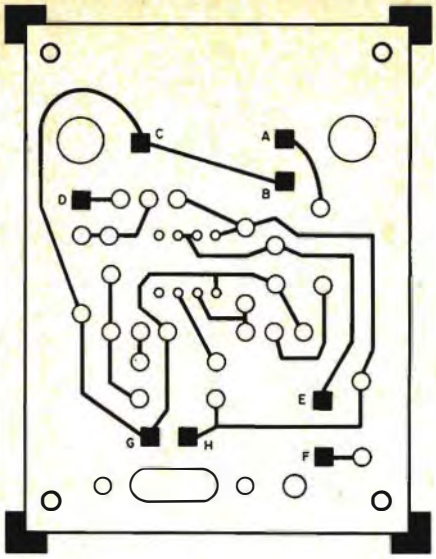

Fig. 2. BioBox Printed Circuit Board

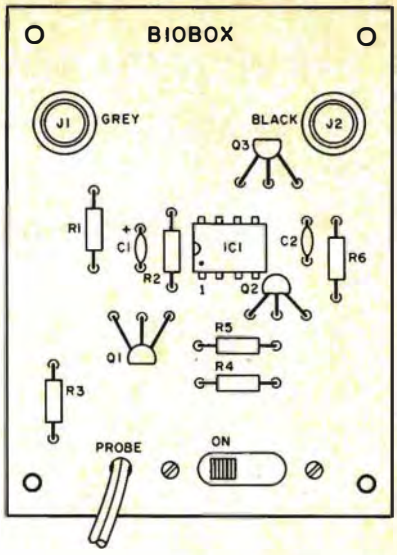

Fig. 3. Component Placement

Program Listing 1. Biofeedback Monitor Utility

```
                        00010 *********************************
                        00020 *  BIOFEEDBACK MONITOR          *
                        00030 *        UTILITY                *
                        00040 *---REV #1--14 APR 83---*
                        00050 *    J.J. BARBARELLO            *
                        00060 *********************************
                        00070 *  FOR USE WITH BIOBOX          *
                        00080 *      HARDWARE ONLY            *
                        00090 *********************************
3F00                    00100          ORG     3F00H
3F00 1A   50            00200          ORCC    #50H
3F02 86   FF            00300          LDA     #255
3F04 B7   FF20          00400          STA     0FF20H
3F07 C6   08            00500          LDB     #8
3F09 5A                 00600 J1       DECB
3F0A 26   FD            00700          BNE     J1
3F0C 86   03            00800          LDA     #3
3F0E B7   FF20          00900          STA     0FF20H
3F11 1A   50            01000          ORCC    #50H
3F13 C6   01            01100          LDB     #1
3F15 8E   0000          01200          LDX     #0
3F18 86   FE            01300 CONT     LDA     #0FEH
3F1A BA   FF20          01400          ORA     0FF20H
3F1D 81   FE            01500          CMPA    #0FEH
3F1F 27   06            01600          BEQ     DONE
3F21 3A                 01700          ABX
3F22 8C   0000          01800          CMPX    #0
3F25 26   F1            01900          BNE     CONT
3F27 BF   3F2B          02000 DONE     STX     3F2BH
3F2A 39                 02100          RTS
3F2B      00            02200 MSB      FCB     $0
3F2C      00            02300 LSB      FCB     $0
3F2D 86   00            02400          LDA     #0
3F2F C6   01            02500          LDB     #1
3F31 8E   0400          02600          LDX     #400H
3F34 A6   84            02700 SCRN1    LDA     ,X
3F36 81   7F            02800          CMPA    #127
3F38 22   04            02900          BHI     SCRN2
3F3A 86   3F            03000          LDA     #63
3F3C A4   84            03100          ANDA    ,X
3F3E A7   80            03200 SCRN2    STA     ,X+
```

Listing continued

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Listing continued

```
3F40 8C   0600      03300        CMPX    #600H
3F43 26   EF        03400        BNE     SCRN1
3F45 39             03500        RTS
                    03600        END     3F00H
00000 TOTAL ERRORS
CONT     3F18
DONE     3F27
J1       3F09
LSB      3F2C
MSB      3F2B
SCRN1    3F34
SCRN2    3F3E
```

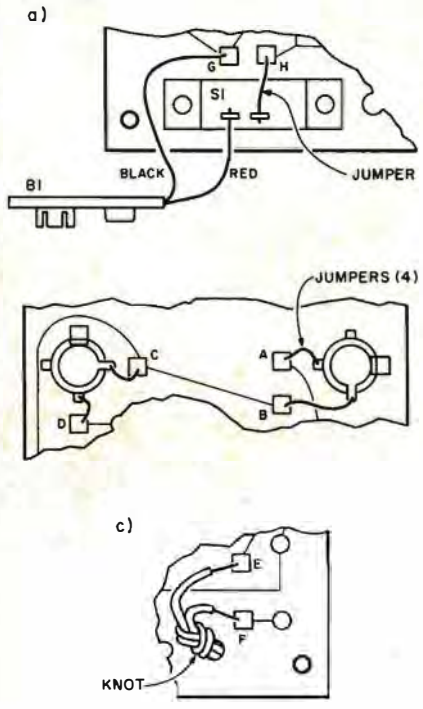

Fig. 4. Placement of J1, J2, S1, and B1

(peripheral interface adaptor) U4. This device sends out and receives data from the cassette recorder. By sending a value of 255 to U4, you generate a level of about 1 volt at the AUX (large grey) cassette plug.

You want to maintain this level for a short time so that the BioBox can sense it. So, next you load the B register with the decimal value 8. Then you decrement B until it reaches zero. This delay maintains the level long enough for the BioBox to sense it.

With this done, you reload the A register with decimal 3 and send it to U4. This returns the AUX level to its previous state. Now that you have finished sending data out, you restore the interrupts by again executing the command ORCC #50H. Like an on/off switch, this command toggles the state of the interrupt-flag bits.

As in Basic, you must initialize your variable before you begin counting. First you load the B register with 1 (the count increment). Then you load index register X (where the count will be stored) with 0. You count until the cassette's EAR plug sends a positive voltage level.

Bit 0 of memory location FF20 is the cassette-data input, so you load the A register with 0FEH (254 decimal) and OR it with the contents of location 0FF20H. The results of this action are stored in the A register. If bit 0 contained a 1 (not triggered), register A will contain 0FFH, and the comparison to 0FEH will not cause a branch to DONE. Instead, the ABX command

See List of Advertisers on page 130

R1,R2,R3,R4,R5,R6 ... 10,000-ohm, ¼-watt resistor
C1 ..... 1 μF, 10-volt electrolytic capacitor
C2 ..... 0.01 μF, 10-volt disk capacitor
IC1 ..... 555 timer IC
J1,J2 ..... 1/8-inch phono jack
Q1,Q2,Q3 ..... 2N2222 or PN2222A NPN silicon transistor
S1 ..... SPST slide switch (Radio Shack p/n 275-406)
B1 ..... 9-volt battery snap

Miscellaneous: 5 feet #24 AWG stranded speaker wire, 1 package hook-and-loop fasteners (Radio Shack p/n 64-2345), 1½-by-1¼-inch household aluminum foil, two #4-40-by-¼ inch machine screws, two #4-40 nuts, four #6 flat washers, printed circuit board, case, solder, etc.

Note: A complete kit of parts, including the Bio program on cassette tape, is available for $22.50 from J.J. Barbarello, R.D. #1, Box 241H, Tennent Road, Englishtown, NJ 07726. New Jersey residents add 5 percent tax. Similar kits are available for the Models I, II, and III. Write for details.

Table I. List of Materials

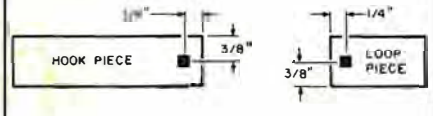

Fig. 5. Placement of 1/8-inch Squares in Hook Pieces

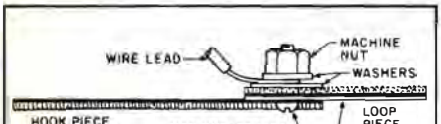

Fig. 6. Assembly of the Hook and Loop Pieces

adds the contents of the B register to index register X (incrementing it by 1).

Before you return, however, you check to see if index register X has been incremented past FFFFH to 0. This occurs if your timing cycle takes too long, or if there was a fault in the BioBox hardware such that it never sends back a trigger pulse. If this happens, you abort the process and proceed to DONE. Otherwise, you branch to CONT.

When the result of the ORing of the A register and location FF20H produces FEH (bit 0 changed to "0" by the BioBox's output), the CMPA #0FEH and BEQ DONE instructions cause execution to jump to DONE. Regardless of how you get to DONE, the contents of index register X are stored in memory locations 3F2BH (most-significant byte) and 3F2CH (least-significant byte) before returning from this subroutine (RTS).

Lines 2200 and 2300 reserve space for storing the count. The second part of the subroutine begins at line 2400. The A register is initialized to zero, the B register to 1, and the X register to 400H (the beginning of the screen). Line 2700 loads the X register with the first character from the screen. Then the ASCII value of this character is compared to 127. If it is greater (i.e., a graphics character), you branch to SCRN2. If it is less, you AND it with 63. This converts it from a light background to a dark green background.

At SCRN2, you store the contents of the A register to the screen area pointed to by the value of the IX register and then increment the IX register by one. You then check for the end of the screen (600H). If not there yet, you go back to line 2700 (SCRN1). When IX equals 600H you return to Basic.

This code instantaneously reverses all characters (and spaces) from light to dark green background, while leaving the graphics unaffected.

The Basic Program

Now I'll proceed with the BioBox Basic program shown in Program Listing 2. Line 10 clears 1,000 bytes for string storage and sets top of Basic memory to 16127. It also dimensions an array that will hold your biofeedback results and defines the USR entry points for the interface subroutine (USR0) and the screen reversing (USR1).

Line 20 clears the screen and defines strings that the program will use. Line 30 checks the status of flag variable FLG. The program branches back to this point several times, so FLG determines if this is the initial run (FLG = 0) or a branch (FLG not = 0).

Lines 40–70 define the code for the machine-language subroutines and POKE that code into memory. Line 80 defines the colors of the boxes that your Biofeedback display will use. Lines 90–130 set up the screen display with normal characters. Line 140 "beeps" and then reverses the display (wi USR1). If this is not the initial run, FL is greater than zero and the "Instru tions?" query is skipped. Otherwis line 150 gives you the option to revie the instructions contained in a subro tine starting at line 600.

Line 160 sets the FLG and asks you t select your initial mood (see the instru tions for an explanation of this). Lir 170 creates a rapidly blinking questio mark cursor while waiting for a singl key input between 2 and 9. Lines 18 and 190 blank out the squares to th right of the starting row you specifie (initial mood).

Line 200 initializes variables and th interface via USR0. Then lines 210 an 220 sample the interface five time determine an average reading (XC which will also be referred to as th "old" count), and calculate INC an XL. INC, the increment, is the min mum count change required to remov or add one display square (the count i the number obtained by sampling th interface).

XL, low count, is the initializatio average count less 50 percent, and is ar bitrarily defined as the point wher maximum calm has been attained. Lin 230 clears the display area by printing blank black line (NL$, or null line).

The biofeedback monitoring encom passes lines 240–400. First, you print th appropriately colored square in the cur rent position (R = row, C = column) Then you sample the interface (X = USR0(0)) and retrieve the coun (GOSUB 550). If X = 0, you hav counted past 65,535 or have encoun tered some other type of fault. There fore, line 250 prints the "Fault" mes sage, branches to the "Press any key" subroutines and upon return restarts vi the GOTO 20.

If you retrieve a valid count, the tim (XT) is incremented and the keyboar polled for an R (restart) or E (end) in put. If none is received, the curren square is blanked out (this creates th blinking effect). Line 290 checks to se if the count change is less than one in crement. If so, execution branches t line 400 where a delay proportional t the current count is created before re turning to line 240 for the next sample

If the change is greater than one in crement, line 300 checks to see if th count is increasing (less tense) o decreasing. For an increasing count line 320 increases XO by one increment Then R and C are checked and adjuste if necessary to point to the top of th preceding column (if the last square i the current column is being removed)

If C has not been decremented past 0, you jump to the subroutine at line 500, where a fixed delay is created and the time is updated. Then you return to line 310.

This procedure continues until the difference between X and XO is less than one increment. The same procedure is followed in lines 360–380 for a decreasing count.

If at any time all squares are removed, execution passes to line 340, which displays the "Maximum calm attained" message, and you are allowed to restart or end. Lines 500–710 contain various subroutines, including that to display the instructions. The restart/end subroutine begins at line 740. This subroutine is used throughout the program and lets you restart or end at almost any time. It also calls another subroutine that gives you the option to save the results of any trial for later presentation ("Store results," beginning at line 840).

The End routine begins at line 890. When End has been selected, line 900 proceeds to print the results previously stored in the T array. Notice that the "Factor" is a relative measure of results, since it reflects number of squares removed per unit time. Since up to 50 trials can be stored, the FOR... NEXT loop starting at line 920 prints results in groups of 10 maximum, waits for you to press any key, and then continues. Line 950 lets you restart or truly end. In this manner, you can select the End function at any time, review your results, and then restart to continue monitoring.

Building the BioBox

You can build the BioBox circuit on a perfboard, project board, or using the printed circuit board (PCB) of Fig. 2. The PCB produces the best results. Once you've fabricated the PCB, install all components according to Fig. 3, observing the orientations of C1, IC1, Q1, Q2, and Q3. Next attach J1, J2, S1, and B1 as shown in Fig. 4. You can house the unit in any suitable case.

The last item you must fabricate is the bioprobe set. It consists of two identical bioprobes, which are attached to the index and middle fingers of one hand. Its only purpose is to make electrical contact with the skin surface. Before beginning you need one package of self-sticking hook-and-loop fasteners (Radio Shack part 64-2345), 5 feet of #24 AWG stranded speaker wire (two-conductor zip cord), two #4-40-by-¼-inch machine screws, two #4-40 machine nuts, four #6 washers, a small piece of household aluminum foil, and an Exacto knife.

Radio Shack part 64-2345 comes with two sets of hook-and-loop fasteners, each 3 by 1 inches. The hook portion contains precise rows of material that look like small fish hooks. The loop portion looks like a fuzzy material. Before beginning, slit between the conductors on one end of the zip cord. Grasp the two conductors and "unzip" the wire to a length of about 7 inches. Make a knot at the end of the separation.

Now, to make a bioprobe, follow these steps:

1. Cut a 1¼-by-¾-inch piece of loop material from one of the 3-by-1-inch loop pieces.
2. Cut one of the 3-by-1-inch hook pieces to 3 by ¾ inches.
3. Using the Exacto knife, cut a ⅛-inch square in one of the short ends of each of the pieces just formed (see Fig. 5).
4. Obtain a 1½-by-1-inch piece of aluminum foil. Remove the blue backing paper from the loop piece and place the aluminum foil on the self-sticking surface of the loop piece. Trim off the excess foil.
5. On the end of the hook piece with the ⅛-inch square, measure back ½-inch and make a cut just deep enough so the ½-by-¾-inch of backing paper can be removed. Remove that blue backing piece, leaving the rest intact.
6. Place the loop piece on the exposed self-stick surface of the hook piece so the ⅛-inch squares align and the aluminum foil is in the middle (see Fig. 6).
7. Make a single puncture in the aluminum within the ⅛-inch square. Do not remove the aluminum; you only want to be able to insert a screw.
8. Insert a #4-40-by-¼-inch screw through the ⅛-inch square so that the screw head rests against the hook piece. Place a single #6 washer over the end of the screw.
9. Strip ¾ of an inch of insulation from one conductor on the separated end of the zip cord. Wrap the exposed wire around the screw end so that the insulation ends at the surface of the washer.
10. Place another washer on the screw over the wire. This creates a sandwich with the washers on the outside and the wire in between.
11. Secure the assembly with a #4-40 nut. Do not rotate the screw while tightening the nut. The aluminum foil is making contact with the screw in the ⅛-inch square, and you do not want to break this contact.
12. Remove the remaining blue backing from the hook piece. Now touch the self-stick material until the oils from your hand render it unsticky.

Repeat the 12 steps to make another bioprobe. You will now have the two bioprobes on the separated end of the zip cord. Strip ¼ of an inch of insulation from the two conductors on the free end of the zip cord. Pass this end through an opening in your case and attach either conductor to either of the two remaining holes in the PCB. Snap a 9-volt battery into B1, place S1 to the off position, and reinstall the circuit in your case.

Using the BioBox

The area should be quiet, and you should relax yourself by loosening tight clothes, removing your shoes, and so forth. Sit in a comfortable position that provides arm and elbow support. For best results, your hands should be clean and dry and the room temperature should be around 70 degrees F.

Type in, save, and then run the Bio program. After the initial screen displays, remove the plugs from your cassette deck. Place the black plug in J2 (out) and the large grey plug in J1 (in). The small grey plug is not used. Place S1 (power) to the on position.

Notice that the display consists of a title at the top (on dark green background, which I call "reverse green"). The second line is where all messages appear (in this instance, you'll see "Instructions ? Y/N"). When an input is required, you'll see a rapidly blinking question mark, replacing the normal cursor. Below the message line is the monitoring graph of 10 columns of squares bordered in reverse green.

If you now press Y, you'll hear a beep and the first screen of instructions will appear. At the bottom of the screen will be the prompt "Press any key to continue". This prompt will also appear in other parts of the program, also on the bottom line. After reading the display, pressing any key brings the next screen of instructions. There are four instruction screens, with the last advising that you can press R (restart) or E (end) at any time.

When you press any key, the monitoring screen is redrawn, and "Select initial mood (2–9)" appears on the message line (this is where you would be if you answered N to the instructions prompt). At this point place the bioprobes on your fingers and press the number 5. Columns 6–10 disappear, and "Initializing" appears on the message line. The top block on the rightmost row (fifth row in this instance) blinks five times as initialization pro-

ceeds. Then the message line clears.

You are now monitoring. Make a tight fist with the hand containing the bioprobes. Note that squares are added to the display. When you relax your hand, the squares will begin to disappear. Now relax and try to remove all boxes on the display.

To simulate a fault, turn the BioBox's power off. After a second or two, "Fault" appears in the message line and "Press any key to continue" appears at the screen bottom. Pressing any key lets you restart. Turn the BioBox power back on and select an initial mood (number between 2 and 9). If you are successful and remove all squares, the message "Maximum calm attained" overwrites the title and "[R]estart, or [E]nd" appears on the message line.

The message line indicates your selection by printing "Restart" or "End", with the question "Store results (Y/N)". You would not store results if, for instance, you're interrupted during the trial, or some other annoyance created invalid results. Otherwise, you would store the results to gauge your progress during the sessions.

This same message appears if at any time you press R or E. However, during monitoring, it might be necessary to hold the R or E key down for a second or so for the key to be recognized. Use the restart option if you feel you've calmed as far as you can and want to store the results and try again. Use the end option when you want to end the session or review results so far.

When you select the end option, your results are displayed. If more than 10 trials have been made, 10 at a time will be displayed (with the "Press any key to continue" prompt appearing at the bottom). When the last trial result is displayed, the question "Restart (Y/N)" appears. Answering N ends the program, while a Y answer restarts.

The results display contains five columns, labeled Trial #, Start, End, Time, and Factor. For each trial, the Start and End columns show the number of squares you started and ended with. For instance, if you initially selected mood 6 and achieved maximum calm, the Start indication would be 60 (6 columns × 10 squares/column = 60) and the End indication would be zero.

The next column indicates the elapsed time of the session (not in seconds, but arbitrary units of time). The final column gives an indication of how well you did. It is a ratio of the number of squares removed per one unit of time. The object is to get this number as close to zero without going negative, which indicates squares were added, not removed.

Summing It Up

With this series, I've shown you how simple interface circuits can make your CoCo more interesting and versatile. The BioBox can turn the CoCo into a sophisticated biofeedback monitoring system with which you can monitor and gauge your progress. (You might even wish to add storage and/or printing of the results to the Bio program.)

By reviewing the results, you might find it possible to determine events and conditions that add to tension or stress in your daily life. Even without these benefits, the BioBox makes for a relaxing interlude and can be a lot of fun. (Try using it as a lie detector at your next party!)■

Address correspondence to James Barbarello, RD #1, Box 241 H, Tennent Road, Englishtown, NJ 07726.

Program Listing 2. Biofeedback Monitor

```
1 REM**  BIOFEEDBACK MONITOR
2 REM**  NAME: BIO
3 REM**  REV #0, 3 APR 1983
4 REM**
10 CLEAR 1000,16127:DIM T(50,3):
DEFUSR=16128:DEFUSR1=16173
20 CLS:B$="":C$="":BF$=CHR$(203)
+CHR$(128):TTL$="       BIOFEEDB
ACK MONITOR      ":NL$=STRING$(3
2,128):PRINTTTL$;
30 IF FLG>0 THEN 90 ELSE PRINT@3
2,"  (C) 1983 BY J.J. BARBARELLO
   ";
40 DATA 26,80,134,255,183,255,32
,198,8,90,38,253,134,3
50 DATA 183,255,32,26,80,198,1,1
42,0,0,134,254,186,255
60 DATA 32,129,254,39,6,58,140,0
,0,38,241,191,63,43,57,0,0,134,0
,198,1,142,4,0,166,132,129,127,3
4,4,134,63,164,132,167,128,140,6
,0,38,239,57
70 FORI=16128 TO 16197:READ M:PO
KE I,M:NEXT I
80 A(1)=163:A(2)=163:A(3)=131:A(
4)=131:A(5)=147:A(6)=147:A(7)=24
3:A(8)=243:A(9)=179:A(10)=179
90 FORI=1TO10:BF$=BF$+CHR$(A(I))
+CHR$(128):NEXTI
100 FORI=102TO390STEP32:PRINT@I,
BF$;:NEXT
110 PRINT@422,CHR$(203);CHR$(195
);:FORI=1TO10:PRINTCHR$(199);CHR
$(195);:NEXT
120 PRINT@456,"1 2 3 4 5 6 7 8 9
 10":PRINT@488,"CALM          T
ENSE";
130 FORI=0TO5:PRINT@I*32+164,MID
$("^TENSE",I+1,1);:NEXT
140 SOUND100,1:PRINT@32,NL$;:X=U
SR1(0):IF FLG>0 THEN 160
150 PRINT@38,"INSTRUCTIONS (Y/N)
...";:P=60:GOSUB 800:IF AI$<>"N"
 THEN GOSUB 600
160 FLG=2:PRINT@33,"SELECT INITI
AL MOOD (2-9)...";:
170 AR$=INKEY$:IF AR$="" THEN PR
INT@62,"?";:PRINT@62,CHR$(128);:
GOTO 170 ELSE GOSUB 760:IF VAL(A
R$)<2 OR VAL(AR$)>9 THEN 170
180 PRINT@62,AR$;:CC=VAL(AR$):R=
104:C=CC*2:AB$=STRING$((10-CC)*2
,128)
190 FORI=0TO9:PRINT@R+C+32*I,AB$
```

Listing continued

THE PROGRAM STORE

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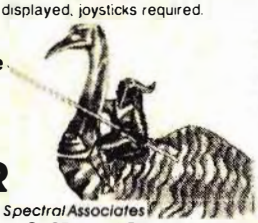

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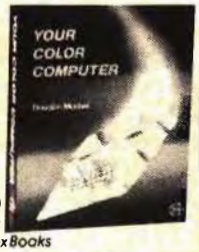

by Douglas Mosher from Sybex Books

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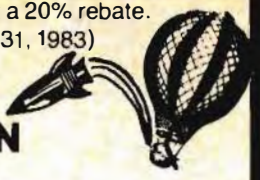

by Tim Purves from Computer Shack

New and totally different! Not only a great game with plenty of action but an exceptional learning tool to improve your programming skills. Included is the complete commented printout of the entire source code. See how the game was written and executed so that the mad balloonist drops bombs on unweary pedestrains. You can run and dodge, but to no avail, he'll get you, it's just a matter of time!

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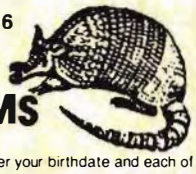

from Armadillo Int'l Software

Predict your "good days"! Enter your birthdate and each of the biorhythms will be drawn . . . physical, emotional and intellectual. Uses a graphic mode not normally available without extended basic to produce high resolution graphics. What will happen on your next critical day?

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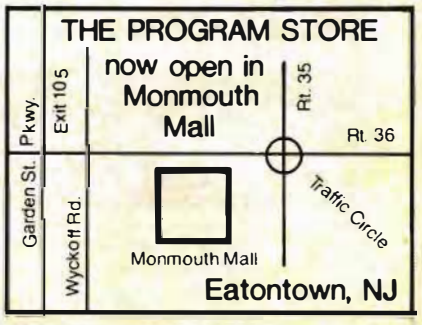

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Listing continued

```
;:NEXT:PRINT@32,NL$;:C=C-2
200 PRINT@42,"INITIALIZING";:Y=0
:FLG=2:XT=0:X=USR(0):GOSUB 550
210 FOR I=1TO5:PRINT@R+C,CHR$(A(
CC));:X=USR(0):GOSUB550:PRINT@R+
C,CHR$(128);:FORJ=1TO40:NEXTJ
220 Y=Y+X:NEXT:XO=Y/5:INC=XO/(10
*(CC+5)):XL=XO-CC*INC*10
230 PRINT@32,NL$;
240 PRINT@R+C,CHR$(A((C+2)/2));
250 X=USR(0):GOSUB550:IFX=0THENP
RINT@43,"F A U L T";:GOSUB 530:G
OTO20
260 XT=XT+X/30000
270 GOSUB 740
280 PRINT@R+C,CHR$(128);
290 IF ABS(XO-X)<INC THEN 400
300 IF X<XO THEN 360
310 IF X<XO THEN 390
320 PRINT@R+C,CHR$(128);:XO=XO+I
NC:R=R+32:IF R=424 THEN R=104:C=
C-2
330 IF C>-1 THEN GOSUB 500:GOTO
310
340 PRINT@0," **** MAXIMUM CALM
ATTAINED ****";:PRINT@38,"<R>EST
ART, OR <E>ND..";
350 PRINT@60,CHR$(128);:GOSUB 74
0:PRINT@60,"?";:GOTO 350
360 PRINT@R+C,CHR$(A((C+2)/2));:
R=R-32:IF R<104 THEN R=392:C=C+2
370 IF C>18 THEN C=18:R=104:GOTO
 390
380 XO=XO-INC:PRINT@R+C,CHR$(A((
C+2)/2));:GOSUB 500:GOTO 300
390 X=XO
400 FOR I=1TO(X-XL)*250/XL:NEXTI
:XT=XT+I/460:GOTO 240
500 REM* DELAY LOOP
510 FOR Z=1 TO 50:NEXT:XT=XT+.25
:RETURN
520 REM** PRESS ANY KEY
530 PRINT@448,STRING$(32,128);"
PRESS ANY KEY TO CONTINUE...";
540 AI$=INKEY$:IF AI$=""THEN PRI
NT@510,"?";:PRINT@510,CHR$(128);
:GOTO 540 ELSE SOUND 100,1:RETUR
N
550 REM** RETRIEVE COUNT
560 X=PEEK(16171)*256+PEEK(16172
):RETURN
600 REM** INSTRUCTIONS
610 GOSUB 880:PRINT@32,"********
**INSTRUCTIONS**********";NL$;:X
=USR1(0):PRINT"    THE COCO BIOF
EEDBACK SYSTEM MEASURES & DISPLA
YS YOUR CHANGESIN MOOD. BEFORE B
EGINNING, CHECKTHAT THE HARDWARE
 INTERFACE IS  ATTACHED AND POWE
R IS APPLIED."
620 PRINT"    NEXT, ATTACH ONE B
IOPROBE   TO YOUR INDEX FINGER A
```

Listing continued

Listing continued

```
BOVE THE  FIRST JOINT. THEN PLAC
E THE     REMAINING BIOPROBE ON
YOUR      MIDDLE FINGER ABOVE IT
S FIRST   JOINT."
630 GOSUB 530:GOSUB 880
640 PRINT"    WHEN THESE INSTRUC
TIONS ARE DONE, YOU WILL BE ADVI
SED TO     ";CHR$(34);"SELECT IN
ITIAL MOOD (2-9)...";CHR$(34):PR
INT"PRESS A NUMBER BETWEEN 2 (CA
LM) AND 9 (TENSE). FOR INSTANCE,
 IF YOU'RE IN AN AVERAGE MOOD, P
RESSTHE NUMBER 5."
650 PRINT"    YOUR MOOD IS REPRE
SENTED BY THE 100 BLOCKS ON THE
DISPLAY.  WHEN YOU INPUT YOUR IN
ITIAL MOODTHE HIGHER TENSION-IND
ICATING   BLOCKS WILL DISAPPEAR.
"
660 GOSUB 530:GOSUB880
670 PRINT"    THE OBJECT IS TO R
ELAX AND, IN THE PROCESS, MAKE A
LL THE    BOXES DISAPPEAR. IF YO
U GET MORETENSE, THE BOXES WILL
BEGIN RE- APPEARING. THE BLINKIN
G BOX WILLREMIND YOU WHERE YOU C
URRENTLY  ARE. IT BLINKS FASTER
WHEN YOURE";
680 PRINT"MORE TENSE, AND SLOWER
 WHEN YOU CALM DOWN.":PRINT"
IF A HARDWARE FAULT OCCURS, A ME
SSAGE WILL APPEAR AND ALLOW YOU
TO RESTART BY PRESSING <R>.":' I
F YOU WISH TO RESTART AT ANY   O
THER TIME, PRESS<R>. WHEN YOU WI
SH TO END, PRESS<E>.
690 GOSUB 530:GOSUB 880
700 PRINT@128," ":PRINT"   IF YO
U WISH TO RESTART AT ANYOTHER TI
ME, PRESS <R>. WHEN YOU WISH TO
END, PRESS <E>.":PRINT:PRINT:PRI
NT"** THIS ENDS THE INSTRUCTIONS
 **"
710 GOSUB 530:FLG=2:GOTO20
740 REM* RESTART/END
750 AR$=INKEY$:IF AR$=""THEN RET
URN
760 IF AR$="R"ORAR$="r"THEN PRIN
T@32,"RESTART. ";:GOSUB 840:GOTO
 20
770 IF AR$="E"ORAR$="e"THEN PRIN
T@32,"  END.  ";:GOSUB 840:GOTO
890 ELSE RETURN
790 REM**  YES/NO ANSWER
800 AI$=INKEY$:IF AI$=""THENPRIN
T@P,CHR$(63);:PRINT@P,CHR$(128);
:GOTO 800ELSENU=ASC(AI$)
810 IFNU>91THENNU=NU-32
820 AI$=CHR$(NU):IFAI$<>"Y"ANDAI
$<>"N"THEN800ELSE SOUND 50,1:RET
URN
840 REM* STORE RESULTS
850 PRINT"STORE RESULTS (Y/N).."
```

Listing continued

See List of Advertisers on page 130

Listing continued

```
;:P=62:GOSUB 800:PRINT@62,AI$;
860 IF AI$="Y" THEN IF INC<>0 TH
EN S=S+1:T(S,1)=CC:T(S,2)=(XO-(Y
/5))/INC:T(S,3)=XT
870 RETURN
880 CLS0:PRINTTTL$;NL$;:X=USR1(0
):RETURN
890 REM* END
900 ST=1:TN=0:CLS0:PRINTTTL$;:IF
 S=0 THEN 950
910 PRINT@32,"**********  RESUL
TS  **********";:X=USR1(0):PRINT
"TRIAL#  START  END  TIME  FACTO
R";STRING$(32,"-");
920 FORI=ST TO S:IF T(I,2)=0 THE
N FTR=0 ELSE FTR=T(I,3)/T(I,2)
930 PRINTUSING"  ##     ###   ##
#  #### ####.##";I;T(I,1)*10;T(I
,1)*10-T(I,2);T(I,3);FTR;
940 TN=TN+1:IF TN=10 THEN GOSUB
530:TN=0:ST=ST+10:CLS0:PRINTTTL$
;:GOTO 910 ELSE NEXT
950 PRINT@416,"RESTART (Y/N)..."
;:P=433:GOSUB 800:IF AI$="Y" THE
N 20 ELSE PRINT@416,"         PR
OGRAM ENDED."
```

Air Traffic Controller is a computer model of an air traffic control situation in which Remotely Piloted Vehicles (RPV's) are operated by the controller in landing on and taking off from designated runways.

32K Extended Basic

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By Ken Kalish

Devil Assault is a mult-level multi-screen game in which bird-like creatures, robots and the devil himself assault your home base which you must defend.

16K Machine Language

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32K Machine Language DISK ONLY 27.95

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BY KENNETH C. ANDERSON

INTRODUCTION TO MULTICOLOR GRAPHICS—PART III

*In Part II of this series (*HOT CoCo, *September 1983), the author discussed how to compile a color file and how to use the colors to dress up otherwise drab graphics programs.*

What should you do when a graphics problem stops you short? Head straight for the Drawing Board.

Making the most of your computer's color graphics power is one of the more enjoyable aspects of Color Computer use. Here are just a few things you can do with Program Listings 1 and 2:

- Produce graphics directly on the screen.
- Keep what you like and discard the rest.
- Use any PMODE, mixed or straight.
- Use any of the more than 1,000 possible color hues in most PMODEs.
- Explore multicolor applications available in 256-by-191 screen resolution.
- List anything you want to keep.

Each program pushes the memory capacity of a 16K Color Computer to its limits. If you are lucky enough to have a 32K or 64K machine, keep the programs separate rather than merging them into one. Instead, increase the amount of memory reserved by the CLEAR and DIM statements.

Both programs use two joysticks to locate pixel coordinates and PSET a point on the screen. The red button of each joystick should be facing away from you. That is the top. Adjust both sticks to their approximate center locations, making sure that the left joystick is on your left.

To cover the entire screen with two sticks and still be able to locate any pixel on the 256-by-191 grid, I had to use one as a "multiplier" and the other as an "adder." The left stick gives you a general screen area and is your "multiplier." Use the right stick to find a specific point within a 63-by-63-pixel area. The right stick is the "adder" because it moves one pixel at a time.

Drawing Board

Before you run this program enter PCLS to clear the screen. Begin with Drawing Board. When you run the pro-

Program Listing 1. Drawing Board

```
1 CLS:PCLS
2 CLEAR 1300:DIMH$(200)
3 DIMH(30),C(30),X(30),Y(30),X1(30),Y1(30),X2(30),Y2(30),L(30),R
(30),HW(30),ST(30),EN(30),BC(30)
4 PMODE4,1:SCREEN1,1:PMODE3,1
5 A=JOYSTK(0):B=JOYSTK(1):V=JOYSTK(2):W=JOYSTK(3)
6 X=A+INT(V*3.05):Y=B+INT(W*2.032)
7 IFX>255THENX=255:IFY>191THENY=191
8 C$=INKEY$
9 IFC$="1"THENC=1
10 IFC$="2"THENC=2
11 IFC$="3"THENC=3
12 IFC$="4"THENC=4
13 IFC$="5"THENPMODE4,1
14 IFC$="6"THENPMODE3,1
15 IFC$="7"THENPMODE1,1
16 IFC$="8"THENPMODE1,3
17 IFC$="9"THENSCREEN1,1
18 IFC$="0"THENSCREEN1,0
19 IFC$="C"THENPCLS:
20 IFC$="L"THEN31
21 IFC$="D"THEN32
22 IFC$="R"THEN35
23 IFC$="P"THEN43
24 IFC$="H"THEN48
25 IFC$="B"THEN56
26 IFC$="S"THENL=5
27 IFC$="T"THEN63
28 IFC$="X"THENL=1:PCLS
29 PSET(X,Y,C)
30 GOTO5
31 X1=X:Y1=Y:GOTO5
32 L=2:X2=X:Y2=Y:COLORC,0
33 LINE(X1,Y1)-(X2,Y2),PSET
34 GOTO5
35 INPUT"RADIUS (1-255)";R
36 INPUT"HEIGHT/WIDTH RATIO (0-4)";HW
37 INPUT"START POINT (0-1)";ST
38 INPUT"END POINT (0-1)";EN
```

Listing continued

System Requirements

16K RAM
Extended Color Basic
Two Joysticks

gram, you should see a dot of color on the screen, located to the left of center. If this description does not match what you see, check lines 5–7 and 29–30.

First, test the colors. Both programs start in a mixed mode—3 superimposed on 4—and the colors are, therefore, different from those in straight PMODEs. Keys 1–4 select the primary colors in each mode. Key 1 erases the dot to the background color, while key 4 puts a dot on the screen. The dot is white, bright blue, or yellow. With 2 and 3 you will get blue and red.

Unfortunately, the computer likes to switch these two colors sometimes, although it keeps the same color for 2 as long as you do not turn off the machine. If you want 2 to be blue, keep pressing the reset button until it comes up on the screen.

Next, see how much area the right stick covers. Move it to the upper left corner, and select a color from 2 to 4. Press L to set the starting coordinates for a line. Move the stick to the lower left corner. Press D to set the ending coordinates and "do" the line. Press H to "hold" it.

If you have trouble, check lines 20, 31, 21, and 32–34. Don't worry about the extra dots. You will take care of them later.

Press L, and move the stick to the bottom right corner. Press D, H, and L, and move the stick to the top right corner. Press D, H, and L, and move the stick to the top left corner. Press D and H. You should now have a rectangular area on your screen. This indicates the area you can cover with the right stick.

Do not change colors during this stage. If you did change colors, go back and repeat the rectangle, using one color for all the lines.

Next, be sure the CIRCLE function is working. Move the dot near the center of the rectangle. Press R (for round). The text screen appears, and you must provide further instructions. For now, use a radius of 40, and answer the other questions with the number 1. You should see a circle that is the same color as the rectangle. Check lines 22 and 35–42 if you run into trouble.

Pretend that you do not like this color. To erase it, press the number 1 to select the background color, and then press R. The previous CIRCLE instructions should appear on the text screen. Copy them and the circle should disappear from the graphics screen. Since it overlapped the rectangle, it will leave a blank spot at each overlapping point, but you do not have to worry about that.

Produce a circle in a different color that is entirely outside the rectangle.

Listing continued

```
39 PRINT:IFHW>4ORST>1OREN>1THENPRINT"EXCEEDS LIMITS - DO OVER.":
GOTO35
40 PMODE4,1:SCREEN1,1:PMODE3,1
41 L=3:CIRCLE(X,Y),R,C,HW,ST,EN
42 GOTO5
43 INPUT"BORDER COLOR (1-4)";BC
44 IFBC>4THENPRINT"EXCEEDS LIMITS - DO OVER.":GOTO43
45 PMODE4,1:SCREEN1,1:PMODE3,1
46 L=4:PAINT(X,Y),C,BC
47 GOTO5
48 H=H+1:IFH=>26THENPRINT:PRINT"CAUTION: ONLY "30-H"MORE MAY BE
HELD";:INPUTE$:PRINT
49 CO=H:C(H)=C:X(H)=X:Y(H)=Y:X1(H)=X1:Y1(H)=Y1:X2(H)=X2:Y2(H)=Y2
:L(H)=L:R(H)=R:HW(H)=HW:ST(H)=ST:EN(H)=EN:BC(H)=BC
50 IFL=1THENH$(H)="PCLS"
51 IFL=2THENH$(H)="COLOR "+STR$(C(H))+": LINE ("+STR$(X1(H))+","
+STR$(Y1(H))+")-("+STR$(X2(H))+","+STR$(Y2(H))+"),PSET"
52 IFL=3THENH$(H)="CIRCLE ("+STR$(X(H))+","+STR$(Y(H))+"),"+STR$
(R(H))+","+STR$(C(H))+","+STR$(HW(H))+","+STR$(ST(H))+","+STR$(E
N(H))
53 IFL=4THENH$(H)="PAINT ("+STR$(X(H))+","+STR$(Y(H))+"),"+STR$(
C(H))+","+STR$(BC(H))
54 IFL=5THENH$(H)="PSET ("+STR$(X(H))+","+STR$(Y(H))+","+STR$(C(
H))+")"
55 GOTO4
56 FORH=1 TO CO
57 IFL(H)=1 THEN PCLS
58 IFL(H)=2 THENCOLORC(H),0:LINE(X1(H),Y1(H))-(X2(H),Y2(H)),PSET
59 IFL(H)=3THENCIRCLE(X(H),Y(H)),R(H),C(H),HW(H),ST(H),EN(H)
60 IFL(H)=4THENPAINT(X(H),Y(H)),C(H),BC(H)
61 IFL(H)=5 THENPSET(X(H),Y(H),C(H))
62 NEXT:GOTO5
63 FORH=1 TOCO
64 PRINTH"."+H$(H)
65 IFH/3=INT(H/3)THENPRINTTAB(4);:INPUT"<ENTER> TO CONTINUE";E$
66 NEXT:INPUTE$:GOTO4
```

Program Listing 2. Easel

```
1 CLS
2 DIM CO(10),I(9),P(10),T(10),TP(10),C(10,8),X(10,10),Y(10,10),D
$(10,10),VS(10,8),S(10,8)
3 CO=CO+1:I=1:P=0
4 PRINT"SELECT COLOR CODE (8 MAX)"
5 PRINT"CODE #"CO" OF 10 :"
6 PRINTTAB(2)"COLOR # "I;:INPUT C(CO,I)
7 IFC(CO,I)=0THENI=I-1:GOTO9
8 I=I+1:IFI=9THENI=8ELSE6
9 T(CO)=I:TC=CO
10 INPUT"VERTICAL SIZE OF MODULE";VS
11 INPUT"DEGREE OF SLANT";S
12 INPUT"HOW MANY MODULES ACROSS";MA
13 INPUT"HOW MANY MODULES DOWN";MD
14 PMODE4,1:SCREEN1,1:PMODE3,1
15 A=JOYSTK(0):B=JOYSTK(1):V=JOYSTK(2):W=JOYSTK(3)
16 X=A+INT(V*3.05):Y=B+INT(W*2.032)
17 IFX=>255THENX=255:IFY=>191THENY=191
18 IFX+S<0THENX=X+1:GOTO18
19 C$=INKEY$
20 IFC$="N"THEN3
21 IFC$="H"THEN58
22 IFC$="B"THEN68
23 IFC$="D"THENGOSUB39
24 IFC$="T"THEN80
25 IFC$="M"THEN10
26 IFC$="C"THENPCLS
27 IFC$="1"THENC=1
28 IFC$="2"THENC=2
29 IFC$="3"THENC=3
30 IFC$="4"THENC=4
31 IFC$="5"THENPMODE4,1
32 IFC$="6"THENPMODE3,1
33 IFC$="7"THENPMODE1,1
34 IFC$="8"THENPMODE1,3
35 IFC$="9"THENSCREEN1,1
36 IFC$="0"THENSCREEN1,0
37 PSET(X,Y,C)
38 GOTO15
39 Y1=Y+VS:Y2=Y
40 FORF=1TOMD
41 X1=X:X2=X+S
42 FORG=1TOMA
43 GOSUB49
44 X1=X1+1:X2=X2+1
```

Listing continued

Listing continued

```
 45 NEXT
 46 Y1=Y1+VS:Y2=Y2+VS
 47 NEXT
 48 RETURN
 49 FORI=1TOT(CO)
 50 COLOR C(CO,I)
 51 LINE(X1,Y1)-(X2,Y2),PSET
 52 X1=X1+1:X2=X2+1
 53 IFX2=>255THENX2=255
 54 IFY1=>191THENY1=191
 55 IFY2=>191THENY2=191
 56 NEXT
 57 RETURN
 58 P=P+1
 59 IFP=7THENPRINT:PRINT"CAUTION: YOU MAY HOLD ONLY ONE  MORE PAT
CH IN THIS COLOR.";:INPUTE$:PRINT
 60 X(CO,P)=X
 61 Y(CO,P)=Y
 62 S(CO,P)=S
 63 VS(CO,P)=VS
 64 TP(CO)=P
 65 MA(CO,P)=MA
 66 MD(CO,P)=MD
 67 GOTO14
 68 FORCO=1TOTC
 69 FORP=1TOTP(CO)
 70 X=X(CO,P)
 71 Y=Y(CO,P)
 72 MA=MA(CO,P)
 73 MD=MD(CO,P)
 74 S=S(CO,P)
 75 VS=VS(CO,P)
 76 GOSUB39
 77 NEXT
 78 NEXT
 79 GOTO15
 80 FORCO=1TOTC
 81 PRINT"COLOR CODE #"CO":"
 82 FORI=1TOT(CO)
 83 PRINTC(CO,I);
 84 NEXT
 85 PRINT:PRINT"MODULE LOCATIONS:"
 86 FORP=1TOTP(CO)
 87 PRINT"VS="VS(CO,P)":S="S(CO,P)":X="X(CO,P)":Y="Y(CO,P)
 88 PRINT"MA="MA(CO,P)":MD="MD(CO,P)
 89 IFP/5=INT(P/5)THENPRINTTAB(2);:INPUT"<ENTER> FOR NEXT";E$:PRI
NT
 90 NEXT
 91 IFCO=TC THEN15
 92 PRINTTAB(2)"<ENTER> FOR CODE #"CO+1;
 93 INPUTE$
 94 PRINT:NEXT
```

When you have done that, press H to hold it, then continue. Do not move the joysticks for this.

You should still have one color that you have not used yet. Choose it now and remember what the code was for the color of the circle. Press P to paint. The text screen appears, and you should request a border color where the painting is supposed to stop. Enter the color of the circle. Check lines 23 and 43–47 to solve any problems.

You painted over the rectangle, right? For testing purposes, let's assume that you did not want to do that, so you have to correct the error. Press C to PCLS the graphics screen (line 19).

Do you know why the screen cleared to white (buff)? The last PMODE instruction was 3, 1. When you called for PCLS, the screen cleared to that mode. Take this opportunity to see how easy it is to change modes. Press 5, 9, and 6. This should return you to mixed mode 3 on 4 (lines 13-19). You might want to change to the other modes and screens, but be sure to end by pressing 5, 9, and 6.

"If you want to paint the rectangle instead of the circle, choose any color except the color of the border."

Building Blocks

Now that you have the black, blank screen back, press B to "build" all the graphics you put on hold earlier. Not only did you get rid of the extra dots, but the rectangle no longer has the blank spots. Lines 24 and 48–54 hold the graphics, while lines 25 and 55–61 build the graphics.

If a bug is in the holding operation, it will probably affect the next operation, too. If a bug is in the building operation, the next operation should work fine. If both have bugs, you are on your own.

If you want to paint the rectangle instead of the circle, choose any color except the color of the border. You must always do the drawing in a color that contrasts the paint color. Press P, enter

the color of the rectangle, and hold it.

I have included two controls that you might not need. If you do not need them, you can gain a little memory by deleting all the lines involved except line 29. The two commands are S (lines 26 and 54) and X (lines 28 and 50). Pressing C clears the screen directly. If you need to PCLS in your program, you must use X to PCLS, then H to remember it. Likewise, pressing S and H holds the PSET command for program use.

To use the highest resolution—256-by-191 pixels—for all your graphics, erase what you have, and "build" it again in a higher resolution. Press C and 7. If the screen does not remain black, press 5, 9, and 7. Now press B to build your graphics in mixed mode 1 on 4, beginning on graphics page 1.

In the mixed mode, PMODE 1,1 uses the first two graphics pages, which appear as the top half of the PMODE 4,1 screen. The effect is to double your resolution. To use the bottom half, press 8 and B. This builds the graphics in PMODE 1,3 over PMODE 4,1 starting on page 3.

By using these two modes together, you can use the highest resolution of any color including the multicolor graphics in Listing 2. You can also superimpose the modes to create similar graphics at three different locations. Pressing 6 and B brings you back to the beginning (lines 13–18).

Now assume that you want to use this work in an actual program. Instead of spending all your time with pencils and charts, simply press T (for text). Your entire program appears on the screen, with each color code, command, and coordinate listed in the same order as you put them on hold. All you have to do is write in the PMODEs you want for your program, then copy the instructions.

If you are using a printer, just rewrite the end of the program to print out H$(H). You can omit line 65. Check lines 27 and 63–66 if you have trouble.

If you have 32K, double the amounts used in the DIM statements, and change the number 30 in line 48 to the same amount.

Both Programs

Key	Function
1	COLOR 1
2	COLOR 2
3	COLOR 3
4	COLOR 4
5	PMODE 4,1
6	PMODE 3,1
7	PMODE 1,1
8	PMODE 1,3
9	SCREEN 1,1
0	SCREEN 1,0
C	PCLS
H	holds graphics in memory
B	builds held graphics
T	text for held graphics printed
Drawing Board Only	
L	line starting point
D	does LINE
R	round figure's center
P	paints in primary color only
S	sets a pixel for program use only
X	PCLS for program use only
Easel Only	
N	encodes a new color and sets module size
D	does a module
M	changes module size in same color

Table 1. Control Box for Drawing Board and Easel

Easel

When you are familiar with Drawing Board, you are ready to enter and run Easel (Listing 2). It does the same thing for multicolor applications that Drawing Board does for lines and circles.

Both programs use the same control keys for the following functions: color selection, PMODE, SCREEN, PCLS, Do, Hold, Build, and Text. In Easel, however, the DO command constructs a module of color instead of a line. Both programs allow you to work in mixed or straight modes, including the combination that gets the highest resolution.

Those of you who have used Color File (see Part II of this series) can see that Easel works the same way Color File does. You choose the variables for the dimensions of the module, select a color code from your file, and determine how much area that color will cover. Area means the number of modules across and down.

To review briefly, begin with a code to two colors. Each color in the code must be one of the primary colors, 1–4. Start with a vertical size of 2, a slant of positive or negative, one module across and one module down.

When the graphics screen appears, you see the familiar dot. This is the loca-

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```
10 '   C O L O R   C H A R T
20 '
30 PMODE4,1:PCLS3:SCREEN1,1:PMODE3,1
40 '
50 ' DATA FOR COLOR CODES
60 '
70 DATA VIOLET,2,4,3,1,0,BLUE-VIOLET,3,3,4,1,2,0,BLUE,2,2,3,0,BL
UE-GREEN,3,3,1,0
80 DATA GREEN,3,3,2,4,1,0,YELLOW-GREEN,3,4,4,1,0,YELLOW,2,1,4,0,
YELLOW-ORANGE,1,4,4,2,0
90 DATA ORANGE,1,1,4,2,0,RED-ORANGE,1,2,1,2,0,RED,2,1,1,2,1,0,RE
D-VIOLET,2,4,2,3,1,0
100 '
110 '     MAIN PROGRAM
120 '
130 POKE65495,0
140 C$="RED":GOSUB320
150 VS=5:S=5:X=152:Y=0:MA=17:MD=38:GOSUB430
160 C$="YELLOW":GOSUB320:X=61:MA=27:GOSUB430
170 C$="BLUE":GOSUB320:X=0:MA=22:GOSUB430
180 POKE65494,0
190 C$="ORANGE":GOSUB320:X=156:MA=9:GOSUB430
200 C$="GREEN":GOSUB320:X=63:MA=8:GOSUB430
210 C$="VIOLET":GOSUB320:X=0:MA=6:GOSUB430
220 C$="RED-VIOLET":GOSUB320:X=230:MA=4:GOSUB430
230 C$="RED-ORANGE":GOSUB320:X=187:MA=4:GOSUB430
240 C$="YELLOW-ORANGE":GOSUB320:X=141:MA=5:GOSUB430
250 C$="YELLOW-GREEN":GOSUB320:X=98:MA=4:GOSUB430
260 C$="BLUE-GREEN":GOSUB320:X=54:MA=5:GOSUB430
270 C$="BLUE-VIOLET":GOSUB320:X=17:MA=3:GOSUB430
280 GOTO140
290 '
300 ' DATA READING SUBROUTINE
310 '
320 RESTORE
330 READ D$
340 IF D$=C$ THEN 350 ELSE 330
350 CO=0:TC=0
360 CO=CO+1:TC=CO:READ C(CO)
370 IFC(CO)=0THENTC=TC-1:GOTO390
380 TC=CO:GOTO 360
390 RETURN
400 '
410 'MODULE PLOTTING SUBROUTINE
420 '
430 Y1=Y+VS:Y2=Y:FORF=1TOMD
440 X1=X:X2=X+S:FORG=1TOMA
450 FORCO=1TOTC:COLORC(CO):LINE(X1,Y1)-(X2,Y2),PSET
460 X1=X1+1:X2=X2+1:IFX2=>255THENX2=255
470 IFY1=>191THENY1=191
480 IFY2=>191THENY2=191
490 NEXT:X1=X1+1:X2=X2+1:NEXT
500 Y1=Y1+VS:Y2=Y2+VS:NEXT:RETURN
```

Program Listing 3. Color Chart

tion of the upper left portion of the module. Press D (for Do), and a single module of color appears. Hold it for future reference, and press M to assign new instructions for using the same color in a different way.

Now use a vertical size of 5, a slant of negative 1, 20 modules across, and six modules down. When the graphics screen appears, move the joysticks to find a location near the upper left portion of the screen. "Do" the patch. You get the same primary colors in a patch much larger than the other one and in a different design configuration.

Easel lets you choose a code of up to eight primary colors. If you use eight, there are 65,536 possible combinations. If you used *all* the codes, from two-color codes up to and including eight-color codes, you would have a palette of more than one quarter million choices. I suggest, therefore, that you begin to experiment with codes of two, three, or four colors.

The vertical size and the slant do have an effect on some colors. Slant affects design more than anything else, but it does this in conjunction with vertical size. If you intend to use this program to paint, as an artist paints a canvas, you will find that a vertical size of five or less will probably work best and that the slant should be nearly the same (plus or minus) as the vertical size.

Press H to hold up to eight locations of the same color. Each location can use different dimensions for vertical size, slant, and number of modules across and down. In addition, you can use up to 10 different colors before you exhaust the memory of a 16K machine. Again, if you have 32K, you can increase the numbers in the DIM (line 2) and "caution" (line 59) statements.

Because of the nature of multicolor graphics, it is impossible to erase a module in the same way you did in Drawing Board, especially if you have a drawing on the screen to help your painting operation. To erase, you need a color code of 1, used once for each number of colors in your code and in the same dimensions. This, unfortunately, costs you one of your possible 10 colors.

It is better to start with a smaller dimension than you need, then press M to change dimensions, and try again. Repeat this procedure until you have covered the entire area, then hold the module. This way, you do not have to erase anything or waste any storage space.

Since you cannot erase in the usual manner, I have omitted a PCLS statement from Easel to allow you to erase in a different manner.

Note that most control keys are the same for both Drawing Board and Easel. The new features of Easel include the N key, which allows you to encode another color (lines 20 and 3–9), and the M key, which allows you to change dimensions without changing colors (lines 25 and 10–13). The program also has two subroutines. One (lines 49–57) constructs a single module; the other (39–48) uses the module to build a patch of color to your specifications.

As in Drawing Board, pressing T does not list some portions of a finished program. These include the PMODE you will work in, the color codes for your specific project, and the two subroutines mentioned above.

Program Listing 3, Color Chart, is an illustration of a finished program. Your computer might produce different colors than mine, but in this case the procedure is the important thing.

By using DATA statements in the manner illustrated, you can list the code for every color in your project. Each color used here has a name, followed by the code and a zero. The zero tells the computer the code has no more primary colors. The colors I use vary in the length of the code. They are not used in the same order in which they are given in the DATA statements. This proves you can use any color in any way.

The subroutine from lines 320–380 reads the data. The first thing it looks for is D$, which can be either letters or numbers. It compares this to C$, which is the name of the color you have chosen to use in your program. When it finds a match, it constructs the code for that color and returns. You must use this routine only when you wish to control

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the colors. I did not use it in Easel.

You must also use the second subroutine, lines 430–500, to construct your color modules.

In your main program, you simply assign a color name to each operation, then send the computer to construct the code for that color. Easel provides the rest.

Be aware that lines 130 and 180 use the double-speed POKE. If it does not work on your computer, delete those lines before you run the program.

You must consider one more procedure. It ties Drawing Board and Easel together for a powerful and efficient graphics tool.

Assume you are ready to add muticolor features to a program that you compiled with Drawing Board. Load Easel, then enter the compiled program, starting with line 1000. When you have entered the program, add 3990 RUN.

At line 4000, add the data-reading subroutine. At line 5000, add the module-building subroutine.

Type RUN 1000 and press enter. When your compiled program finishes, it encounters line 3990 and jumps to the beginning of Easel. Because Easel has no PCLS, your graphics program stays on the screen, ready for multicolor additions.

When you use up the allotment of colors Easel allows, you can add what you have to the end of your compiled program. First, add the DATA statements for the code construction, then add the main program. Leave room for the DATA statements you will add at the next step. Construct your multicolor program like Color Chart. Type C$=, followed by the color name, GOSUB 4000 to read the code, use the list of variables you copied from Easel, and GOSUB 5000 to produce modules.

This lets you use some of the computer's memory twice. Easel doesn't reserve space for arrays until it runs, so a start at line 1000 allows you to use this memory. When Easel runs, the other program does not need the memory, so Easel can access it. Each time you add to your program at line 1000, it all goes on the screen before Easel starts. Eventually, you will run out of memory, but it may surprise you how long it takes.

I have made these programs as easy as possible for you to achieve some super results. They offer power and flexibility, but it is up to you to realize their potential in your own applications. ■

Address correspondence to Kenneth C. Anderson, 1055 Zophi, Nashville, TN 37216.

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BY KARL ANDREASSEN

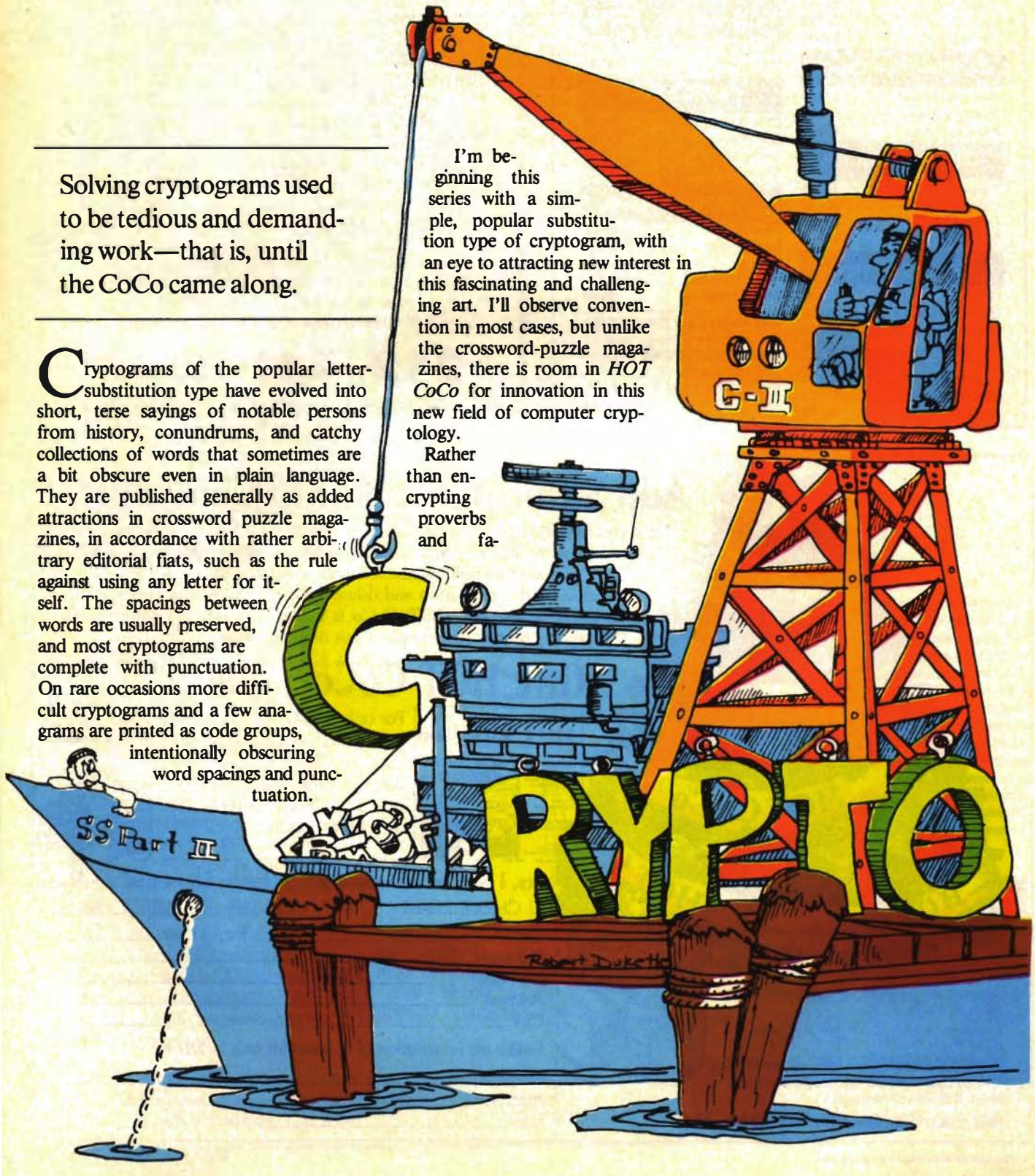
COLORFUL CRYPTOLOGY—PART II

Solving cryptograms used to be tedious and demanding work—that is, until the CoCo came along.

Cryptograms of the popular letter-substitution type have evolved into short, terse sayings of notable persons from history, conundrums, and catchy collections of words that sometimes are a bit obscure even in plain language. They are published generally as added attractions in crossword puzzle magazines, in accordance with rather arbitrary editorial fiats, such as the rule against using any letter for itself. The spacings between words are usually preserved, and most cryptograms are complete with punctuation. On rare occasions more difficult cryptograms and a few anagrams are printed as code groups, intentionally obscuring word spacings and punctuation.

I'm beginning this series with a simple, popular substitution type of cryptogram, with an eye to attracting new interest in this fascinating and challenging art. I'll observe convention in most cases, but unlike the crossword-puzzle magazines, there is room in *HOT CoCo* for innovation in this new field of computer cryptology.

Rather than encrypting proverbs and fa-



mous quotations, as traditional crypto puzzles do, the hidden messages in this column are more likely to mention computers and cryptology itself. Some awareness of likely subjects can sometimes be quite useful in solving a cryptogram, as I'll discuss later.

Last month's cryptograms were probably very easy for some readers, but more difficult for those who have never before tried their hand at divining the hidden message in what, at first look, is a garbled string of letters. Take a look at Table 1 for the solutions to all three messages.

The first two communications translated quite easily when run through the program, but I enciphered the third with a different key alphabet than the one provided. There is a lag of two to three months between the time I write these articles and the time they appear in *HOT CoCo*, so I have not yet received your solutions for the third cryptogram.

While you can use lots of paper and pencil to solve cryptograms of that type, the computer has provided a much more efficient way. But don't throw your paper and pencils away yet; there will be times when these secondary memory aids will come in handy.

For the benefit of the beginning cryptographers, I'll discuss an approach to solving last month's third cryptogram. First, count each repeated letter. The letter that appears most frequently probably stands for an E, although O, T, or A are also likely candidates. So

THERE ARE FOUR AND SIXTY WAYS
OF CONSTRUCTING CRYPTO CIPHERS AND EVERY
SINGLE ONE OF THEM IS USEFUL
WITHIN CERTAIN RESTRICTIVE BOUNDS

THE ONLY PERFECT CIPHER IS ONE
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EYES EXCEPT THE ADDRESSEE

BRING FOUR BAGS OF JOJOBA BEANS
BUT KEEP DESTINATION QUIET TO
AVOID TIPPING OTHER PLANTERS

Table 1. Solutions to Last Month's Cryptograms

Program Listing. Easy Cryptocracker

```
10 CLS:'CSAVE "CRYPTEZ1"
20 PRINTTAB(7)"EASY CRYPTOCRACKE
R":PRINTTAB(7)"BY KARL ANDREASSE
N":PRINTTAB(7)"COPYRIGHT (C) 198
3"
30 CLEAR1000:DIM A$(300),B$(300)
,C$(26),D$(300),E$(26)
40 FORX=1TO26:C$(X)=CHR$(X+64):
NEXT X
50 PRINT:PRINT"THIS CRYPTANALYST
'S HELPER IS":PRINT"FOR USE WITH
 SINGLE ALPHABET":PRINT"CRYPTOGR
AMS.  ENTER CYPHERTEXT"
60 PRINT"ALLCAPS WITHOUT PUNCTUA
TION.":PRINT"TOUCH <*> TO END IN
PUT. READY?":PRINT"<Y>:"
70 Z$=INKEY$:IF Z$=""THEN 70
80 IF Z$="Y"THEN CLS:PRINT"ENTER
 CIPHERTEXT: ":GOTO 100
90 IF Z$=<>"Y"THENPRINT"TOUCH <Y
> OR <BREAK> <Y?>":GOTO 70
100 Z$=INKEY$:IFZ$=""THEN 100
110 IF Z$="*" THEN PRINT:CLS:GOT
O 160
120 IF ASC(Z$)=13 THEN 100
130 I=I+1:A$(I)=Z$:PRINT Z$;
140 IFI>300 THEN CLS*GOTO160
150 GOTO 100
160 FOR W=1TO31
170 IF V=>I THEN 200
180 V=V+1:IF B$(V)>""THEN PRINT
B$(V);ELSE PRINT".";
190 IF B$(V)=" "THEN D$(V)=" "
200 NEXT W:PRINT
210 FOR X=1 TO 31
220 IF U>I THEN 240
230 U=U+1:PRINT A$(U);
240 NEXT X:PRINT:IF I>V THEN160
250 U=0:V=0
260 FOR X=1 TO 26:IF C$(X)=A1$TH
EN E$(X)=A2$
270 NEXT X:PRINT
280 FOR X=1 TO 26:PRINT C$(X);
290 NEXT X:PRINT
300 FOR X=1TO26:IF E$(X)>""THEN
PRINT E$(X);ELSE E$(X)="-":PRINT
"-";
310 NEXT X:PRINT
320 PRINT:LINEINPUT"PLAINTEXT LE
TTER ?: ";A1$
330 LINEINPUT"REPLACING ? LETTER
: ";A2$
340 IF A1$="!"OR A2$="!"THEN GOS
UB420
350 IF A1$="*"OR A2$="*"THENEND
360 IF A1$="#"OR A2$="#"THEN GOS
UB400
370 FOR X=1 TO I
380 IF A$(X)=A2$ THEN B$(X)=A1$
390 NEXT X:CLS:GOTO160
400 FOR X=1TOI:B$(X)=".":NEXTX
410 FOR X=1TO26:E$(X)="-":NEXTX:
RETURN
420 FOR X=1TOI
430 A$=A$+B$(X):IF D$(X)=CHR$(32
)THENA=A+LEN(A$)-1:PRINT#-2,A$;:
A$=""
440 IF LEN(A$)>59 THEN PRINT#-2,
A$:A$="":PRINT#-2
450 IF A>40 THEN PRINT#-2, :PRIN
T#-2:A=0:B=0
460 NEXT X:PRINT#-2,A$:PRINT#-2
470 FOR X=1TO26:PRINT#-2,E$(X);
480 NEXT X:PRINT#-2
490 FOR X=1TO26:PRINT#-2,C$(X);
500 NEXT X:PRINT#-2:PRINT#-2
510 RETURN
```

make a simple table of at least the first five most-frequent letters.

Next, look for two-letter words. There are two. Note also that the same letter that begins one of these words ends the other. This is a worthy clue. Another clue stands out in the eighth word: It contains a double letter, such as you would find in the word "been."

```
. . . . . .
AQJMH EPVQ ABHT PE IPIPAB AFBMT
. . . . . .
AVS LFFO CFTSJMBSJPM RVJFS SP
. . . . . .
BUPJC SJOOJMH PSGFQ OKBMSFQT

ABCDEFGHIJKLMNOPQRSTUVWXYZ
--------------------------

PLAINTEXT LETTER?:
REPLACING ? LETTER:
```

Fig. 1. Initial Presentation of Plaintext Working Line and Ciphertext

But plaintext N is a high-frequency letter, and the letter O ending the encrypted word occurs only four times in the message, compared with P, which appears eight times. Thus, you can almost certainly rule out the word "been," because O does not occur frequently enough to be a likely substitute for N. The Fs might well stand for Es, though, for a word such as "keep."

Consider the first and the thirteenth words. They both have the three-letter suffix, JMH. Finding two of them in a short message narrows the choices sharply, suggesting that at least two of the three letters might be high-frequency letters.

Two possible substitutions might be END or AND, but would the individual letters, applied elsewhere in the cryptogram, yield probable words? As you test this by filling in the spaces above the appropriate letters in the cryptogram, the results do not reveal other possible words. Erase and try again—perhaps ING might be more fruitful.

You can't help but become more aware of your language and its grammar, spelling, and punctuation as your skill in cryptanalysis increases. You'll do lots of writing and erasing, though. Wouldn't it be great if we had a program that would let us cut and try without all the pencil and paperwork? Hey! We have it!

Easy Cryptocracker

Use the Program Listing to lay out last month's cryptogram. Type in the message exactly as it appears, and be careful not to make a mistake. If you do, you'll have to start typing all over again, because the mistake will be in the CoCo's memory. Even though the erasure and correction you make will appear on the screen, the computer will still recognize the mistake. When you've finished, you should have a display similar to Fig. 1.

The dots above the ciphertext lines represent the possible positions of letters or spaces in the plaintext. The dashes below the alphabet are spaces in which you can put the letters of the key alphabet as you uncover them.

It is not necessary to discover the crypto alphabet to crack the cryptogram, but by keeping a running tally of what you find, you sometimes discover a key-letter pattern before you recognize some of the more difficult-to-decipher plaintext. If this occurs, you can apply the next logical letter in the pattern to a letter in the cryptogram, and thus possibly reveal a formerly obscure word.

Custom calls for the dashes representing the unknown letters to be placed above the standardly ordered alphabet. As you use the program, you will find that it's most convenient to write in the key letters as you find them.

I've included a printer sequence in the program for those who want to print out the discovered message.

Operator	Function
*	End of ciphertext
*	Prompt input to end session
#	Erase and start over
!	Print out plaintext
. (followed by letter to be erased)	Erase one letter of ciphertext
- (preceded by letter to be erased)	Erase one cipher-alphabet letter
Space bar	Spaces between plaintext words

Hit the enter key after each of the above, except the first.

Table 2. Program Operators

```
OCAKV IAVWGT NCIXBQOD POAO AOKCGBMOKV DBNWKO
NOIXCQBICK LOMBIOD PXOQ OKOIGABIBGV FOICNO ITNNTQWKCIO
NTAO ITNWKOS OKOIGATNOIXCQBICK LOMBIOD POAO LOMOKTWOL
```

Fig. 2. From the Simple to the More Complex

```
YNW MVQMWEY VD MVLEAYWOT DVO MOUEYVGVIU
LCU NCFW VOSISQCYWR KSYN MNCOGWT HCHHCIW
CQR NST RSDDWOWQMW WQISQW
```

Fig. 3. Engines Can Make a Difference

```
HB MBLYZECOJ HOCWL BX CQCMEOBGIM NZLWG
YOBSOWLLCOJ IG W PWF GBE ZGQIVC
BZO HOCWLJ BX IGECQQISCGE MBLYZECOJ
```

Fig. 4. Artificial Thinking May Be 'Round the Corner

The Program

In only 51 lines, this program makes a convenient notepad to take on the dreary part of the cryptanalyst's job, formerly done with pencil and paper. It allows you to input up to 300 alphanumeric characters (about 55 words) of cryptogram. This size allows adequate screen working space. If the cryptogram to be solved is no longer than this, you can enter it in two shifts, or more. I haven't used color.

Line 30 reserves string space for five string arrays. Line 70 is the first INKEY$ loop, allowing the title and initial directions to remain on screen until you're ready to start work.

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Line 100 is the second INKEY$ loop for typing the cryptogram into working memory. Habit might cause you to hit the enter key when you don't want to. Therefore, line 120 shunts program action back to the INKEY$ loop when this occurs.

When typing the program into memory, be careful to sight the difference between a numeral 1 and a capital I, as in line 130. This line also assigns each typed letter to its array position and displays it.

Also, be careful not to confuse a zero and the capital letter O; present publishing convention does not often provide for the slash-zero (Ø). Line 150 completes the INKEY$ loop.

If the cryptogram runs more than 300 characters or if you input an asterisk, lines 140 and 110 jump the loop and print the collected arrays on the screen. The first pass prints a series of dots in the line above each crypto-message line (lines 160–200), followed by the crypto message (lines 210–240).

The variables U and V are counters that keep the dots and letters synchronized. Line 240 keeps all lines one character short of maximum for CoCo's screen, and after the entire message is printed, line 250 nulls the counters. Lines 260–410 lay out the standard and crypto alphabets. They also print the trial letters of plaintext on screen above the cryptogram lines, as each letter is input through lines 320 and 330.

You can select the option of erasing the trial lines and starting over by inputting the number sign (line 360) instead of answering either or both input prompts with letters.

When you have completed your solution of the cryptogram to your satisfaction, you can, if you have a printer, opt to touch the exclamation point instead of a letter. Line 340 will then jump the program to the printout routine (lines 420–510). When all is complete, an asterisk answer to either or both prompts ends the program (line 350).

Using Easy Cryptocracker

You should CSAVE the program immediately after you have debugged it to your complete satisfaction. Use the suggested filespec in line 10, or use one of your own devising. Next, type last month's third cryptogram into the program. Use the asterisk after the final character of your message.

First, take out the dots representing spaces between the words in the ciphertext. Touch the space bar, then the enter key, space bar, and enter. Spaces should appear directly above the spaces between ciphertext words as the lines are relaid in their new configuration.

I mentioned earlier that there were two two-letter words with interesting letter arrangements. The same letter that appears last in the second two-letter word (SP), appears first in the first one (PE).

Make a brief listing of as many two-letter words as you can remember; it might be worthwhile to make a permanent reference table of such words as you progress in cryptology. Of the common two-letter words, notice that only those beginning with O have multiple counterparts that end with O; AT would require ?A, IT would require ?I and WE would require a counterpart of E? to qualify. Therefore, O is the best candidate for the repeated letter.

Of two-letter words beginning with O, you find OF, ON, and OR; and of those ending with O, you find TO, NO, SO, DO, and GO. So enter an O above the letter P: Type O, then hit the enter key, then press P, and then enter.

With the O established, the double letters in the eighth word suggest EE because of the high frequency of those letters. Therefore, enter an E substitute for the letter F. To do this, enter E, then hit the enter key, F, and enter in answer to the prompts.

Note that an E appears automatically over every letter F in the message, but not enough letters are present as yet to give a solid clue for another educated guess.

The two identical three-letter suffixes are now worthy of attention. To shorten the procedure, now that you are catching on to how the magic is done, try ING for the suffixes. This will bring up the five-letter word ending in ING for attention; quite possibly it's "being," or "bring," or "doing." Others are possible, but try the B and R and see if it helps suggest rounding out other words in your developing plaintext lines.

Do you see a pattern building in the alphabet line? There is one, for the discerning eye, now that the five-letter word is found: Note how close alphabetically each cipherkey letter is to its plaintext alphabet counterpart.

If you find you get nowhere with a given trial word, you can erase single letters by answering the first prompt with a period and then pressing enter. For the second prompt, use the ciphertext letter below the letter you wish to erase.

This leaves a false letter in the cipher alphabet, so you should change it as well. At the first prompt, enter the standard alphabet letter that stands above the letter you wish to erase. Enter a dash at the second prompt.

If you feel you have made an impossible hodgepodge of your effort and want to start over, enter the number sign and then hit the enter key twice. This will erase the entire trial text plus the incorrect cipher alphabet. Then restore the spaces between words as noted at the beginning of these instructions. Table 2 is a ready reference to the special program operators and their functions.

To print out your solution, touch the exclamation point and enter. To end the session, touch the asterisk and enter.

Cryptograms

The cryptograms for this month (Figs. 2, 3, and 4) have personal computers as a common subject. This is an important clue; a "probable word" sometimes makes the difference between solving or not solving a cryptogram. Take the word "computer," for example. It has eight letters, none of which are repeated. If the preliminary skirmish in the plaintext line nets COM...ER it is almost obvious what the word will be.

Good hunting! You have become interested in one of the fastest-growing computer applications, with many fascinating adventures ahead. I await your letters and only wish I could answer them all in person. Please be patient. I will mention selected letters in future months. ■

Send correspondence to Karl Andreassen, 14750 Chianti Road, Cloverdale, CA 95425.

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BY RICHARD RAMELLA

ANIMATE

With help from a juggling graphic named Judy, I'm going to show you how to put your own animated figures into the CoCo. It's easy and systematic. And if Donald Duck can animate, so can you.

The 72-line program, Juggling Judy, is both a demonstration of the method and a template for your future efforts. It contains all the building blocks and most of the programming you will need to create different effects. I think you will more easily understand what comes later if you type in the program now and watch it run.

Judy is charming and talented, isn't she? She is made of three poses that are drawn into three sets of eight string arrays. The program then quickly prints these arrays over one another at the same screen location.

With these three poses, Judy would be a three-stage animation, except that I let top and bottom halves choose any of the three available positions separately, and this creates a nine-position animation. I'll explain that a bit later.

To understand how to use this program for your own animations, you must let me explain the whole thing. It begins, not with the program, but on page 276 of the Radio Shack manual, *Getting Started with Color Basic.*

The two rows of 16 shapes in the middle of the page are character graphics, and I'll show you how to use them to make animated shapes. Put new labels atop each of these graphics. CHR$(128) becomes A$, CHR$(129) becomes **B$**, and so on until CHR$(143) becomes P$. These shortened symbols represent the CHR$ graphics in the program.

Now, how does this work in the program? In line 270 Z = 96, Z becomes the number value that colors all the graphics building blocks magenta. You can change this color to any multiple of 16, up to 112, to create any of the seven possible colors. The bottom of page 276 of the manual lists these numbers and their corresponding colors.

Would you like to program animated graphics? This demonstration offers you some helpful techniques.

Line 180 A$ = CHR$(128) makes A$ a blank, and lines 190–330 assign CHR$ shapes B$ through P$. You know what these shapes are because you've written the new names atop each on page 276 of the manual. These are the building blocks, and all future animation programs you write can be just as this program is, through line 330.

The animation's three poses are assembled between lines 340–570. They are contained in the following string arrays: A$(1) to H$(1), A$(2) to H$(2), and A$(3) to H$(3). Notice that I've made most of these from eight concatenated (added together) symbols. The exception is Z$, which I assembled in lines 140–160 from 10 blanks. I purposely made this 10 rather than eight spaces wide because the juggled balls will appear where Z$ is printed.

I have an easy way to draw and assemble the poses of an animation. Look at Fig. 1, which is nothing more than a grid representing CHR$ positions of the

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pictures you will draw. At left are the string array names, A$(X) to H$(X). Here, X equals 1, 2, or 3. In the top right corner, I've divided a grid cell into four smaller cells as a reminder that the 15 CHR$ graphics (excluding the blank CHR$(128) can have any shape that conforms to these lines.

Put another way, you can fill one, two, three, or four of these sections with light and in any combination. To simplify that idea, look at Fig. 2, which is a drawing of Judy's first position.

After I made the drawing, I filled in all the squares (A$ to P$) with the name of the graphic that describes the shape within the grid cell. Lines 340–410 transfer this pose. Lines 420–490 and 500–470 transfer the second and third poses, respectively.

When you draw the three poses, label the graphics within them according to the values set in lines 180–330, and string these values together in the string arrays, you're all set.

In my program, lines 580–610 draw Judy's stage and showbill. All the animation occurs in an endless looping through lines 640–800.

In line 630, R begins with a value of 12. This is the screen position at which the program will print the top left corner of the three graphics squares. The value of R changes, allowing the little juggler to hop and slide left and right on her stage. Skipping around a bit among lines 640–800 should help you understand the animation.

By letting X and Y choose separate random values of 1–3 in lines 640 and 650, I made a nine-position animation possible out of only three poses. In a moment, I'll explain fully.

Line 660 sets a random value of F from 1–5. I'll translate line 670 into plain English: If F equals 1, then Judy moves one position left, and if F equals 2, then she moves one position right. What happens is that the PRINT@ position of R increases or decreases by one position every so often. In that way, the juggler not only dances but moves from side to side. Line 680 restricts R to 8 at left and 22 at right, thus preventing Judy from dancing off either end of the stage.

Lines 690–760 print the string arrays of any of the three poses. The first line is printed at position R, and the succeeding seven lines are printed below R.

It is here that I've created the nine positions. Lines 690–730, the top of the body, choose from three positions set by X = RND(3).

Lines 770–790 account for the three balls always in the air at different places above Judy's head. Line 780 is a SET(X,Y) command.

Making Z$ a string of 10 blank characters ensures that each printing erases the balls.

Note that each succeeding animation block is printed over the previous one. For this reason, it isn't necessary to erase anything.

Also note that all the string arrays be-

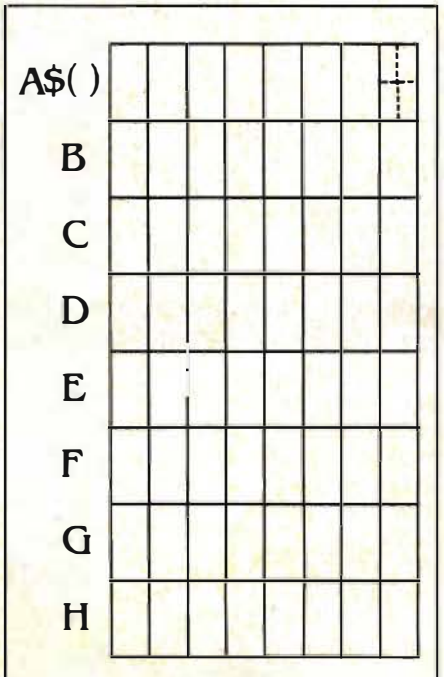


Fig. 1. Grid Representing CHR$ Positions

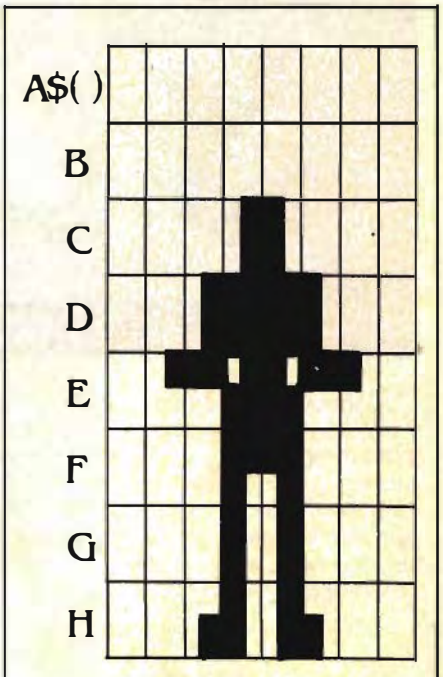


Fig. 2. Judy's First CHR$ Position

gin and end with a blank—A$. Because the figure moves in either direction, these last positions must be blank to enable the program to erase all parts of the previous graphic.

Juggling Judy strains the limits of a 4K CoCo. If you have 16K or more memory, you'll have room for such enhancements as music and more stages of animation.

In three-stage animation it's best to draw two extreme poses, 1 and 3, and another, 2, which is the mid-point between the extremes. Then loop through (1 2 3 3 2 1) and you will get fluid movement.

I departed from tradition by giving my animation nine positions. Also, I chose the animations in a way that if each were a point on a triangle, it could go to either of the other points without loss of fluidity.

Last advice: Keep your early attempts simple.

I'm willing to field questions on this technique and to help anyone having trouble typing in the program (but send a listing or tell where and what error messages you get). I can't answer unless you send a stamped, self-addressed envelope (Canadians send 40 cents in coin and a self-addressed envelope). ■

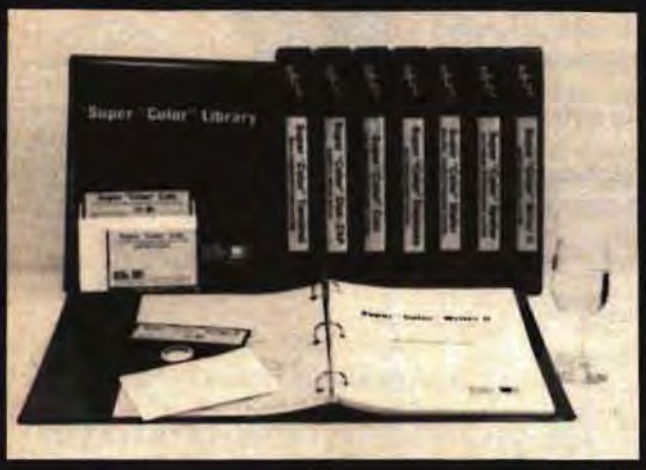
Richard Ramella writes "Elmer's Arcade," HOT CoCo's monthly game column. Contact him at 1493 Mt. View Ave., Chico, CA 95926.

Program Listing. Juggling Judy

```
100 REM * JUGGLING JUDY / TRS-80
 COLOR BASIC 4K
110 REM * RICHARD RAMELLA 1493 M
T VIEW AVE. CHICO, CA 95926
120 CLS(0)
130 CLEAR 300
140 FOR A=1 TO 10
150 Z$=Z$+CHR$(128)
160 NEXT A
170 Z=96
180 A$=CHR$(128)
190 B$=CHR$(129+Z)
200 C$=CHR$(130+Z)
210 D$=CHR$(131+Z)
220 E$=CHR$(132+Z)
230 F$=CHR$(133+Z)
240 G$=CHR$(134+Z)
250 H$=CHR$(135+Z)
260 I$=CHR$(136+Z)
270 J$=CHR$(137+Z)
280 K$=CHR$(138+Z)
290 L$=CHR$(139+Z)
300 M$=CHR$(140+Z)
310 N$=CHR$(141+Z)
320 O$=CHR$(142+Z)
330 P$=CHR$(143+Z)
340 A$(1)=Z$
350 B$(1)=Z$
360 C$(1)=A$+A$+A$+F$+K$+A$+A$+A
$
370 D$(1)=A$+A$+F$+P$+P$+K$+A$+A
$
380 E$(1)=A$+E$+M$+H$+L$+M$+I$+A
$
390 F$(1)=A$+A$+A$+O$+N$+A$+A$+A
$
400 G$(1)=A$+A$+A$+K$+F$+A$+A$+A
$
410 H$(1)=A$+A$+B$+K$+F$+C$+A$+A
$
420 A$(2)=Z$
430 B$(2)=Z$
440 C$(2)=C$(1)
450 D$(2)=A$+A$+F$+P$+P$+M$+M$+A
$
460 E$(2)=A$+E$+M$+H$+L$+A$+A$+A
$
470 F$(2)=A$+A$+O$+M$+N$+A$+A$+A
$
480 G$(2)=A$+E$+I$+A$+F$+A$+A$+A
$
490 H$(2)=A$+A$+A$+A$+F$+C$+A$+A
$
500 A$(3)=Z$
510 B$(3)=Z$
520 C$(3)=C$(2)
530 D$(3)=A$+M$+M$+P$+P$+K$+A$+A
$
540 E$(3)=A$+A$+A$+H$+L$+M$+I$+A
$
550 F$(3)=A$+A$+A$+O$+M$+N$+A$+A
$
560 G$(3)=A$+A$+A$+K$+A$+E$+I$+A
$
570 H$(3)=A$+A$+B$+K$+A$+A$+A$+A
$
580 FOR A=256 TO 287
590 PRINT @ A,CHR$(246);
600 PRINT @ A+64,CHR$(249);
610 NEXT
620 PRINT @ 291," J U G G L I N
G  J U D Y ";
630 R=12
640 X=RND(3)
650 Y=RND(3)
660 F=RND(5)
670 IF F=1 THEN R=R-1 ELSE IF F=
2 THEN R=R+1
680 IF R<8 THEN R=8 ELSE IF R>22
 THEN R=22
690 PRINT @ 0+R,A$(X);
700 PRINT @ 32+R,B$(X);
710 PRINT @ 64+R,C$(X);
720 PRINT @ 96+R,D$(X);
730 PRINT @ 128+R,E$(X);
740 PRINT @ 160+R,F$(Y);
750 PRINT @ 192+R,G$(Y);
760 PRINT @ 224+R,H$(Y);
770 FOR G=4 TO 8 STEP 2
780 SET(R*2+RND(13)+1,RND(4)-1,G
)
790 NEXT G
800 GOTO 640
810 END
```

Super "Color" Library™

For the TRS-80 Color and TDP System 100 Personal Computers



No matter what kind of problem you are trying to solve with the Color Computer, there is a program in the ever-expanding integrated, **Super "Color" Library** that will give you the solution. Faster, Better, Smarter!

Every Library program features **MEMORY-SENSE** to determine your computer's memory, from 16 to 64K, and adjusts automatically to maximize work space. All programs, except the **Super "Color" Speller** and **Super "Color" Disk-ZAP**, feature a true lowercase display with below line descenders. Each program has been written specifically for the Color Computer in fast machine code to be totally compatible for optimum performance — Something a motley assortment of programs from diverse sources or a passel of overpriced, wallet-FLEXing software from a bygone era simply can not achieve.

The **Super "Color" Library** has all the power, speed, dependability and compatibility you will ever need so build your library a volume at a time or put the full power of the complete library of problem solvers to work right away.

— NEW! —

64K Compatible

Super "Color" Writer II™

32x16 & 51-64-85x21&24 WITH REAL LOWERCASE DISPLAY

VERSION 3.0 By Tim Nelson

THE INTELLIGENT WORD PROCESSOR

The **Super "Color" Writer II** is for those who desire the best. It is the most powerful, fastest, most dependable and versatile word processor available for the Color Computer, from 16 to 64K. The **Super "Color" Writer II** has features for the most demanding professional, yet it is easy enough for newcomers to master.

Of course the **Super "Color" Writer II** has all the features you would expect from the highest quality word processor, such as a clear, crisp and readable professional display with your choice of display colors, 9 display formats: standard 32x16 & 51-64-85x21 &24 with real lowercase descenders; full 4-way cursor control, sophisticated edit commands, the ability to edit any BASIC program or ASCII textfile, seven delete functions, locate and change, wild card locate, a real block move & copy, word wrap-around, programmable tabs, display memory used and left, non-breakable space, multiple headers and footers, dynamic text formatting, comprehensive format parameters, use with ANY printer at any baud rate from 110 to 9600 baud, automatic justification, automatic pagination, automatic centering, automatic flush right, underlining, superscripts, subscripts, pause print, single-sheet pause, optionally print comments, append text files, available in a ROMPAK cartridge for maximum work space, but that's only half of the story. No other program can even begin to compare in features with the **Super "Color" Writer II.**

Check These Exclusive Features

MEMORY-SENSE adjusts to computer's memory (16-64K) for maximum work space; TYPE-AHEAD, TYPAMATIC KEY REPEAT and KEY BEEP for the pros; 3 PROGRAMMABLE FUNCTIONS; AUTO PHRASE INSERT; COLUMN CREATION; TEXT FILE LINKING; HELP MENU; A TRUE EDITING WINDOW IN ALL 9 DISPLAY MODES; TRUE FORMAT WINDOW to display line lengths up to 255 characters, with horizontal and vertical scrolling to replicate the printed page including centered lines, headers, footers, page breaks, page numbers, margins, giving a perfect printed document every time. Also makes hyphenation a snap. **TRUE AUTOMATIC JUSTIFICATION** for neat, even left and right hand margins. Ability to use CHARACTER CODES for printing special characters available with your printer; freedom to embed as many PRINTER CONTROL CODES as desired anywhere in the text, **EVEN WITHIN JUSTIFIED TEXT**; 90-plus page tutorial manual.

ADDITIONAL DISK FEATURES: Read a directory, Display free granules, Save with Automatic Verification, Load and Append ASCII files, and BASIC programs, Kill files, and Link files from disk for continuous printing. 54K bytes of workspace available with a 64 K system. Only the best offers all of these features.

TAPE $69.95 **ROMPAK $89.95** **DISK $99.95**

Tutorial only $15.00 (Refundable with purchase)
Tape & Disk require 32K for lowercase display
Previous **Super "Color" Writer II** owners call for upgrade policy

Super "Color" Mailer™

By Tim Nelson

The **Super "Color" Mailer** is a powerful multi-purpose mailing list merging and sorting program including lowercase display that uses files created by the **Super "Color" Writer II.** Combine files, sort and print mailing lists, print "Boilerplate" documents, automatically insert text in standardized forms, address envelopes, the list is endless.

TAPE $39.95 **DISK $59.95**

Operators Manual only $10.00 (Refundable with purchase)

NEW

Super "Color" Speller™

By Peter A. Stark

The **Super "Color" Speller** is a fast machine-code proofreading program to correct **Super "Color" Writer** files. Automatically proofreads your documents against a 20,000 word stock dictionary, plus your own customized dictionary and corrects typos or marks them for special attention.

AVAILABLE ON DISK ONLY $69.95

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32x16 & 51-64-85x21&24 Display With Lowercase Descenders And 16 Thru 64K Too!

NEW Super "Color" Calc™

ELECTRONIC SPREADSHEET By Kevin Herrboldt

Now you can answer those "What if?" financial projection, forecasting, budgeting, engineering and calculating questions with precision, speed and power using the **Super "Color" Calc**, truly the finest electronic worksheet and financial modeling program available for the Color Computer, from 16 to 64K. Now every Color Computer owner has access to a calculating and planning tool rivaling VisiCalc™ containing all its features and commands and then some. You need only change one variable and you instantly see how that change affects your assumptions. You can even use VisiCalc templates freely with **Super "Color" Calc!** Combine spread sheet tables with **Super "Color" Writer II** documents to create ledgers, projections, statistical and financial reports and budgets.

Features include: 9 display formats, standard 32x16 & 51-64-85x21&24 with real lowercase descenders * MEMORY-SENSE to adjust to computer's memory (16-64K) for maximum work space: Full-size 63x256 worksheet * Easy to use * HELP Menus to make learning faster * Machine code speed and high precision * Total flexibility in calculating * Up to FOUR VIDEO DISPLAY WINDOWS to compare and contrast results of changes * Sine and Cosine functions, Averaging, Exponents, Algebraic functions, and base 10 or 16 entry * Multi-layered Column and Row Ascending and Descending sorts * Locate formulas or titles in fields * Easy entry, replication and block moving of frames * Global or Local column width control up to 81 characters each * Create titles of up to 255 characters * Typamatic Key Repeat * Key beep * Type-ahead * Print up to 132 column worksheet * Prints at any baud rate from 110 to 9600 * Print formats savable along with worksheet * Enter control codes for customized printing.

DISK FEATURES: Read a directory; Display free granules; Kill files, Save with Automatic Verification; Load files; Append disk files for complete worksheet printing. 54K bytes of worksheet space available with a 64K system.

Tutorial and sample templates are supplied with the program.

ROMPAK $89.95 **DISK $99.95**

Tutorial only $15.00 (Refundable with purchase)
Disk requires 32K for lowercase display.

Super "Color" Disk-ZAP™

By Tim Nelson

Now the dreamed-of repair of I/O errors is a reality. The **Super "Color" Disk-ZAP™** is the ultimate repair utility for simple and quick repair of all repairable disk errors. Designed with the non-programmer in mind, the **Super "Color" Disk-ZAP™** will let you retrieve all types of bashed files, including BASIC and Machine Code programs.

This high-speed machine code disk utility has a special dual cursor screen display to show HEXIDECIMAL and ASCII displays simultaneously. You are able to: Verify or modify disk sectors at will * Type right onto the disk to change unwanted program names or prompts * Send sector contents to the printer or any other RS-232 device * Search the entire disk for any grouping of characters * Copy sectors * Backup tracks or entire disks * Repair directory tracks and smashed disks * Full prompting to help you every step of the way * 50-plus page Operators Manual which helps you simply and quickly fix the vast majority of disk errors, and teaches the rudiments of disk structure and repair.

AVAILABLE ON DISK ONLY $49.95

Operators Manual only $10.00 (Refundable with purchase)

Super "Color" Terminal™

THE FINEST TERMINAL PROGRAM ANYWHERE!
Version 3.0 By Dan Nelson

The best has become even better, with many new features including 9 display formats, 32x16 & 51-64-85x21&24 with real lowercase descenders, plus compatibility with the 64K Color Computer. This user-friendly program makes communicating with ANY computer a breeze even for a newcomer. Communicate using your modem with all the popular information services such as Dow Jones, Compuserve, The Source, and local BBS's, clubs, friends, or the main-frame at work. You can also communicate directly with other microcomputers, such as the TRS-80 I, III, II, other Color Computers, Apples, IBM PCs, etc., via RS-232 without using a modem. Save the information or PRINT IT!

FEATURES: MEMORY-SENSE to adjust to computer's memory (16-64K) for maximum work space; Selectively print data at baud rates from 110 to 9600 * 54K of data storage with 64K disk system * 128 character ASCII keyboard * Automatic graphics mode * Word mode (word wrap) for unbroken words * Send & receive **Super "Color" Writer II, Database & Calc** files, ASCII files, Machine Language & BASIC programs * Set communications baud rate from 110 to 9600; Duplex: Half, Full; Echo; Word length: 5, 6, 7 or 8; Parity: Odd, Even or None; Stop Bits: 1-9 * Local linefeeds to screen * Save and load ASCII files, Machine Code & BASIC programs * Unique CLONE feature for copying any tape * Lower case masking * 10 Keystroke Multiplier (MACRO) buffers to perform repetitive pre-entry log-on tasks and send short messages * Programmable prompt or delay for send next line * Selectable character trapping * Files compatible with other Library programs.

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Operators Manual only $10.00 (Refundable with purchase)
Previous **Super "Color" Terminal** owners call for upgrade policy.

NEW Super "Color" Database™

This high speed machine language program including true lowercase displays fills all your information management needs, be they for your business or home. Inventory, accounts, mailing, lists, family histories, you name it, the **Super "Color" Database** will keep track of all your data.

The **Super "Color" Database** features MEMORY-SENSE to adjust to computer's memory (16-64K) for maximum work space. It is structured in a simple and easy to understand menu system with full prompting for easy operation. Your data is stored in records of your own design, each divided into as many fields as you need. All files are fully indexed for speed and efficiency. Full sort of records is provided for easy listing of names, figures, addresses, etc., in ascending or descending order. The math package performs arithmetic operations and updates other fields which is especially useful when used as an order entry and invoicing system. You can create reports, or lists for mailings, or whatever. Create files compatible with the **Super "Color" Writer II and Terminal.** Up to five different print formats are available, and control codes may be imbedded for customized printing.

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AUTHORS' SUBMISSIONS ARE ENCOURAGED. 128

BY LEROY W. GROSS

KNIGHT RIDER

Draw and paint a three-dimensional image on your screen with the use of variable coordinates.

This program demonstrates some three-dimensional effects that are possible on the Color Computer. Using the DRAW command combined with string variables and PAINT commands, you can superimpose one graphics image over another.

Separating the string variable containing the outline of the image from the DRAW command containing the screen coordinates permits the program to call an image to more than one place. You can also use variables for coordinates to animate figures.

The trees in the accompanying listing are examples of images imposed at two locations and differing in scale.

The knight and his horse demonstrate the variable coordinates and the ability to pass in front or in back of other objects, with no disruption of any of the images.

This program also demonstrates the process of using two screens for smoother animation. You might compare each s
which contains a slightly different picture from the next, so that you can readily see the importance of the order of drawing and painting.

As presented, this program shows the development of each frame. Deleting lines 215 and 405 smoothes the animation. These lines also show the effect of moving the screen statement on animation effects.

System Requirements

16K RAM
Extended Color Basic

Program Description

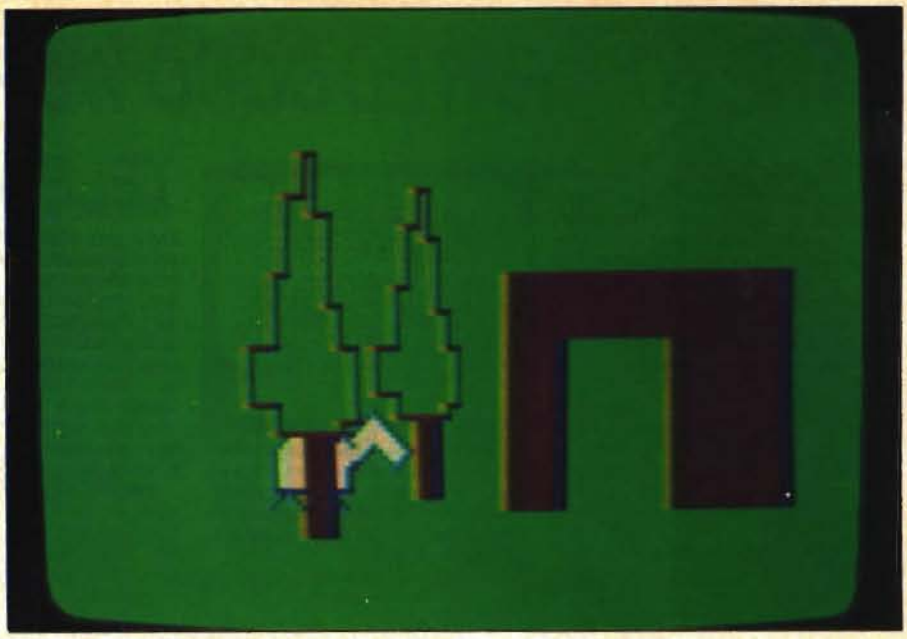
- Line 100 is minor housekeeping.
- Line 110 sets the starting point for horse and rider.
- Line 120 is the string variable for the horse.
- Lines 130 and 140 are the horse's legs.
- Lines 150 and 160 are the knight, in two positions.
- Line 170 is tree foliage.
- Line 180 is the tree trunks.
- Line 190 has the coordinates and scale for the rearmost (right) tree.
- Line 200 has the coordinates and scale for the foremost (left) tree.
- Line 210 designates the resolution and starting page for the first frame and subsequent odd-numbered frames and clears them.

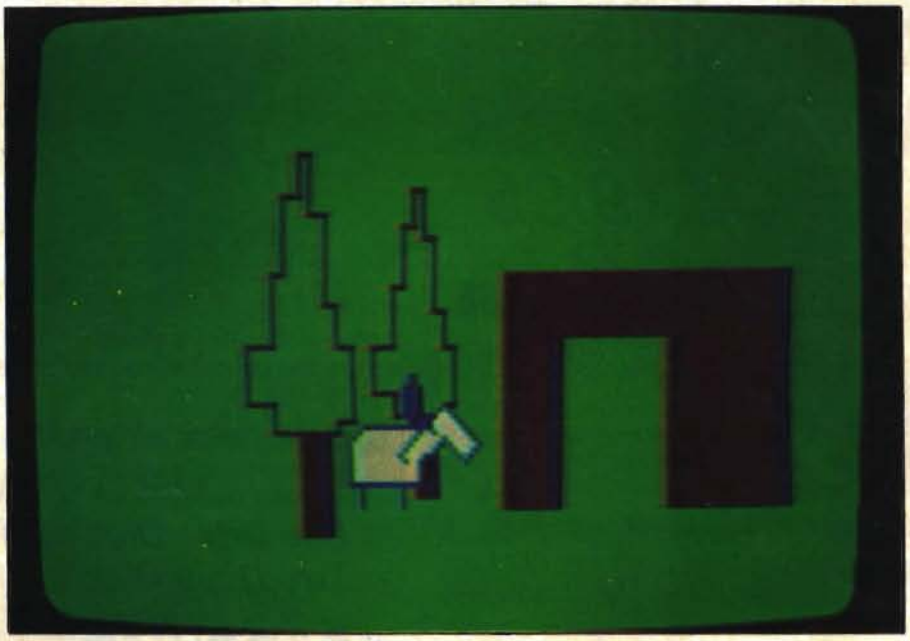
Program Listing. Riding Knight

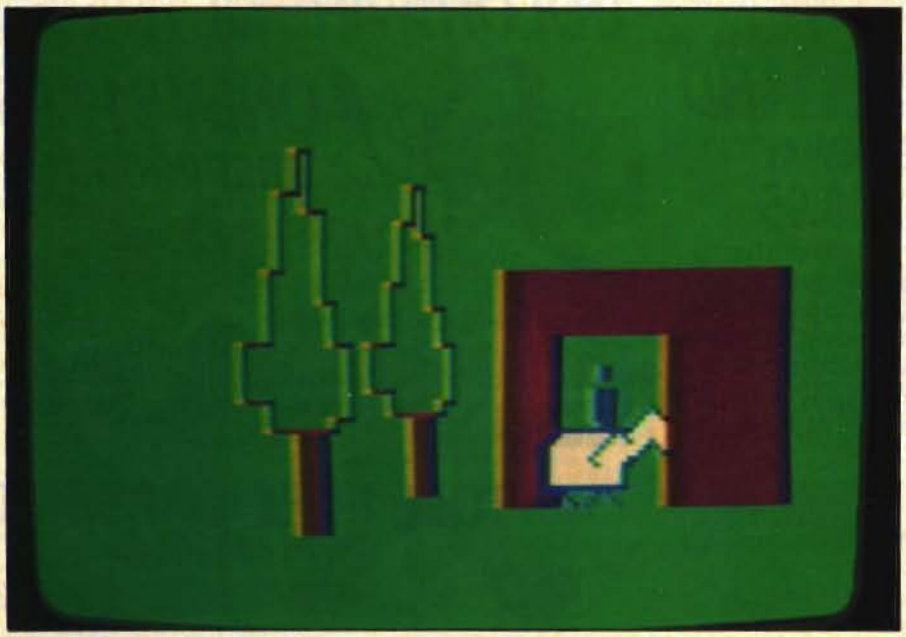
```
10 'RIDING KNIGHT BY LW GROSS
20 '394 A SAN BRUNO AVE.
30 'BRISBANE CA. 94005
40 ' 2/2/83
100 CLEAR:PCLS:PMODE1,1
110 A=60:B=40:C=20
120 A$="C3BU9BL10E4F4E3H7G4L12G3
D7R14U4E1"
130 B$="C3BD8BL2H3G3BL2H3G3
140 B2$="C3BD9BL5U4L8D4"
150 K1$="C3BU8BR9H1E4H3U5R2U2L1D
2R2D5NL3F3"
160 K2$="C3BU7BR10H1E4H3U5R2BU2U
2L1D2BD2R2D6F3"
170 TR$="BD7L3U2L2U4R2U5R1U5R1U3
R1D4R1D6R1D3R1D5L1D1L2"
180 T$="L1D7R2U7"
190 TE$="BM118,96S16"
200 T2$="BM75,96S20"
210 PMODE1,1:PCLS
215 SCREEN1,0
220 A1$="S8BM"+STR$(A)+",160"
230 DRAWTE$
240 DRAWTR$
250 DRAWT$
260 LINE(150,96)-(170,157),PSET,
BF
270 PAINT(120,145),4,4
280 DRAW A1$
290 DRAWA$
300 DRAWB$+K2$
310 PAINT(A-30,122),3,3
320 PAINT(A-30,145),2,3
```

Listing continued

Riding Knight demonstrates an animation technique that gives the illusion of three dimensions on your video screen. In this sequence, it appears that the knight rides first "behind" a tree, then in "front" of another, and finally "into" the castle.







- Line 215 calls for lines 220–380 to be executed while being displayed on the screen.
- Line 220 designates the variable coordinates for the horse and rider.
- Lines 230–250 draw and place the rear tree.
- Line 260 is a filled box forming the left side of the door.
- Line 270 paints the tree trunk.
- Lines 280–320 draw, position, and paint the horse and rider.
- Line 330 reverts the outline color to red. (A blue outline is called in A$.)
- Line 340 is a filled box forming the right side of the doorway.
- Line 350 is yet another filled box comprising the remainder of the building, from lintel to roof.
- Line 360 draws and positions the nearest tree and paints the trunk.

THE TOP–RATED COCO WORD PROCESSOR:

TELEWRITER-64

Colorware researched the word processors available for the Color Computer. We came to the very same conclusion that so many review articles have! Telewriter-64 is, by far, the superior word processor for the Color Computer.

Why is Telewriter so much better than the others? For one thing, it has overcome the 32x16 character display limitation of the Color Computer. No small feat, Telewriter accomplishes this by generating its own set of characters in software. You select 51x24, 64x24 or 85x24 character displays by merely issuing a format command. If you have ever used a word processing system, you know how important it is to be able to see a good portion of your text on the screen.

Telewriter-64 also generates true lower case characters. This is much preferable to the reverse characters that merely "represent" lower case letters in other co-co word processors.

Telewriter-64 is feature packed. Besides the standard features found in any word processor, Telewriter also includes: user-friendly full-screen editing, rapid cursor and scrolling control, page jump, right justification, menu-driven disk or cassette access, compatability with spelling checkers (such as Spell-and-Fix), and a clever double check that asks the user "Are you sure?" before executing any operation that would kill any sizeable amount of your text.

Telewriter-64 runs on any 16K, 32K, or 64K system (extended Basic not required) and works with any printer. It has all of the control codes necessary to take full advantage of all of the features in any printer. There is even a "typewriter" mode which sends typed lines directly to your printer.

With advanced word processing software such as this, your color computer becomes a truly powerful word processing system, with a price that makes sense for the personal user.

Beyond impressive capability, Telewriter-64 simply makes any kind of writing a pleasure. It is a truly sophisticated system that is marvelously easy to learn and enjoyable to use.

Disk $59.95
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Place your modem or printer where you want. 15 ft. cable with four-pin male and four-pin female DIN connectors.

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High quality cable and high force, gold plated contacts ensure the utmost in connection reliability for your CoCo or TDP-100.

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- Contour molded, full travel keys for fast smooth typing.
- Custom made to fit precisely. Has same key layout.
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GHOST GOBBLER

From Spectral Associates, this "Pac" theme game is the best of it's type. Brilliant color, action and sound, just like an arcade gobble your way to glory, but watch for those ghosts! Get in on the wild fun of this game craze now. Tape: $21.95, Disk: $25.95

DONKEY KING

DONKEY KING

You simply can not buy a more impressive game for your color computer than this new wonder from Tom Mix. The graphics, sound, and animation are all just astonishing! There are four different graphic screens and each is endless fun. Requires 32K. Tape: $24.95, Disk: $27.95

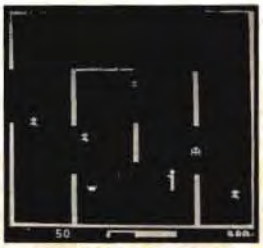
GHOST GOBBLER

PROTECTORS

There are several good versions of the "Defender" theme available for the CoCo. None, however, rival this one from Tom Mix. No other game matches the detailed graphics and sheer excitement of this top seller. Requires 32K. Tape: $24.95, Disk: $27.95

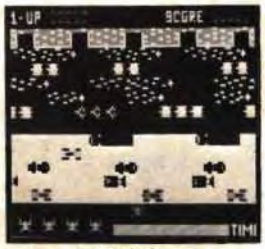
CREATURE FEATURE

From Color Software, comes a lightening swift shoot & dodge the enemy game. It's clever cross between "Robotron" and "Beserk" themes, with bullets flying everywhere. Solid, shoot-em-up-fun. Requires 16K. Tape: $17.95. Disk: $19.95



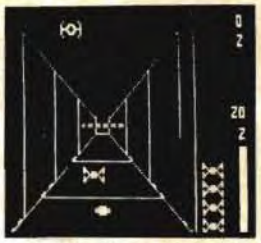
ANDROID ATTACK

Spectral Associates' very well done "Berserk" type game with some interesting added features. Each cassette contains both the 16K and 32K version. The 32K version has voice output! Plenty of action. Tape: $21.95



FROGGER

Just released by The Cornsoft Group, this is the officially licensed version from Sega, the arcade manufacturer. It has it all! 4 lane super highway, snakes, turtles, logs, alligators, etc. Lots of action and laughs! Requires 16K. Tape: $19.95



INTERGALACTIC FORCE

Your space fighter roars into the Death Corridor. Lock-on and blast the enemy fighter from the sky. Now try dropping one into Death Star's narrow exhaust vent. It takes skill and guts. Good luck! With "Star Wars" theme song. From Anteco. Tape: $24.95

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SUPER JOYSTICK MODULE

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$19.95

★ It's a Joystick Interface.

Now you can connect any Atari compatible joystick to your CoCo. These sticks are extremely rugged & provide very fast response and real arcade type action. They will improve the play of almost any game. The difference will amaze you!

★ It's a Rapid Fire Module!

Press the fire button on your joystick and get a great burst of fire instead of just a single shot! Adds tremendously to the many shooting type games that do not have repeat fire. With variable burst speed.

★ It's a 6ft. Extender Cord.

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ONLY
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A well proven joystick, the Atari is known for being rugged and reliab e. It gives good response and is the standard among home video players. Now at a great price! Use with module above.

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ONLY
$14.95
A GREAT BUY!

This one has received outstanding reviews. Its unique design fits the hand beautifully and it has the truly fast and positive response needed for high speed play. Actually out-performs some joysticks that cost $50 or more.

WICO FAMOUS "RED BALL"

THE BEST YOU CAN BUY

$34.95

The high performance joystick from the people who make them for the arcade machines. Built to take the abuse of even the most enthusiastic player. This is the best! Wico #15-9730. Use with module above.

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● Line 370 paints the foliage of the nearest tree yellow. This step is important. If you eliminated it, the computer, in line 380, would find the designated area already green and ignore the instruction, thereby letting the knight and his steed show through.

● Line 390 is a dummy line until you delete line 215. Then line 390 displays the completed first frame.

● Lines 400–590 are similar to lines 210–390. The horse and rider are different for animation purposes, as are the starting page number for the second frame and subsequent even-numbered frames.

● Line 600 advances the horse and rider, from left to right, across the screen.

● Line 610 returns the horse and rider to the left side of the screen for the rerun, which line 620 calls.

The greatest enemy of speed in this type of animation is the PAINT command. The smaller the areas painted, the faster the program runs. ■

Address correspondence to L.W. Gross, 394 A San Bruno Ave., Brisbane, CA 94005.

Listing continued

```
330 COLOR4,1
340 LINE(210,96)-(254,157),PSET,
BF
350 LINE(150,76)-(254,97),PSET,B
F
360 DRAWT2$+TR$+T$:PAINT(77,160)
,4,4
370 PAINT(77,96),2,4
380 PAINT(77,96),1,4
390 SCREEN1,0
400 PMODE1,3:PCLS
405 SCREEN1,0
410 A=A+6
420 A2$="S8BM"+STR$(A)+",158"
430 DRAWTE$
440 DRAWTR$
450 DRAWT$
460 LINE(150,96)-(170,157),PSET,
BF
470 PAINT(120,145),4,4
480 DRAW A2$
490 DRAWA$
500 DRAWB2$+K1$
510 PAINT(A-26,123),3,3
520 PAINT(A-30,143),2,3
530 COLOR4,1
540 LINE(210,96)-(254,157),PSET,
BF
550 LINE(150,76)-(254,96),PSET,B
F
560 DRAWT2$+TR$+T$:PAINT(75,160)
,4,4
570 PAINT(75,96),2,4
580 PAINT(75,96),1,4
590 SCREEN1,0
600 A=A+6:B=A-20
610 IFA>251THEN110
620 GOTO210
```

✓See List of Advertisers on page 130

BY MARK D. GOODWIN

JOURNEY TO THE CENTER OF THE ROM—PART I

Since the introduction of the Color Computer, there has been an ever-increasing interest in 6809 Assembly-language programming. This interest has led to a great deal of curiosity about the routines contained in the Color Basic ROM. Knowledge of the many routines in the Color Basic ROM greatly simplifies the development of highly complex Assembly-language programs.

This series will provide an in-depth look at the Color Basic ROM. The first two installments explain the background information that will give you a full understanding of the Color Basic ROM.

Next, I'll present a 6809 disassembler program. With this disassembler, you can produce your own source-code listing of the Color Basic ROM. Finally, I'll devote the rest of the series to line-by-line comments for a key RAM area and the entire Color Basic ROM.

I'll assume that the reader has a basic understanding of 6809 Assembly-language programming. If you do not possess this knowledge, I recommend that you acquire a book about 6809 Assembly-language programming and do a little homework before reading the material in this series. Trying to understand this series without first understanding 6809 Assembly language would be like trying to understand algebra without first understanding basic math.

The Color Computer

To understand how the Color Basic interpreter performs its various operations, you must first understand how Color Basic uses certain key areas of memory. Figure 1 is a general memory map for the Color Computer. The Color Basic interpreter sections off the computer's memory. Furthermore, Color Basic assigns a specific purpose to each of these areas of memory.

> Before you become proficient at Assembly language, you must know what's inside that little chip.

The Basic Communications Area

The memory area from $0000 to $03FF is the Basic communications area. This area is where the Color Basic interpreter holds temporary values, provides buffer space, and stores pointers. In a future installment, I'll present detailed explanations for each location in the Basic communications area.

Video Memory

The memory area from $0400 to $05FF is the video memory. Each location in video memory holds one character. Furthermore, these characters can be either alphanumeric or graphic. Figure 2 illustrates where each character in video memory appears on the video display.

For alphanumeric characters, the Color Computer uses special screen codes to display the desired character. Although ASCII codes will work in some cases, the majority of screen codes are quite different from their corresponding ASCII codes.

To illustrate the difference between the screen codes and the ASCII codes, let's try displaying a character and see what happens. For the purpose of this example, you'll try to display a 1 in the upper left corner of the video display.

You can simply POKE the character's value into memory location $0400. The decimal equivalent of $0400 is 1024. The ASCII code for a 1 is 49. There-

0000–03FF	Basic Communications Area.
0400–05FF	Video Memory.
0600–0FFF	Program, Variable Storage, Free Memory, Stack Area, String Space, and Reserved Memory (4K RAM).
0600–3FFF	Program, Variable Storage, Free Memory, Stack Area, String Space, and Reserved Memory (16K RAM).
0600–7FFF	Program, Variable Storage, Free Memory, Stack Area, String Space, and Reserved Memory (32K RAM).
8000–9FFF	Reserved for the Extended Color Basic ROM.
A000–BFFF	Color Basic ROM.
C000–FEFF	Reserved for the Disk Extended Color Basic ROM or a ROM Pack.
FF00–FFFF	Input/Output Area.

Fig. 1. Color Computer Memory Map

Character	ASCII Code Dec.	Hex	Screen Code Dec.	Hex
space	32	20	96	60
!	33	21	97	61
"	34	22	98	62
#	35	23	99	63
$	36	24	100	64
%	37	25	101	65
&	38	26	102	66
'	39	27	103	67
(	40	28	104	68
)	41	29	105	69
*	42	2A	106	6A
+	43	2B	107	6B
,	44	2C	108	6C
-	45	2D	109	6D
.	46	2E	110	6E
/	47	2F	111	6F
0	48	30	112	70
1	49	31	113	71
2	50	32	114	72
3	51	33	115	73
4	52	34	116	74
5	53	35	117	75
6	54	36	118	76
7	55	37	119	77
8	56	38	120	78
9	57	39	121	79
:	58	3A	122	7A
;	59	3B	123	7B
<	60	3C	124	7C
=	61	3D	125	7D
>	62	3E	126	7E
?	63	3F	127	7F
@	64	40	64	40
A	65	41	65	41
B	66	42	66	42
C	67	43	67	43
D	68	44	68	44
E	69	45	69	45
F	70	46	70	46
G	71	47	71	47
H	72	48	72	48
I	73	49	73	49
J	74	4A	74	4A
K	75	4B	75	4B
L	76	4C	76	4C
M	77	4D	77	4D
N	78	4E	78	4E
O	79	4F	79	4F
P	80	50	80	50
Q	81	51	81	51
R	82	52	82	52
S	83	53	83	53
T	84	54	84	54
U	85	55	85	55
V	86	56	86	56
W	87	57	87	57
X	88	58	88	58
Y	89	59	89	59
Z	90	5A	90	5A
[	91	5B	91	5B
\	92	5C	92	5C
]	93	5D	93	5D
↑	94	5E	94	5E
←	95	5F	95	5F
inverted@	96	60	0	00
a	97	61	1	01
b	98	62	2	02
c	99	63	3	03
d	100	64	4	04
e	101	65	5	05
f	102	66	6	06
g	103	67	7	07
h	104	68	8	08
i	105	69	9	09
j	106	6A	10	0A
k	107	6B	11	0B
l	108	6C	12	0C
m	109	6D	13	0D
n	110	6E	14	0E
o	111	6F	15	0F
p	112	70	16	10
q	113	71	17	11
r	114	72	18	12
s	115	73	19	13
t	116	74	20	14
u	117	75	21	15
v	118	76	22	16
w	119	77	23	17
x	120	78	24	18
y	121	79	25	19
z	122	7A	26	1A
inverted [	123	7B	27	1B
inverted \	124	7C	28	1C
inverted]	125	7D	29	1D
inverted ↑	126	7E	30	1E
inverted ←	127	7F	31	1F

Table 1. Screen Codes

✓See List of Advertisers on page 130

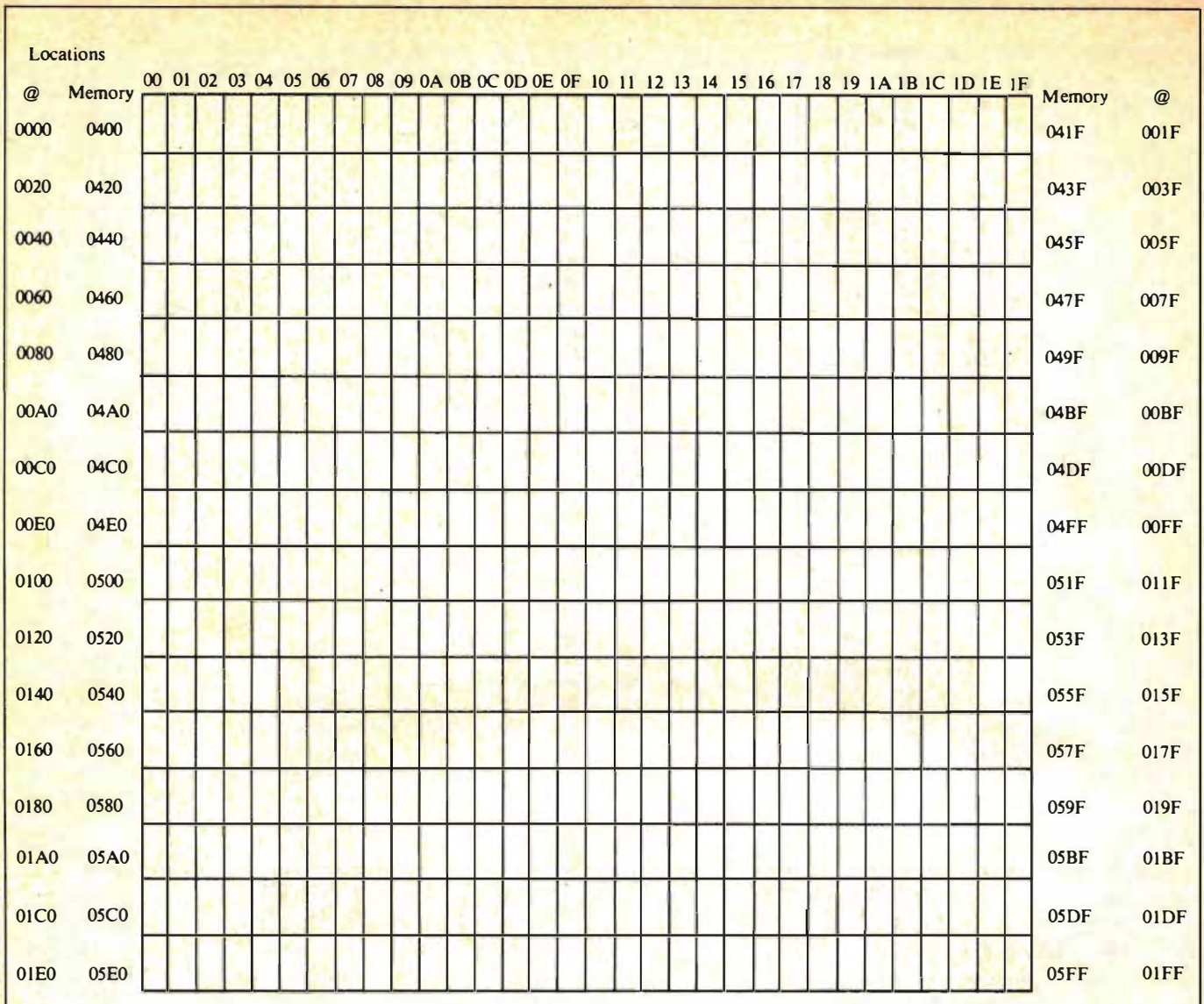


Fig. 2. Video Memory

fore, to display a 1 in the upper left corner of the video display, you enter POKE1024,49.

If you tried the above example, you should have seen a 1 displayed in the upper left corner of the screen. However, the character displayed isn't a black character with a green background as you might have expected. Instead, it's a green character with a black background. From this example, you can see that you must use the special screen codes to display a character correctly. Table 1 is a list of the ASCII codes and their corresponding screen codes.

As stated earlier, the Color Computer can display graphic characters as well as alphanumeric characters. The screen codes 128 to 255 ($80 to $FF) are used to display graphic characters. With these codes, you can construct any 2-by-2 graphic character with a selection of eight colors.

Figure 3 illustrates the codes used to display green graphic characters. To display a similar character in a different color, just add a color value to the green graphic character's code. The color values for the remaining seven colors are:

16—yellow
32—blue
48—red
64—buff
80—cyan
96—magenta
112—orange.

128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143
White areas indicate green
Dark areas indicate black
128 129 130 131 132 133 134 135
136 137 138 139 140 141 142 143

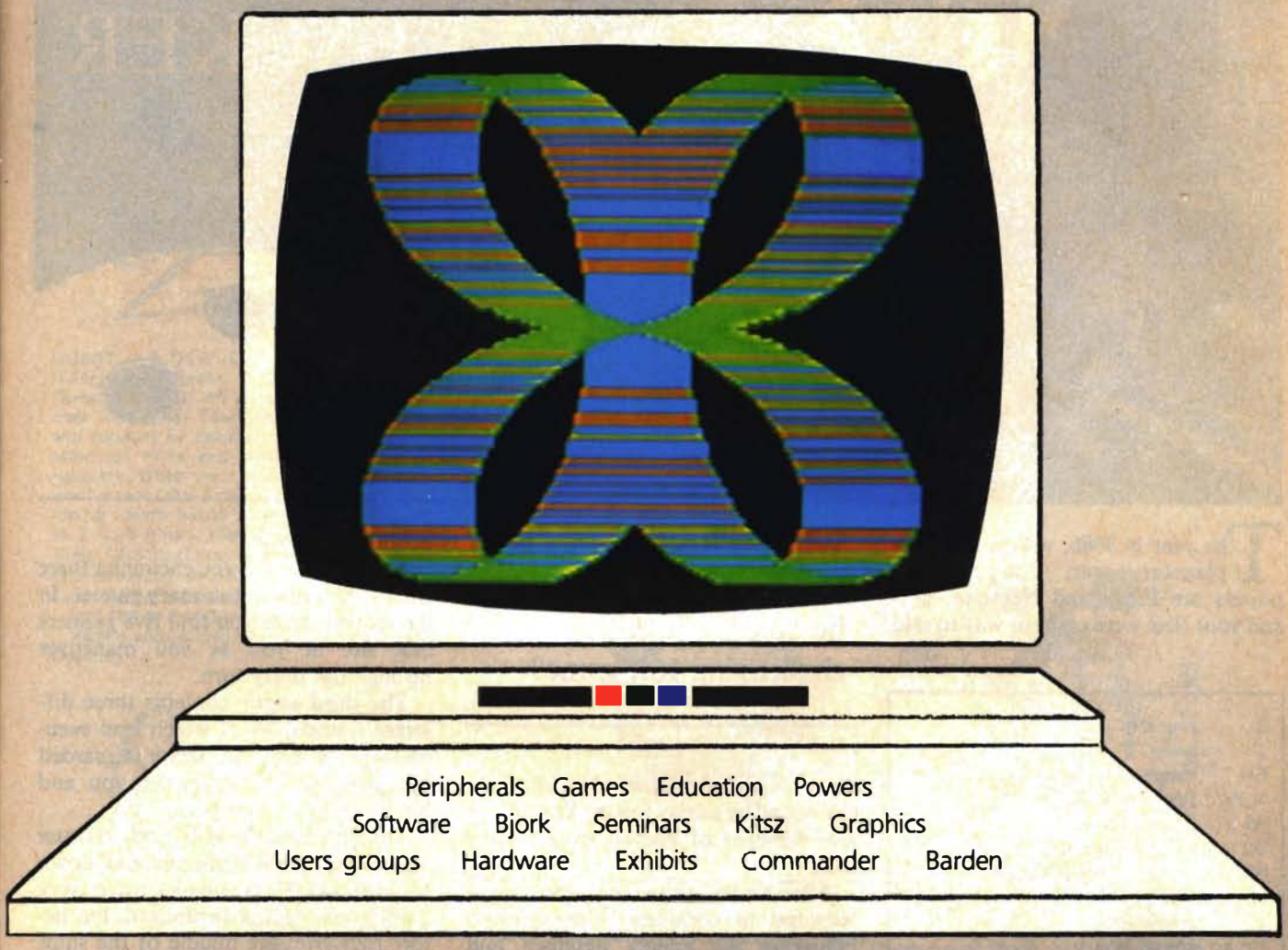
Fig. 3. Graphic Codes

Looking Ahead

Next month, I'll take a detailed look at the remaining areas of the Color Computer's memory. If any readers have questions about the material in this series, please feel free to write me. Please include a self-addressed stamped envelope for my reply. ■

Address correspondence to Mark D. Goodwin, Star Route 79, Box 103, Orland, ME 04472.

ColorExpo'83



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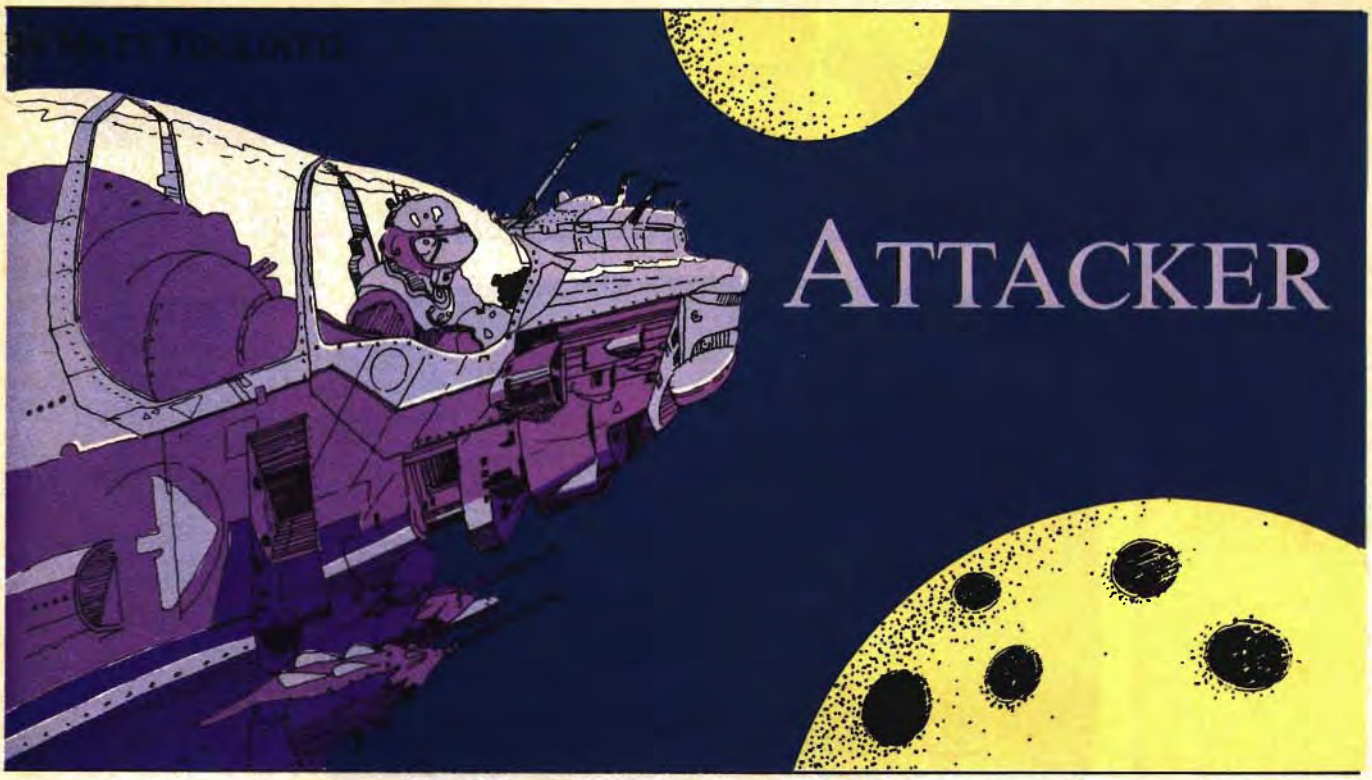

The year is 3486, a time of interplanetary war. The principal powers are Earth and Neptune. You and your fleet were on your way to raid the enemy headquarters when you were ambushed by enemy forces. You are the lone survivor of Earth's once mighty fleet.

Where's Rocky Jones now that we need him? Could he save earth in this challenging 16K game?

After eluding the enemy, you race to Neptune to complete your mission: Penetrate the enemy defenses and destroy their headquarters. Remember—you are Earth's last hope!

How to Play

The right joystick controls your ship. You can move up, down, and at various speeds forward, but you cannot move backward. Holding the joystick to the right sends your ship forward quickly. Holding it in the middle moves you at medium speed, and to the right moves you forward quickly. To fire press the fire button and push the joystick in the direction in which you wish to aim.

Game Sectors

The game consists of eight different sectors (see Fig. 1). In each sector you encounter different types of defenses and obstacles that you must overcome. You must leave each sector through the existing doorways.

In the first sector you encounter three enemy ships and a stationary gunner. In the second sector you find five gunners that fire at you as you maneuver through the snake turn.

The third sector contains three different tunnels, all of which lead eventually to the exit. This sector is guarded by ships that move toward you and leave bombs in their paths.

The fourth sector is difficult because the enemy ships move up and down while firing. Their missiles travel very quickly and cannot be dodged, but before they fire, the middle of the ships turn white, which gives you a warning.

In the fifth sector, you find gunners again. Here, you must exit through a long tunnel to the top of the screen. To do so you must plan your course carefully.

In the sixth and seventh areas you encounter laser gates which open and close. You must fly through them without touching them.

The eighth sector contains the headquarters, one laser gate, and three gunners. To destroy the headquarters you must shoot down onto it. You get a free ship the first time you hit it. After you

S	your ship
C	eraser
EN	enemy ships
X,Y	your coordinates
A$	explosion sound
SC	sector you are in
NM	number of player's ships
ES	enemy speed
T	general loop
P	general loop
U	general loop
I	general loop
G	general loop
DF	general
AA	general
RT	general
HH	subroutine flag
V,W	your last position
P,P2	enemy position
P3,P4	enemy's last position
A,B	joystick reads
D	firing flag
Z	enemy life flag
SS	your score
D1,D2	direction of enemy shots
M1,M2	position of enemy shots
M3,M4	the last position of the enemy shots
R	flag for enemy shooting
CC	color to be used
MN	base hit flag

Table 1. Variable List

System Requirements

16K RAM
Extended Color Basic

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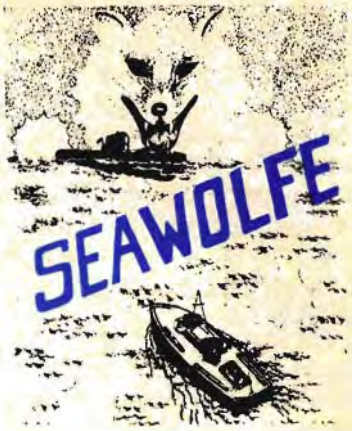

SEAWOLFE — ALL MACHINE CODE In this high speed arcade game, you lay out patterns of torpedoes ahead of the attacking PT boats. Requires Joysticks, at least 13k RAM, and fast reflexes. Lots of Color and Sound. A fun game. Tape or Disk for Vic20, Commodore 64, and TRS-80 Color. NOTE: tape will not transfer to disk!

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destroy the headquarters, a door to the outside world opens to give you an exit. Now you go back to sector one to meet new and faster enemies.

Modifications

The game is fairly difficult now, but you can make it more or less so by altering some of the variables in line 20. By changing NM (see Table 1), you can add to or subtract from your ship allotment. Changing ES alters the speed of the enemy ships, and changing SC allows you to begin in whatever sector you choose.

You can alter the shape of your ship by changing the DRAW statement in line 40, but stay within the 10-by-13 boundaries. You can also add new sectors or change the existing ones by using the variable list and program breakdown. But as it is, the game only leaves about 150 bytes on a 16K machine, so you are limited as to what you can add. ■

Address correspondence to Matt Togliatti, 348 S. Orchard, Park Forest, IL 60466.

0–9	is the introduction routine.
10–20	sets up variables and graphics mode.
30–40	sets shape of player's ship.
50	sends program to draw landscape for sectors.
60–90	puts remaining ships, score, and enemy ships on screen.
100–110	reads joysticks and changes X,Y coordinates.
120	sends program to enemy movement loop.
130	checks to see if player has left sector.
140	updates player's position on screen and checks if player fired.
150–160	checks to see if player hit mountains and ends main loop.
170–270	is player's shooting routine.
280	provides enemy ship's explosion.
290	provides enemy headquarters' explosion.
300–330	decides what ship, if any, player hit.
340–390	is the score printing routine.
400–430	is the movement routine for ships in first sector.
440–550	is the routine for all gunners and their shots.
560–590	is the bomber routine for sector 3.
600–660	provides fourth sector ship movement and shooting.
670–690	is the first laser gate routine.
700–720	is the second laser gate routine.
730–750	provides laser gate in headquarters sector.
760–770	is player's blow-up routine.
780	is the game-over message.
790–800	is the play-again tester.
810–940	draws mountains and caves for sectors 1–7.
950	sets game back to first sector after completing eighth.
960	draws cave for eighth sector.
970–1080	makes different enemy ships and positions them.

Table 2. Program Breakdown

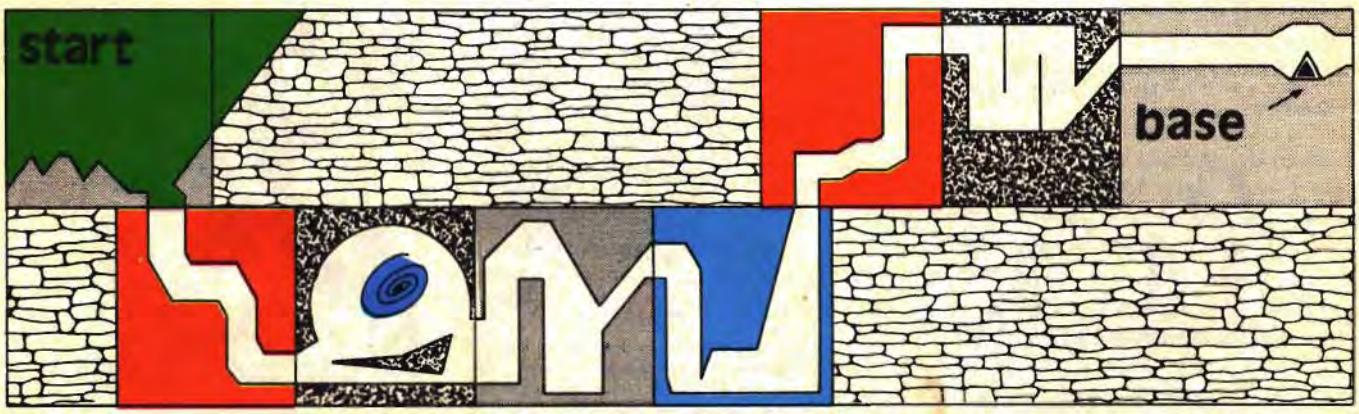
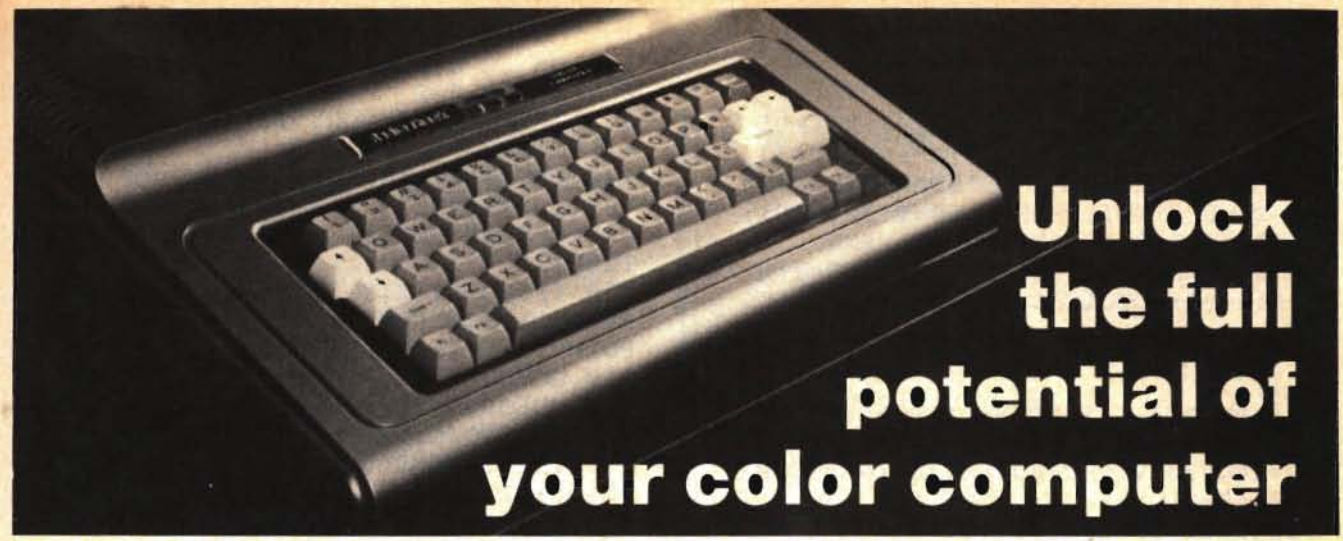


Fig. 1. Game Sectors



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0 CLS:POKE65495,0
1 G=0:PRINT@44,"ATTACKER":PRINT@
104,"BY MATT TOGLIATTI":PRINT@44
8,"PRESS ANY KEY TO START":FORT=
P TO U STEPI:PRINT@160+T*32,STRI
NG$(32,143+16*G);:G=G+1:NEXT
2 IF INKEY$=""THENIFP=0THENP=7:U
=0:I=-1:GOTO1ELSEP=0:U=7:I=1:GOT
O1
10 CLEAR35:DIMS(1,1),C(1,1),EN(1
,1)
20 PMODE4,1:SCREEN1,1:PCLS:PMODE
3,1:X=10:Y=26:A$="T150O1V31CDCGA
BV25CV20CV15DV10DV5EV1E":SC=1:NM
=3:ES=2
30 GET(0,0)-(1,1),C,G
40 CIRCLE(20,20),5,7,1,.25,.75:D
RAW"BM20,17C7R2D1R2D1R2D1NR2D1L2
D1L2D1L2":PAINT(20,20),8,7:GET(1
5,15)-(28,25),S,G
50 MN=0:PMODE4,1:PCLS:PMODE3,1:O
N SC GOTO970,990,1010,1030,990,1
060,1070,1080,950
60 LINE(100,0)-(200,12),PRESET,B
:PAINT(102,2),5,5:LINE(98,13)-(1
50,13),PSET:IFNM-1=0THEN80ELSENN
=NM-1:IFNN>3THENNN=3
70 FORT=1TONN:PUT(88+T*13,1)-(10
1+T*13,11),S,PSET:NEXT
80 HH=1:V=X:W=Y:GOTO340
90 HH=0:FORT=1TO5:IFZ(T)=0THENPU
T(P1(T),P2(T))-(P1(T)+10,P2(T)+1
0),EN,PSET:P3(T)=P1(T):P4(T)=P2(
T):NEXTELSENEXT
100 X=X+3:A=JOYSTK(0):B=JOYSTK(1
):IFA>45THENX=X+2ELSEIFA<15THENX
=X-2
110 IFB>45THENY=Y+4ELSEIFB<15THE
NY=Y-4
120 ON SC GOTO400,440,560,600,45
0,670,700,730
130 IFY<2ORX>242ORY>180THENSC=SC
+1:GOTO50
140 PUT(V,W)-(V+13,W+10),C,PSET:
PUT(X,Y)-(X+13,Y+10),S,PSET:V=X:
W=Y:D=PEEK(65280):IFD=126ORD=254
THEN170
150 IFPPOINT(X,Y-1)>5ORPPOINT(X+
14,Y+1)>5ORPPOINT(X+14,Y+9)>5ORP
POINT(X,Y+11)>5THEN760
160 GOTO100
170 COLOR6:IFB<15ORB>45THEN220
180 T=0:GOTO300
190 IFT=0THEN200ELSEZ(T)=1:DE=P1
(T)+5:GOTO210
200 IFA>45THENDE=255ELSEDE=0
210 LINE(X+6,Y+5)-(DE,Y+5),PSET:
SOUND253,1:LINE-(X+6,Y+5),PRESET
:IFZ(T)=1THEN280ELSE150
220 IFMN=0ANDSC=8ANDB>45ANDX+6=>
195ANDX+6=<215THEN290
230 FORT=1TO5:IFZ(T)=0ANDX+6=>P1
(T)ANDX+6=<P1(T)+10THEN240ELSENE
XT:GOTO250
240 IF(B>45ANDP2(T)>Y)OR(B<15AND
P2(T)<Y)THEN270ELSENEXT:GOTO250
250 IFB<15THENDE=10ELSEDE=191
260 LINE(X+6,Y+5)-(X+6,DE),PSET:
SOUND253,1:LINE-(X+6,Y+5),PRESET
:IFZ(T)=1THEN280ELSE150
270 Z(T)=1:DE=P2(T)+5:GOTO260
280 SS=SS+SC+ES:PUT(P1(T),P2(T))
-(P1(T)+11,P2(T)+11),EN,PSET:POK
E65494,0:PLAYA$:POKE65495,0:PUT(
P1(T),P2(T))-(P1(T)+11,P2(T)+11)
,C,PSET:GOTO340
290 MN=1:LINE(X+6,Y)-(X+6,90),PS
ET:SOUND253,1:LINE-(X+6,Y),PRESE
```

Listing continued

↙See List of Advertisers on page 130

Listing continued

```
T:SS=SS+50:FORT=195TO205:PUT(T,8
0)-(T+10,90),C,PSET:NEXT:FORT=30
TO70:LINE(215,T)-(255,T),PRESET:
NEXT:IFES=2THENNM=NM+1:GOTO60ELS
E100
300 FORP=T+1TO5:IFZ(P)=0ANDY+5=>
P2(P)ANDY+5=<P2(P)+10THEN310ELSE
NEXT:GOTO190
310 IFA<15THEN330
320 P1(0)=255:IF P1(P)<P1(T) AND
 P1(P)>X THENT=P:NEXTP:GOTO190EL
SENEXTP:GOTO190
330 P1(0)=0:IF P1(P)>P1(T) AND P
1(P)<X THENT=P:NEXTP:GOTO190ELSE
NEXTP:GOTO190
340 RESTORE:COLOR7:D=150:U=SS:I=
INT(U/1000):U=U-I*1000:GOSUB380
350 RESTORE:D=160:I=INT(U/100):U
=U-I*100:GOSUB380
360 RESTORE:D=170:I=INT(U/10):U=
U-I*10:GOSUB380
370 RESTORE:D=180:I=U:GOSUB380:I
FHH=1THEN90ELSE150
380 FORT=0TOI:READL$:NEXT:PUT(D,
1)-(D+8,11),C,PSET:DRAW"BM"+STR$
(D)+",1"+L$:RETURN
390 DATAR6D10L6U10,BR4D10,R6D5L6
D5R6,R6D5NL6D5L6,D5R6U5D10,NR6D5
R6D5L6,NR6D5R6D5L6U5,ND2R6D5L2D5
,R6D5L6U5D10R6U5,D5R6U5NL6D10
400 FORT=1TO3:IFZ(T)=1 THENNEXT:
GOTO430ELSEIF X>P1(T) THENP1(T)=
P1(T)+ES ELSE P1(T)=P1(T)-ES
410 IF Y>P2(T) AND P2(T)+ES<150
THEN P2(T)=P2(T)+ES ELSE P2(T)=P
2(T)-ES
420 PUT(P3(T),P4(T))-(P3(T)+10,P
4(T)+10),C,PSET:PUT(P1(T),P2(T))
-(P1(T)+10,P2(T)+10),EN,PSET:P3(
T)=P1(T):P4(T)=P2(T):NEXT
430 G=5:GOTO450
440 G=1
450 FORT=G TO5:IFZ(T)=1ANDM1(T)=
0THENNEXT:GOTO130ELSEIFM1(T)>0TH
EN530ELSEIFZ(T)=1THENNEXT:GOTO13
0ELSEIFRND(2)=1THENNEXT:GOTO130E
LSED1=0:D2=0:M1(T)=P1(T)+5:M2(T)
=P2(T)+5
460 IFY=P2(T)THEN510ELSEAA=(X-P1
(T))/(Y-P2(T)):IFABS(AA)=<.5THEN
490ELSEIFABS(AA)=>2.5THEN510
470 IF X<P1(T) THEND1=-ES-2 ELSE
D1=ES+2
480 IF Y<P2(T) THEND2=-ES-2:GOTO
520ELSED2=ES+2:GOTO520
490 IF Y<P2(T) THEN D2=-ES-2 ELS
ED2=ES+2
500 GOTO520
510 IF X<P1(T) THEN D1=-ES-2 ELS
ED1=ES+2
520 M1(T)=M1(T)+D1:M2(T)=M2(T)+D
2:D1(T)=D1:D2(T)=D2:NEXTT:GOTO13
0
530 M1(T)=M1(T)+D1(T):M2(T)=M2(T
)+D2(T):IFM2(T)<0ORM1(T)<0 THENM
1(T)=0:PRESET(M3(T),M4(T)):NEXT:
GOTO130ELSEIFPPOINT(M1(T),M2(T))
>5 THEN550ELSEPRESET(M3(T),M4(T)
):PSET(M1(T),M2(T),6):M3(T)=M1(T
):M4(T)=M2(T):NEXT:GOTO130
540 M3(T)=M1(T):M4(T)=M2(T):NEXT
:GOTO130
550 IFM1(T)=>X-2 AND M1(T)=<X+15
 AND M2(T)=>Y-2 AND M2(T)=<Y+12
THENPRESET(M3(T),M4(T)):GOTO760E
LSEM1(T)=0:PRESET(M3(T),M4(T)):N
EXT:GOTO130
560 FORT=1TO5:IFZ(T)=1THENNEXT:G
OTO130ELSEIFX<P1(T)THENP1(T)=P1(
T)-ES ELSE P1(T)=P1(T)+ES
570 IFY>P2(T)THENP2(T)=P2(T)+ES
ELSE P2(T)=P2(T)-ES
580 PUT(P3(T),P4(T))-(P3(T)+10,P
4(T)+10),C,PSET:PUT(P1(T),P2(T))
-(P1(T)+10,P2(T)+10),EN,PSET:P3(
T)=P1(T):P4(T)=P2(T):IFRND(12-ES
)=1THENCIRCLE(P1(T)+15,P2(T)+5),
5,7:PAINT(P1(T)+15,P2(T)+5),7,7
590 NEXT:GOTO130
600 COLOR8:FORT=1TO5:IFZ(T)=1THE
NNEXT:GOTO130ELSEIFY>P2(T)ANDPPO
INT(P1(T)+5,P2(T)+11)=5THENP2(T)
=P2(T)+ES ELSEIFPPOINT(P1(T)+10,
P2(T)-1)=5THENP2(T)=P2(T)-ES
610 PUT(P3(T),P4(T))-(P3(T)+10,P
4(T)+10),C,PSET:PUT(P1(T),P2(T))
-(P1(T)+10,P2(T)+10),EN,PSET:P3(
T)=P1(T):P4(T)=P2(T)
620 IFR(T)>0THEN640ELSEIF P2(T)+
5=>Y-15 AND P2(T)+5=<Y+25 THENR(
T)=1:NEXT:GOTO130
630 NEXT:GOTO130
640 R(T)=R(T)+1:IFR(T)>4THEN650E
LSELINE(P1(T),P2(T)+5)-(P1(T)+7,
P2(T)+5),PSET:NEXT:GOTO130
650 M1=P2(T)+5:FORP=P1(T) TO 9 S
TEP-6:IFPPOINT(P,M1)>5 THEN660EL
SELINE(P,M1)-(P+6,M1),PRESET:LIN
E(P,M1)-(P-5,M1),PSET:NEXT:LINE(
P,M1)-(P+6,M1),PRESET:R(T)=0:NEX
T:GOTO130
660 IF P>=X AND P=<X+14 AND M1=>
Y AND M1=<Y+10 THEN760ELSELINE(P
,M1)-(P+6,M1),PRESET:R(T)=0:NEXT
T:GOTO130
670 COLORCC:R=R+RT:IFR=<0ORR=>30
THENRT=-RT:GOTO680ELSEFORT=1TO3:
LINE(P1(T),P2(T)-R)-(P1(T)+30,P2
(T)-R+DD),PSET,B:NEXT:GOTO130
680 IFR=<0THENCC=6ELSECC=5
690 GOTO130
700 R=R+RT:IFR=<0ORR=>30THENRT=-
RT:GOTO710ELSEFORT=1TO3:IFCC=5TH
ENPUT(P1(T)+R,P2(T))-(P1(T)+R+DD
,P2(T)+10),C,PSET:NEXT:GOTO130EL
SEPUT(P1(T)+R,P2(T))-(P1(T)+R+DD
```

Listing continued

Listing continued

```
,P2(T)+10),C,PRESET:NEXT:GOTO130
710 IFR=<0THENCC=6ELSECC=5
720 GOTO130
730 COLORCC:R=R+RT:IFR<0ORR>20TH
EN740ELSELINE(P1(1),P2(1)+R)-(P1
(1)+30,P2(1)+R+DD),PSET,B:LINE(P
1(1),P2(1)+40-R)-(P1(1)+30,P2(1)
+40-R-DD),PSET,B:G=3:GOTO450
740 RT=-RT:IFR=<0 THENCC=6ELSECC
=5
750 G=3:GOTO450
760 POKE65494,0:PLAYA$:PLAYA$:PL
AYA$:POKE65495,0:PUT(V,W)-(V+13,
W+10),C,PSET
770 NM=NM-1:IFNM=<0THEN780ELSE50
780 DRAW"BM170,90C5L90D1R90D1L90
D1R90D1L90D1R90D1L90D1R90D1L90D1
R90D1L90U1R4C6U8R6D2BD2NL2D4NL6B
R4U8R6D4NL6D4BR4U8R4ND4R4D8BR4NR
6U4NR2U4R6BD8BR6U8R6D8NL6BR4BU8D
4R2D4R2U4R2U4BD8BR4NR6U4NR2U4R6B
R4R6D4L6U4D8U4R4D2R2D2"
790 B$=INKEY$
800 A$=INKEY$:IFA$=""THEN800ELSE
RUN
810 COLOR8:DRAW"BM0,160E30F10E25
R10F30R10E10F36R20D40BR50U20H16E
30":PAINT(0,191)
820 X=10:Y=20:DRAW"BM6,16ND190R2
40D160":PAINT(0,0):GOTO60
830 LINE(0,191)-(255,191),PRESET
840 GOTO60
850 Y=6:X=14:DRAW"BM10,2NR60D48F
40R40F10D48F40R114BU40L90H10U48H
40L40H10U50":PAINT(0,0):PAINT(25
5,0)
860 GOTO 60
870 X=6:Y=170:CIRCLE(150,102),10
5,8,.9,.5,1:LINE(50,100)-(0,150)
,PSET:LINE(0,188)-(255,189),PSET
,B:DRAW"BM60,155R100E50D70":LINE
(60,155)-(210,175),PSET:FORT=2TO
30STEP4:CIRCLE(120,90),T,7,.8:NE
XT:PAINT(0,0):PAINT(80,156)
880 T=1:GOTO1020
890 COLOR8:DRAW"BM0,100U40E50R20
F100BD50D30L94U110L25D100L70":LI
NE(255,20)-(170,110),PSET:LINE(2
55,70)-(170,160),PSET:PAINT(0,0)
:PAINT(255,191):X=6:IFY<100THENY
=140
900 GOTO1040
910 X=2:Y=36:DRAW"BM0,20R20F30D9
0E10R100":DRAW"BM0,60D110F20R230
U190":LINE(160,130)-(220,0),PSET
:PAINT(0,0):PAINT(255,191)
920 GOTO60
930 X=8:Y=165:DRAW"BM5,181U60R70
E10R60E10U80R115BD35L55D60G30L60
G10L60D26L90":PAINT(0,0):PAINT(2
50,180):GOTO60
940 X=4:Y=40:DRAW"BM0,30R76D70R4
U70R86D70R14BD40L55U70L4D70L86U7
0L45":LINE(180,100)-(255,20),PSE
T:LINE(180,140)-(255,60),PSET:PA
INT(0,0):PAINT(255,191):GOTO60
950 MN=0:SC=1:SS=SS+200:X=10:Y=2
0:ES=ES+2:GOTO50
960 X=6:Y=50:DRAW"BM0,30R180E10R
30F10R5D40G10L10D10L20U10L10H10L
176"::PAINT(0,0):FORT=0TO10:CIRC
LE(205,90),T,7,.65,.5,1:NEXT:GOT
O60
970 COLOR7:LINE(20,20)-(15,30),P
SET:LINE-(25,30),PSET:LINE-(20,2
0),PSET:PAINT(20,24),6,7:GET(15,
20)-(25,30),EN,G:FORT=1TO3:P1(T)
=RND(230)+10:P2(T)=RND(80)+10:Z(
T)=0:NEXT:Z(4)=1:Z(5)=0:P1(5)=16
6:P2(5)=160:PAINT(20,20),5,5
980 GOTO 810
990 CIRCLE(20,20),5,7:PAINT(20,2
0),6,7:GET(15,15)-(25,25),EN,G:P
AINT(20,20),5,5:FORT=1TO5:Z(T)=0
:M1(T)=0:NEXT
1000 IFSC=2THENP1(1)=30:P2(1)=66
:P1(2)=140:P2(2)=130:P1(3)=200:P
2(3)=170:P1(4)=180:P2(4)=176:P1(
5)=104:P2(5)=140:GOTO850ELSEP1(1
)=80:P2(1)=136:P1(2)=120:P2(2)=1
36:P1(3)=70:P2(3)=176:P1(4)=110:
P2(4)=176:P1(5)=186:P2(5)=100:GO
TO910
1010 CIRCLE(20,20),6,6:PAINT(20,
20),8,6:CIRCLE(20,20),2,7:GET(16
,15)-(26,25),EN,G:GOTO870
1020 Z(T)=0:P1(T)=RND(230)+10:P2
(T)=RND(150):IF PPOINT(P1(T),P2(
T))>5 OR PPOINT(P1(T)+10,P2(T))>
5 OR PPOINT(P1(T)+10,P2(T)+10)>5
 OR PPOINT(P1(T),P2(T)+10)>5 THE
N1020ELSET=T+1:IFT>5THEN60ELSE10
20
1030 DRAW"BM20,20C6NU4NE4NR4NF4N
D4C7NG4NL4NH4":GET(15,15)-(25,25
),EN,G:GOTO890
1040 FORT=1TO5
1050 P1(T)=RND(180)+15:P2(T)=RND
(191):IFPPOINT(P1(T),P2(T))>5ORP
POINT(P1(T)+10,P2(T))>5ORPPOINT(
P1(T),P2(T)+10)>5ORPPOINT(P1(T)+
10,P2(T)+10)>5THEN1050ELSEZ(T)=0
:R(T)=0:NEXT:GOTO60
1060 FORT=1TO5:Z(T)=1:NEXT:P1(1)
=42:P2(1)=156:P1(2)=116:P2(2)=14
6:P1(3)=204:P2(3)=55:R=0:RT=ES-1
:CC=7:DD=ES/2:GOTO930
1070 FORT=1TO5:Z(T)=1:NEXT:P1(1)
=30:P2(1)=70:P1(2)=76:P2(2)=70:P
1(3)=120:P2(3)=70:R=0:RT=ES:DD=E
S:GOTO940
1080 FORT=1TO2:Z(T)=1:NEXT:Z(3)=
0:Z(4)=0:Z(5)=0:P1(4)=190:P2(4)=
20:P1(5)=185:P2(5)=70:P1(1)=100:
P2(1)=30:RT=ES-1:R=0:CC=6:DD=ES/
2:P1(3)=210:P2(3)=20:GOTO960
```

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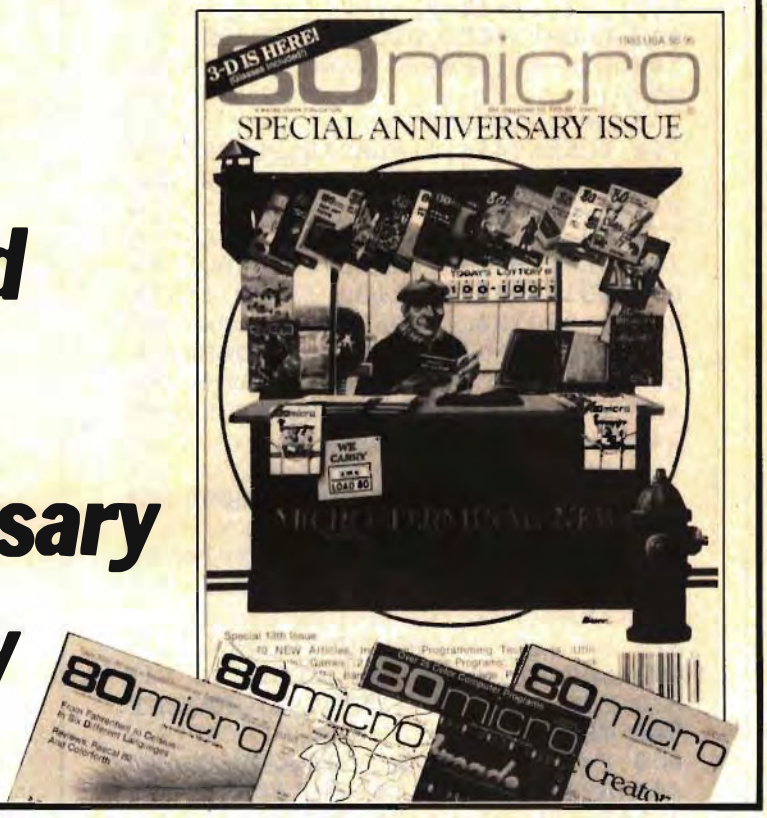

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BY RODRIGUE DUGAL

THE GAME OF TOWERS

Match your mind against the masters of old in this ancient game. Can you rebuild the tower?

Rodrigue Dugal is an analyst-programmer for the French Canadian insurance company La Laurentienne in Quebec City. Write to him at 40 Des Chenes Ouest #3, Quebec, Quebec, Canada G1L 1K3.

The Game of Towers is said to be as old as the world. Its object is to move all the disks from the left tower to the right tower, using the middle one as an intermediary.

To do so, you must follow two rules:

- Never move more than one disk at a time.
- Never put a larger disk on a smaller one.

This program uses seven disks. The screen could hold more, but you probably wouldn't have the patience to deal with them. The minimum number of moves for seven disks is 127.

Once you have loaded and run the program, you can choose to play the game yourself or to watch the computer demonstrate its skill at one of two speeds.

To play the game, use the left and right arrows to move the black cursor at the bottom of the towers. Place the cursor under the tower from which you want to remove a disk. Press the space bar. Move the cursor to the tower where you want to put that disk. Press the space bar again. The disk will move from one tower to the other.

If you get discouraged during the game, press R to return to the menu.

No special techniques are used in this program, except for subroutine 1480, which calls itself at lines 1530 and 1580. This is called recursive programming. ■

System Requirements

16K RAM
Color Basic

Lines	Function
10	Reserve string space.
20-40	Define a blank disk.
50-120	Print the menu.
130-140	Accept only 1, 2, or 3 as a valid answer.
150	The computer excuses itself while preparing for the game.
160-230	Call the different subroutines that initialize the strings of the seven disks and of the bases of the towers.
240-320	Draw the empty towers.
330-350	Assign all the disk strings to the first tower.
360-380	Assign blank disk strings to the second and third towers.
390	Calls the subroutine that draws the actual content of the towers.
400	Defines the cursor.
410	Defines the cursor eraser.
420-430	Print the initial cursor.
440-450	Branch to the computer's logic when asked.
460-470	The mainline when option "1" of the menu is chosen.
480	Returns to the menu.
490-540	Move the cursor.
550	Produces a sound when the space bar is hit and calls the subroutine that analyzes the position of the cursor.
560	Calls the subroutine that checks if the "from" tower is empty. If so, the move is ignored.
570	Command is ignored when the space bar is hit twice under the same tower.
580	The second time the space bar is validly hit, calls the subroutine that assigns the correct disk string to the towers.
590	Returns to the mainline.
600-910	See lines 160-230 above.
920-1070	See line 390 above.
1080-1170	See line 550 above.
1180-1390	See line 580 above.
1400-1630	Computer's logic. Can you think as it does?
1640-1670	See line 560 above.

Table 1. Line Descriptions

```
10 CLEAR 1000
20 FOR X=1 TO 4:BL$=BL$+CHR$(128):NEXT
30 BL$=BL$+CHR$(133+64)
40 FOR X=1 TO 4:BL$=BL$+CHR$(128):NEXT X
50 CLS
60 PRINT @32,"********************************";
70 PRINT @71,"THE GAME OF TOWERS"
80 PRINT @96,"********************************";
90 PRINT @162,"1- YOU PLAY."
100 PRINT @226,"2- COMPUTER'S DEMONSTRATION."
110 PRINT @290,"3- COMPUTER'S DEMONSTRATION"
120 PRINT @325,"(SLOW MOTION)."
130 R$=INKEY$:IF R$="" THEN 130
140 IF R$<>"1" AND R$<>"2" AND R$<>"3" THEN 60
150 CLS:PRINT @230,"ONE MOMEMT ..."
160 GOSUB 600
170 GOSUB 640
180 GOSUB 680
190 GOSUB 720
200 GOSUB 760
210 GOSUB 800
220 GOSUB 840
230 GOSUB 880
240 CLS(0)
250 PRINT @480,BR$(8);
260 PRINT @491,BR$(8);
270 PRINT @502,BR$(9);
280 FOR DP=0 TO 22 STEP 11
290 FOR X=4 TO 452 STEP 32
300 PRINT @X+DP,CHR$(133+64);
310 NEXT X
320 NEXT DP
330 FOR I=1 TO 7
340 A$(I,1)=BR$(I)
350 NEXT I
360 FOR I=1 TO 7
370 A$(I,2)=BL$:A$(I,3)=BL$
380 NEXT I
390 GOSUB 920
400 CR$=CHR$(142+64)
410 CB$=CHR$(143+64)
420 P=484
430 PRINT @P,CR$;
440 IF R$="2" THEN DL=1:GOTO 1400
450 IF R$="3" THEN DL=1500:GOTO 1400
460 R$=INKEY$:IF R$=""THEN 460
470 IF R$<>" " AND R$<>CHR$(8) AND R$<>CHR$(9) AND
R$<>"R" THEN

460
480 IF R$="R" THEN 10
490 P1=P
500 IF R$=CHR$(8) THEN P=P-11:IF P<484 THEN P=506
510 IF R$=CHR$(9) THEN P=P+11:IF P>506 THEN P=484
520 PRINT @P1,CB$;
530 PRINT @P,CR$;
540 IF R$<>" " THEN 460
550 IF R$=" " THEN CC=CC+1:SOUND 150,2:GOSUB 1080
560 GOSUB 1640
570 IF A=B THEN CC=1:GOTO 460

580 IF CC=0 THEN GOSUB 1180
590 GOTO 460
600 FOR X=1 TO 4:BR$(7)=BR$(7)+CHR$(128):NEXT X
610 BR$(7)=BR$(7)+CHR$(143+16)+CHR$(138+16)
620 FOR X=1 TO 3:BR$(7)=BR$(7)+CHR$(128):NEXT X
630 RETURN
640 FOR X=1 TO 3:BR$(6)=BR$(6)+CHR$(128):NEXT X
650 BR$(6)=BR$(6)+CHR$(133)+CHR$(143)+CHR$(143)
660 FOR X=1 TO 3:BR$(6)=BR$(6)+CHR$(128):NEXT X
670 RETURN
680 FOR X=1 TO 3:BR$(5)=BR$(5)+CHR$(128):NEXT X
690 FOR X=1 TO 3:BR$(5)=BR$(5)+CHR$(143+112):NEXT X
700 BR$(5)=BR$(5)+CHR$(138+112)+CHR$(128)+CHR$(128)
710 RETURN
720 BR$(4)=CHR$(128)+CHR$(128)+CHR$(133+96)
730 FOR X=1 TO 4:BR$(4)=BR$(4)+CHR$(143+96):NEXT X
740 BR$(4)=BR$(4)+CHR$(128)+CHR$(128)
750 RETURN
760 BR$(3)=CHR$(128)+CHR$(128)
770 FOR X=1 TO 5:BR$(3)=BR$(3)+CHR$(143+80):NEXT X
780 BR$(3)=BR$(3)+CHR$(138+80)+CHR$(128)
790 RETURN
800 BR$(2)=CHR$(128)+CHR$(133+48)
810 FOR X=1 TO 6:BR$(2)=BR$(2)+CHR$(143+48):NEXT X
820 BR$(2)=BR$(2)+CHR$(128)
830 RETURN
840 BR$(1)=CHR$(128)
850 FOR X=1 TO 7:BR$(1)=BR$(1)+CHR$(143+32):NEXT X
860 BR$(1)=BR$(1)+CHR$(138+32)+CHR$(128)
870 RETURN
880 FOR X=1 TO 9:BR$(8)=BR$(8)+CHR$(143+64):NEXT X
890 BR$(8)=BR$(8)+CHR$(138+64)
900 FOR X=1 TO 9:BR$(9)=BR$(9)+CHR$(143+64):NEXT X
910 RETURN
920 I=1
930 FOR X=416 TO 32 STEP -64
940 PRINT @X,A$(I,1);
950 I=I+1
960 NEXT X
970 I=1
980 FOR X=427 TO 43 STEP -64
990 PRINT @X,A$(I,2);
1000 I=I+1
1010 NEXT X
1020 I=1
1030 FOR X=438 TO 54 STEP -64
1040 PRINT @X,A$(I,3);
1050 I=I+1
1060 NEXT X
1070 RETURN
1080 IF CC>1 THEN 1130
1090 IF P=484 THEN A=1
1100 IF P=495 THEN A=2
1110 IF P=506 THEN A=3
1120 RETURN
1130 IF P=484 THEN B=1
1140 IF P=495 THEN B=2
1150 IF P=506 THEN B=3
1160 CC=0
1170 RETURN
1180 FOR I=7 TO 1 STEP -1
1190 IF A$(I,A)<>BL$ THEN 1220
1200 NEXT I
1210 CC=0:RETURN
1220 FOR J=1 TO 7
1230 IF A$(J,B)=BL$ THEN 1250
1240 NEXT J
1250 FOR K=1 TO 7
1260 IF A$(I,A)=BR$(K) THEN 1280
1270 NEXT K
1280 FOR L=1 TO 7
1290 IF A$(J-1,B)=BR$(L) THEN 1320
1300 NEXT L
1310 L=1
1320 IF K<L THEN SOUND 122,10:RETURN
1330 A$(J,B)=A$(I,A)
1340 A$(I,A)=BL$
1350 CO=CO+1
1360 PRINT @7,CO;
1370 GOSUB 920
1380 IF A$(7,3)=BR$(7) THEN 1380
1390 RETURN
1400 'COMPUTER'S LOGIC
1410 DN=7
1420 T1(1)=1:T2(1)=3:T3(1)=2
1430 NE=1
1440 DD(1)=DN
1450 RZ=0
1460 GOSUB 1480
1470 END
1480 NE=NE+1
1490 DD(NE)=DD(NE-1)-1
1500 T1(NE)=T1(NE-1)
1510 T2(NE)=T3(NE-1)
1520 T3(NE)=T2(NE-1)
1530 IF DD(NE)=1 THEN RZ=RZ+1:A=T1(NE):B=T2(NE):
GOSUB 1480
GOSUB 1610 ELSE
1540 RZ=RZ+1:A=T1(NE-1):B=T2(NE-1):GOSUB 1610
1550 T1(NE)=T3(NE-1)
1560 T2(NE)=T2(NE-1)
1570 T3(NE)=T1(NE-1)
1580 IF DD(NE)=1 THEN RZ=RZ+1:A=T1(NE):B=T2(NE):
GOSUB 1610 ELSE
GOSUB 1480
1590 NE=NE-1
1600 RETURN
1610 FOR X=1 TO DL:NEXT X
1620 GOSUB 1180
1630 RETURN
1640 FOR I=7 TO 1 STEP -1
1650 IF A$(I,A)<>BL$ THEN RETURN
1660 NEXT I
1670 CC=0:GOTO 460
```

Program Listing. The Game of Towers

BY JAMES R. LEE

CONFIDENCE CHECK

Do you have faith in your computer's performance? If you have any doubts, run these quick tests.

The CoCo Checker is a program to run a quick confidence test on the Color Computer. Lines 340–550 perform the printer test. You have the option of uppercase, lowercase, or graphics characters.

Lines 600–710 perform the clear-screen test, which clears the screen in all eight colors with the associated color printed at the top of each screen. If your monitor is not adjusted properly, it is immediately noticeable.

The program displays the color spectrum in the slow mode, so you have time to determine if your monitor needs adjustment.

Lines 760–810 perform the sound test, which displays the sound numbers on the screen. If you were looking for a specific sound, you could jot it down as the test progresses.

The joystick test (lines 990–1080) is the only test that needs special instructions:

1. Move the right joystick to obtain a 0 (zero) reading for the left/right and the up/down positions, which are indicated on the screen.

2. Move the left joystick to obtain a 0 (zero) reading for the left/right and the up/down positions, which are indicated on the screen.

3. Press the fire button on the right joystick, and the display should read 126.

4. Press the fire button on the left joystick, and the display should read 125.

5. Press both fire buttons, and the display should read 124.

6. Press any key to return to the main menu. ■

James (Bob) Lee is a software engineer with Honeywell. Write to him at 1541 Grant Drive, St. Charles, MO 63301.

System Requirements

16K RAM
Extended Color Basic

Program Listing. CoCo Checker

```
10 REM ************************
20 REM * COCO CHECKER          *
30 REM *      BY               *
40 REM *    BOB LEE            *
50 REM * JANUARY 1983          *
60 REM ************************
70 CLS 2
80 PRINT@74,"COCO CHECKER"
90 PRINT@138,"MENU"
100 PRINT@170,"----"
110 PRINT@202,"1 - PRINTER TEST"
120 PRINT@234,"2 - CLEAR SCREEN
TEST"
130 PRINT@266,"3 - SOUND TEST"
140 PRINT@298,"4 - COLOR SPECTRU
M"
150 PRINT@330,"5 - JOYSTICK TEST
"
160 PRINT@362,"6 - QUIT"
170 INPUT "SELECT OPTION 1 TO 6"
;S
180 IF S<1 OR S>6 THEN PRINT "TR
Y AGAIN":FOR I=1 TO 1000:NEXT:GO
TO 70
190 ON S GOTO 230,580,740,840,97
0,940
200 REM ************************
210 REM *   PRINTER TEST       **
**
220 REM ************************
230 CLS 3
240 PRINT@74,"PRINTER TEST"
250 PRINT@138,"MENU"
260 PRINT@170,"----"
270 PRINT@198,"1 - UPPER CASE"
280 PRINT@230,"2 - LOWER CASE"
290 PRINT@262,"3 - GRAPHIC CHARA
CTERS"
300 PRINT@294,"4 - RETURN TO MAI
N MENU"
310 INPUT"SELECT OPTION 1 TO 4";
G
320 IF G<1 OR G>4 THEN PRINT"TRY
 AGAIN":FOR T =1 TO 1000:NEXT:GO
TO 230
```

Listing continued

Listing continued

```
330 ON G GOTO 340,410,510,70
340 FOR I=41 TO 95
350 CLS 2:PRINT@74,"PRINTING UPP
ER CASE"
360 PRINT#-2,CHR$(I);
370 NEXT I
380 PRINT#-2," "
390 PRINT#-2,CHR$(191)
400 GOTO 240
410 FOR I=97 TO 127
420 CLS 2:PRINT@74,"PRINTING LOW
ER CASE"
430 PRINT#-2,CHR$(I);
440 NEXT I
450 PRINT#-2," "
460 PRINT#-2,CHR$(191)
470 PRINT#-2," "
480 PRINT#-2,CHR$(191)
490 PRINT#-2," "
500 GOTO 240
510 FOR I=128 TO143
520 CLS 2:PRINT@74,"PRINTING GRA
PHICS"
530 PRINT#-2,CHR$(I);:PRINT#-2,"
 ";
540 NEXT I
550 PRINT#-2," "
560 GOTO 240
570 REM **********************
580 REM **** CLEAR SCREEN TEST *
***
590 REM **********************
600 FOR C=1 TO 8
610 CLS C
620 IF C=1 THEN PRINT@0,"GREEN"
630 IF C=2 THEN PRINT@0,"YELLOW"
640 IF C=3 THEN PRINT@0,"BLUE"
650 IF C=4 THEN PRINT@0,"RED"
660 IF C=5 THEN PRINT@0,"BUFF"
670 IF C=6 THEN PRINT@0,"CYAN"
680 IF C=7 THEN PRINT@0,"MAGNETA
"
690 IF C=8 THEN PRINT@0,"ORANGE"
700 FOR DLY= 1 TO 1500:NEXT DLY
710 NEXT C
720 GOTO 70
730 REM **********************
740 REM **** SOUND TEST ****
750 REM **********************
760 FOR X=1 TO 255
770 CLS 8
780 PRINT@74,"SOUND TEST"
790 PRINT@202,"SOUND NO ";X
800 SOUND X,1
810 NEXT X
820 GOTO 70
830 REM **********************
840 REM **** COLOR SPECTRUM ****
850 REM **********************
860 CLS 0
870 FOR X=0 TO 63
880 FOR Y=0 TO 31
890 C=INT(X/8 + 1)
900 SET(X,Y,C)
910 NEXT Y,X
920 FOR DLY=1 TO 1500:NEXT DLY
930 GOTO 70
940 CLS 8:PRINT@330,"HOPE I WAS
OF SERVICE"
950 END
960 REM **********************
970 REM*** RIGHT/LEFT JOYSTICK *
**
980 REM **********************
990 CLS 4
1000 PRINT@74,"JOYSTICK TEST"
1010 PRINT@192,JOYSTK(0);:PRINT"
RIGHT JOYSTICK LEFT/RIGHT"
1020 PRINT@224,JOYSTK(1);:PRINT"
RIGHT UP/DOWN"
1030 PRINT@256,JOYSTK(2);:PRINT"
LEFT STICK LEFT/RIGHT"
1040 PRINT@288,JOYSTK(3);:PRINT"
LEFT JOYSTICK UP/DOWN"
1050 P=PEEK(65280)
1060 IF P=255 OR 127 THEN PRINT@
320,"LEFT BUTTON";P
1070 IF P=254 OR 126 THEN PRINT@
352,"RIGHT BUTTON";P
1080 PRINT@442,"PRESS ANY KEY TO
 RETURN TO MENU"
1090 A$=INKEY$:IF A$="" THEN 100
0 ELSE 70
```


See List of Advertisers on page 130

BY MARK D. GOODWIN

SPEEDY ASSEMBLY GRAPHICS

Perhaps the Color Computer's most superb feature is its outstanding graphics displays. Although you can program them from Basic, machine language is a necessity for high-speed graphics.

Because I wanted to take advantage of this speed, I searched through the Extended Color Basic ROM in the hope that I could find some useful ROM routines. I did find the graphics ROM routines, but they're not easily adapted for machine-language programs.

Therefore, I decided to write the subroutines to initialize the hardware, clear the screen, and SET, RESET, and test pixels. You can find the fruits of my labor in the accompanying Program Listing.

These subroutines perform all the functions described above for all but one of the Color Computer's graphics modes. I was unable to get the SG6 mode to function properly. I'm not sure if the documentation for this mode is incorrect in the Color Basic manual, or if it's a hardware bug.

Here are the subroutines that initialize hardware, clear the screen, and SET, RESET, and test pixels.

System Requirements

16K RAM
Editor/Assembler

Using the Subroutines

You can easily implement these subroutines into your programs. Simply make a copy of the source code using an editor/assembler. Once you've done this, you will have these subroutines at your disposal any time you wish to write a graphics program.

Tables 1 and 2 provide the documentation for the four major subroutines in the Listing. While you're studying these descriptions, keep a copy of the Color Basic manual handy for reference.

I think you will find these subroutines are easy to use. They should make your future graphics programming much easier. ■

Address correspondence to Mark D. Goodwin, Star Route 79, Box 103, Orland, ME 04472.

Table 1. Subroutine Documentation

INIT (see line 2 of the Listing) initializes the page-select register, the VDG register, and the control register. This subroutine should always be called at the start of a program to ensure proper graphics operation.

On Entry:
STVM holds the starting address of video memory.
CSET holds the color set flag as follows:
CSET = 0 for color set 0.
CSET <> 0 for color set 1.
GMODE holds the graphics mode as follows:
GMODE = 0 for the SG4 graphics mode.
GMODE = 1 for the SG8 graphics mode.
GMODE = 2 for the SG12 graphics mode.
GMODE = 3 for the SG24 graphics mode.
GMODE = 4 for the G1C graphics mode.
GMODE = 5 for the G1R graphics mode.
GMODE = 6 for the G2C graphics mode.
GMODE = 7 for the G2R graphics mode.
GMODE = 8 for the G3C graphics mode.
GMODE = 9 for the G3R graphics mode.
GMODE = 10 for the G6C graphics mode.
GMODE = 11 for the G6R graphics mode.

Example:

```
        :
LDX     #$5000      X = Start of video memory.
STX     STVM        Save the start of video memory.
LDA     #11         A = Mode value for G6R.
STA     GMODE       Save the graphics mode.
STA     CSET        Set color set to 1.
JSR     INIT        Initialize the hardware.
        :
```

SET (see line 40 of the Listing) sets a graphic pixel.
On Entry:
STVM holds the starting address of video memory.
GMODE holds the graphics mode. (See INIT.)
XVAL holds the X-value. (See Table 2.)
YVAL holds the Y-value. (See Table 2.)
COLOR holds the color value. (SG4–SG24. See Table 2.)
FCOL holds the foreground color. (G1C–G6C. See Fig. 2.)

Example:
* For this example GMODE is set to 0.

```
        :
LDA #50         A = X-value.
STA XVAL        Save the X-value.
LDA #22         A = Y-value.
STA YVAL        Save the Y-value.
LDA #5          A = Color value.
```

Table 1 continued

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Table 1 continued

```
STA COLOR     Save the color value.
JSR SET       Do SET.
:
```

RESET (see line 42 of the Listing) resets a graphic pixel.
On Entry:
STVM holds the starting address of video memory.
GMODE holds the graphics mode. (See INIT.)
XVAL holds the X-value. (See Table 2.)
YVAL holds the Y-value. (See Table 2.)
BCOL holds the background color. (G1C–G6C. See Table 2.)

Example:
* For this example GMODE is set to 11.

```
:
LDA #200      A = X-value.
STA XVAL      Save the X-value.
LDA #73       A = Y-value.
STA YVAL      Save the Y-value.
JSR RESET     Do RESET.
:
```

POINT (see line 44 of the Listing) tests the status of a graphic pixel.

On Entry:
STVM holds the starting address of video memory.
GMODE holds the graphics mode. (See INIT.)
XVAL holds the X-value. (See Table 2.)
YVAL holds the Y-value. (See Table 2.)

On Exit:
Register A contains the result of the test as follows:
SG4–SG24:
A = Color value if the pixel is set.
A = 0 if the pixel isn't set.
A = −1 if it's a nongraphic character.
G1C–G6C:
A = Color value of the pixel.
G1R–G6R:
A = −1 if the pixel is set.
A = 0 if the pixel isn't set.

Example:
* For this example GMODE is set to 11.

```
:
LDA   #56     A = X-value.
STA   XVAL    Save the X-value.
LDA   #157    A = Y-value.
STA   YVAL    Save the Y-value.
JSR   POINT   Do test.
TSTA          Set the flags.
BNE   LP1     Jump if the pixel is set.
:
```

CLS (see line 191 of the Listing) clears the screen.

On Entry:
STVM holds the starting address of video memory.
GMODE holds the graphics mode. (See INIT.)
COLOR holds the color value. (SG4–SG24 and G1R–G6R. See Table 2.)
BCOL holds the background color. (G1C–G6C. See Table 2.)

Example:
* For this example GMODE is set to 11.

```
:
CLRCOLOR      Set color to black.
JSR CLS       Do clear screen.
:
```


GMODE	XVAL MIN	XVAL MAX	YVAL MIN	YVAL MAX	COLOR (RE)SET MIN	COLOR (RE)SET MAX	COLOR CLS MIN	COLOR CLS MAX	FCOL/BCOL MIN	FCOL/BCOL MAX
0	0	63	0	31	1	8	0	8	N/A	N/A
1	0	63	0	63	1	8	0	8	N/A	N/A
2	0	63	0	95	1	8	0	8	N/A	N/A
3	0	63	0	191	1	8	0	8	N/A	N/A
4	0	63	0	63	N/A	N/A	N/A	N/A	1	4
5	0	127	0	63	N/A	N/A	0	1	N/A	N/A
6	0	127	0	63	N/A	N/A	N/A	N/A	1	4
7	0	127	0	95	N/A	N/A	0	1	N/A	N/A
8	0	127	0	95	N/A	N/A	N/A	N/A	1	4
9	0	127	0	191	N/A	N/A	0	1	N/A	N/A
10	0	127	0	191	N/A	N/A	N/A	N/A	1	4
11	0	255	0	191	N/A	N/A	0	1	N/A	N/A

COLOR (RE)SET	COLOR CLS	FCOL/BCOL	COLOR SET 0	COLOR SET 1
	0		Black	Black
1	1*		Green	Green
	1**		Green	Buff
2	2		Yellow	Yellow
3	3		Blue	Blue
4	4		Red	Red
5	5		Buff	Buff
6	6		Cyan	Cyan
7	7		Magenta	Magenta
8	8		Orange	Orange
		1	Green	Buff
		2	Yellow	Cyan
		3	Blue	Magenta
		4	Red	Orange

* SG4 to SG24.
**G1R to G6R.

Table 2. Subroutine Values

Program Listing. Graphics Utility to Initialize Hardware, Clear the Screen, and SET, RESET, and Test Pixels.

```
0001 0600                       NAM GRAPHICS
                                *
                                * Machine Language Graphics
                                * Copyright 1983 Mark D. Goodwin
                                *

                                *
                                * Hardware Initialization
                                * Routine
                                *
0002 0600 B607A7        INIT    LDA $TVM        A=MSB of video.
0003 0603 44                    LSRA            A=512 page.
0004 0604 BEFFC6                LDX #$FFC6      X=Page-select reg.
0005 0607 C607                  LDB #7          B=Register length.
0006 0609 8D35                  BSR SUB         Set the register.
0007 060B B607A9                LDA GMODE       A=Mode.
0008 060E C603                  LDB #3          B=Offset multiplier.
0009 0610 3D                    MUL             B=Table offset.
0010 0611 8E07B1                LDX #GTAB       Point to table.
0011 0614 3085                  LEAX B,X        Point to mode values.
0012 0616 A684                  LDA ,X          A=Mode value.
0013 0618 3410                  PSHS X          Save table pointer.
0014 061A 8EFFC0                LDX #$FFC0      X=VDG Register.
0015 061D C603                  LDB #3          B=Register length.
0016 061F 8D1F                  BSR SUB         Set the register.
0017 0621 3510                  PULS X          Get the table pointer.
0018 0623 7D07AA                TST CSET        Color set 0 or 1?
0019 0626 2603                  BNE A@          Jump if 1.
0020 0628 A601                  LDA 1,X         A=Control value.
0021 062A BC                    FCB $8C         Dummy CMPX #XXXX.
0022 062B A602          A@      LDA 2,X         A=Control value.
0023 062D 3402                  PSHS A          Save control value.
0024 062F B6FF22                LDA $FF22       A=Register value.
0025 0632 8407                  ANDA #7         Clear bits 3 to 7.
0026 0634 AAE0                  ORA ,S+         Combine control values.
0027 0636 B7FF22                STA $FF22       Set control register.
0028 0639 CC0201                LDD #$0201      D=Default colors.
0029 063C FD07AE                STD FCOL        Save them.
0030 063F 39                    RTS             Return.

                                *
                                * Set Register Routine
                                *
0031 0640 44            SUB     LSRA            Carry=Bit value.
0032 0641 2503                  BCS A@          Jump if it's set.
0033 0643 A784                  STA ,X          Reset the register.
0034 0645 BC                    FCB $8C         Dummy CMPX #XXXX.
0035 0646 A701          A@      STA 1,X         Set the register.
0036 0648 3002                  LEAX 2,X        Bump the pointer.
0037 064A 5A                    DECB            Register done?
0038 064B 26F3                  BNE SUB         Loop till done.
0039 064D 39                    RTS             Return.

                                *
                                * Common Graphics Routine
                                *
0040 064E 8601          SET     LDA #1          A=SET value.
0041 0650 BC                    FCB $8C         Dummy CMPX #XXXX.
0042 0651 8680          RESET   LDA #$80        A=RESET value.
0043 0653 21                    FCB $21         Dummy BRN XX.
0044 0654 4F            POINT   CLRA            A=POINT value.
0045 0655 4D                    TSTA            Set flags for graphics.
0046 0656 3401                  PSHB CC         Save the flags.
0047 0658 F607AC                LDB YVAL        B=Y-value.
004B 065B B607A9                LDA GMODE       A=Mode.
0049 065E 2601                  BNE A@          Jump if mode > 0.
0050 0660 54                    LSRB            B=Number of rows.
0051 0661 CE07D5        A@      LDU #YTAB       Point to row table.
0052 0664 A6C6                  LDA A,U         A=Length of row.
0053 0666 3D                    MUL             D=Row offset.
0054 0667 BE07A7                LDX $TVM        X=Start of video mem.
0055 066A 308B                  LEAX D,X        X=Row address.
0056 066C F607AB                LDB XVAL        B=X-value.
0057 066F CE07E1                LDU #XTAB       Point to column tab.
0058 0672 B607A9                LDA GMODE       A=Mode.
0059 0675 A6C6                  LDA A,U         A=Number of shifts.
0060 0677 54            B@      LSRB            Shift column offset.
0061 0678 4A                    DECA            Shift done?
0062 0679 26FC                  BNE B@          Loop till done.
0063 067B 308B                  LEAX B,X        X=Video memory add.
0064 067D B607A9                LDA GMODE       A=Mode.
0065 0680 CE07ED                LDU #MTAB       Point to mask table.
0066 0683 E6C6                  LDB A,U         B=Starting bit mask.
0067 0685 4D                    TSTA            Is mode > 0?
0068 0686 2611                  BNE D@          Jump if mode > 0.
0069 0688 B607AC                LDA YVAL        A=Y-value.
0070 068B 44                    LSRA            Even or odd?
0071 068C 2402                  BCC C@          Jump if even.
0072 068E 54                    LSRB            Shift bit mask.
0073 068F 54                    LSRB            Shift bit mask.
0074 0690 B607AB        C@      LDA XVAL        A=X-value.
0075 0693 44                    LSRA            Even or odd?
0076 0694 2421                  BCC GRAPH       Jump if even.
0077 0696 54                    LSRB            Shift bit mask.
0078 0697 201E                  BRA GRAPH       Jump.
0079 0699 B004          D@      SUBA #4         Is mode < 4.
0080 069B 25F3                  BLO C@          Jump if mode < 4.
0081 069D 44                    LSRA            Color or resolution?
0082 069E 240B                  BCC F@          Jump if color.
0083 06A0 B607AB                LDA XVAL        A=X-value.
0084 06A3 8407                  ANDA #7         Make it 0 to 7.
0085 06A5 2710          E@      BEQ GRAPH       Jump if done.
0086 06A7 54                    LSRB            Shift bit mask.
0087 06A8 4A                    DECA            Dec number of shifts.
0088 06A9 20FA                  BRA E@          Loop.
0089 06AB B607AB        F@      LDA XVAL        A=X-value.
0090 06AE B403                  ANDA #3         Make it 0 to 3.
0091 06B0 2705          G@      BEQ GRAPH       Jump if done.
0092 06B2 54                    LSRB            Shift bit mask.
0093 06B3 54                    LSRB            Shift bit mask.
0094 06B4 4A                    DECA            Dec number of shifts.
```

Listing continued

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Listing continued

```
0095 06B5 20F9              BRA G@          Loop.

                        *
                        * SET Routine
                        *
0096 06B7 F707AD    GRAPH   STB BMASK       Save bit mask.
0097 06BA 3501              PULS CC         Get flags.
0098 06BC 2B4A              BMI RES1        Jump if RESET.
0099 06BE 2771              BEQ PO11        Jump if POINT.
0100 06C0 B607A9            LDA GMODE       A=Mode.
0101 06C3 8004              SUBA #4         Is mode > 3.
0102 06C5 2427              BCC D@          Jump if mode > 3.
0103 06C7 B607B0            LDA COLOR       A=Color value.
0104 06CA 4A                DECA            Decrement it.
0105 06CB B407              ANDA #7         Make it 0 to 7.
0106 06CD 48                ASLA            Shift color mask.
0107 06CE 48                ASLA            Shift color mask.
0108 06CF 48                ASLA            Shift color mask.
0109 06D0 48                ASLA            Shift color mask.
0110 06D1 3402              PSHS A          Save color mask.
0111 06D3 A684              LDA ,X          A=Video character.
0112 06D5 2B01              BMI A@          Jump if graphic.
0113 06D7 4F                CLRA            Make it graphic.
0114 06D8 840F      A@      ANDA #$0F       Mask the pixels.
0115 06DA AAE0              ORA ,S+         Set the color.
0116 06DC BA07AD            ORA BMASK       Set the pixel.
0117 06DF 8A80              ORA #$80        Make it graphic.
0118 06E1 A784      B@      STA ,X          Display the character.
0119 06E3 39                RTS             Return.
0120 06E4 44        C@      LSRA            Color or resolution?
0121 06E5 2407              BCC D@          Jump if color.
0122 06E7 A684              LDA ,X          A=Video character.
0123 06E9 BA07AD            ORA BMASK       Set the pixel.
0124 06EC 20F3              BRA B@          Jump.
0125 06EE B607AE    D@      LDA FCOL        A=Foreground color.
0126 06F1 4A        RES2    DECA            Decrement it.
0127 06F2 8403              ANDA #3         Make it 0 to 3.
0128 06F4 C655              LDB #$55        B=Color multiplier.
0129 06F6 3D                MUL             B=Color mask.
0130 06F7 F407AD            ANDB BMASK      B=Adjusted bit mask.
0131 06FA 3404              PSHS B          Save bit mask.
0132 06FC 7307AD            COM BMASK       Invert old bit mask.
0133 06FF A684              LDA ,X          A=Video character.
0134 0701 B407AD            ANDA BMASK      Reset the pixel.
0135 0704 AAE0              ORA ,S+         Set the pixel.
0136 0706 20D9              BRA B@          Jump.

                        *
                        * RESET Routine
                        *
0137 0708 B607A9    RES1    LDA GMODE       A=Mode.
0138 070B 8004              SUBA #4         Is mode > 3.
0139 070D 2410              BCC C@          Jump if mode > 3.
0140 070F A684              LDA ,X          A=Video character.
0141 0711 2B01              BMI A@          Jump if graphic.
0142 0713 4F                CLRA            Make if graphic.
0143 0714 7307AD    A@      COM BMASK       Invert bit mask.
0144 0717 B407AD            ANDA BMASK      Reset the pixel.
0145 071A 8A80              ORA #$80        Make it graphic.
0146 071C A784      B@      STA ,X          Display the character.
0147 071E 39                RTS             Return.
0148 071F 44        C@      LSRA            Color or resolution?
0149 0720 2505              BCS D@          Jump if resolution.
0150 0722 B607AF            LDA BCOL        A=Background color.
0151 0725 20CA              BRA RES2        Do SET code.
0152 0727 A684      D@      LDA ,X          A=Video character.
0153 0729 7307AD            COM BMASK       Invert bit mask.
0154 072C B407AD            ANDA BMASK      Reset the pixel.
0155 072F 20EB              BRA B@          Jump.

                        *
                        * POINT Routine
                        *
0156 0731 B607A9    PO11    LDA GMODE       A=Mode.
0157 0734 8004              SUBA #4         Is mode > 3.
0158 0736 2415              BCC C@          Jump if mode > 3.
0159 0738 A684              LDA ,X          A=Video character.
0160 073A 2A0C              BPL A@          Jump if non-graphic.
0161 073C E484              ANDB ,X         Is pixel set?
0162 073E 270B              BEQ B@          Jump if not set.
0163 0740 8470              ANDA #$70       Mask the color value.
0164 0742 44                LSRA            Shift the color value.
0165 0743 44                LSRA            Shift the color value.
0166 0744 44                LSRA            Shift the color value.
0167 0745 44                LSRA            Shift the color value.
0168 0746 4C                INCA            Bump the color value.
0169 0747 8C                FCB $8C         Dummy CMPX #XXXX.
0170 0748 86FF      A@      LDA #-1         A=Non-graphic value.
0171 074A 21                FCB $21         Dummy BRN XX.
0172 074B 4F        B@      CLRA            A=Reset value.
0173 074C 39                RTS             Return.
0174 074D 44        C@      LSRA            Color or resolution?
0175 074E 2407              BCC D@          Jump if color.
0176 0750 F407AD            ANDB BMASK      Set or reset?
0177 0753 26F3              BNE A@          Jump if set.
0178 0755 27F4              BEQ B@          Jump if reset.
0179 0757 E684      D@      LDB ,X          B=Video character.
0180 0759 4F                CLRA            Zero color value.
0181 075A 58        E@      ASLB            Shift color value.
0182 075B 49                ROLA            Shift color value.
0183 075C 58                ASLB            Shift color value.
```

Listing continued

Listing continued

```
0184 075D 49          ROLA          Shift color value.
0185 075E 7807AD      ASL BMASK     Shift bit mask.
0186 0761 7807AD      ASL BMASK     Shift bit mask.
0187 0764 24F4        BCC E@        Loop till done.
0188 0766 8403        ANDA #3       Make it @ to 3.
0189 0768 4C          INCA          Bump color value.
0190 @769 39          RTS           Return.

                      *
                      * Clear Screen Routine
                      *
0191 076A B607A9      CLS   LDA GMODE     A=Mode.
0192 076D 8004              SUBA #4       Is mode >3?
0193 076F 2413              BCC B@        Jump if mode > 3.
0194 0771 B607B0            LDA COLOR     A=Color value.
0195 0774 270A              BEQ A@        Jump if color = 0.
0196 0776 4A                DECA          Decrement color value.
0197 @777 8407              ANDA #7       Make it 0 to 7.
0198 0779 48                ASLA          Shift color mask.
0199 077A 48                ASLA          Shift color mask.
0200 077B 48                ASLA          Shift color mask.
0201 077C 48                ASLA          Shift color mask.
0202 077D 8A8F              ORA #$8F      Set all pixels.
0203 077F 8C                FCB $8C       Dummy CMPX #XXXX.
0204 0780 8680        A@    LDA #$80      A=Blank character.
0205 07B2 2010              BRA D@        Jump.
0206 0784 44          B@    LSRA          Color or resolution?
0207 0785 2407              BCC C@        Jump if color.
0208 0787 B607B0            LDA COLOR     A=Color value.
0209 078A 8401              ANDA #1       Make it @ to 1.
0210 078C 2006              BRA D@        Jump.
@211 078E B607AF      C@    LDA BCOL      A=Background color.
0212 0791 C655              LDB #$55      B=Color multiplier.
@213 @793 3D                MUL           B=Color value.
0214 0794 F607A9      D@    LDB GMODE     B=Mode.
0215 0797 58                ASLB          B=Table offset.
0216 0798 8E07F9            LDX #CTAB     Point to length tab.
0217 079B AE85              LDX B,X       X=Video length.
0218 079D FE07A7            LDU STVM      U=Start of video mem.
0219 07A0 A7C0        E@    STA ,U+       Display the char.
0220 07A2 301F              LEAX -1,X     Done?
@221 07A4 26FA              BNE E@        Loop till done.
0222 07A6 39                RTS           Return.

                      *
                      * Variable Storage
                      *
0223 07A7 000@        STVM  FDB @
0224 07A9 00          GMODE FCB 0
0225 07AA 00          CSET  FCB 0
@226 07AB @0          XVAL  FCB @
0227 07AC 0@          YVAL  FCB 0
@228 @7AD 00          BMASK FCB 0
0229 07AE 00          FCOL  FCB 0
0230 07AF 0@          BCOL  FCB 0
0231 07B0 00          COLOR FCB 0

                      *
                      * Initialization Table
                      *
0232 07B1 000008      GTAB  FCB 0,0,8
0233 @7B4 020000            FCB 2,0,0
0234 07B7 040000            FCB 4,0,0
@235 07BA 060000            FCB 6,0,0
0236 07BD 01B0B8            FCB 1,128,136
@237 07C0 019@98            FCB 1,144,152
0238 07C3 02A0A8            FCB 2,160,168
0239 07C6 03B0B8            FCB 3,176,184
0240 07C9 04C0C8            FCB 4,192,2@0
@241 07CC 05D0D8            FCB 5,208,216
0242 07CF 06E0E8            FCB 6,224,232
0243 07D2 06F0F8            FCB 6,240,248

                      *
                      * Length of Row Table
                      *
0244 07D5 2020202010  YTAB  FCB 32,32,32,32,16,16
0245 07DB 2010201020        FCB 32,16,32,16,32,32

                      *
                      * Column Shift Table
                      *
0246 07E1 0101010102  XTAB  FCB 1,1,1,1,2,3,2,3
0247 07E9 02030203          FCB 2,3,2,3

                      *
                      * Bit Mask Table
                      *
@248 07ED 080A0A0AC0  MTAB  FCB 8,10,10,10,$C0,$80
@249 @7F3 C080C080C0        FCB $C0,$80,$C0,$80,$C0,$80

                      *
                      * Video Length Table
                      *
0250 07F9 020008@00C  CTAB  FDB 512,2048,3@72,6144
0251 0801 0400040008        FDB 1024,1024,2@48,1536,3072
0252 080B 0C00180018        FDB 3072,6144,6144
0253 0811                   END

BCOL   07AF  BMASK  07AD  CLS    @76A  COLOR  07B0
CSET   07AA  CTAB   07F9  FCOL   07AE  GMODE  07A9
GRAPH  @6B7  GTAB   07B1  INIT   0600  MTAB   07ED
P011   0731  POINT  0654  RES1   0708  RES2   06F1
RESET  @651  SET    064E  STVM   07A7  SUB    0640
XTAB   07E1  XVAL   07AB  YTAB   07D5  YVAL   07AC
```


✓See List of Advertisers on page 130

BY JAMES W. WOOD

REUSE THOSE ROUTINES

Save time by using routines from one program as parts of another. Three programs show how.

After spending the time to develop a routine, I like to use it in several programs. Careful analysis of the three program listings in this article reveals that lines 120–220 are identical in each. These lines create graphic strings to display the digits 0 through 9.

When reading the listings, think of C$ as colored sections and D$ as dark. The numbers are displayed much like the readout of an LED or LCD. They have a height equal to five PRINT@ positions and a width of three PRINT@ positions. The display is achieved more quickly by strings than would be possible by using SET or POKE. Strings that are all three characters long take the same time to print. Thus, they are better for Clock (Pro-

System Requirements

4K RAM
Color Basic

```
10 CLS:D$=CHR$(128)
20 PRINT"CLOCK PROGRAM"
30 PRINT"COLOR DESIRED"
40 PRINT"  GREEN=1    YELLOW=2"
50 PRINT"    BLUE=3       RED=4"
60 PRINT"    BUFF=5      CYAN=6"
70 PRINT"MAGENTA=7    ORANGE=8":P
RINT:PRINT" TYPE NUMBER (1-8)"
80 A$=INKEY$:IFA$=""THEN80
90 IF ASC(A$)<49 OR ASC(A$)>56 T
HEN80
100 CLS:PRINT:PRINT
110 C$=CHR$(127+16*VAL(A$))
120 T$=D$+D$+C$:W$=C$+D$+D$:X$=C
$+D$+C$:Z$=C$+C$+C$
130 A$(0,1)=Z$:A$(0,2)=X$:A$(0,3
)=X$:A$(0,4)=X$:A$(0,5)=Z$
140 A$(1,1)=T$:A$(1,2)=T$:A$(1,3
)=T$:A$(1,4)=T$:A$(1,5)=T$
150 A$(2,1)=Z$:A$(2,2)=T$:A$(2,3
)=Z$:A$(2,4)=W$:A$(2,5)=Z$
160 A$(3,1)=Z$:A$(3,2)=T$:A$(3,3
)=Z$:A$(3,4)=T$:A$(3,5)=Z$
170 A$(4,1)=X$:A$(4,2)=X$:A$(4,3
)=Z$:A$(4,4)=T$:A$(4,5)=T$
180 A$(5,1)=Z$:A$(5,2)=W$:A$(5,3
)=Z$:A$(5,4)=T$:A$(5,5)=Z$
190 A$(6,1)=Z$:A$(6,2)=W$:A$(6,3
)=Z$:A$(6,4)=X$:A$(6,5)=Z$
200 A$(7,1)=Z$:A$(7,2)=T$:A$(7,3
)=T$:A$(7,4)=T$:A$(7,5)=T$
210 A$(8,1)=Z$:A$(8,2)=X$:A$(8,3
)=Z$:A$(8,4)=X$:A$(8,5)=Z$
220 A$(9,1)=Z$:A$(9,2)=X$:A$(9,3
)=Z$:A$(9,4)=T$:A$(9,5)=T$
230 INPUT"HOUR";H
240 INPUT"MINUTE";M
250 INPUT"SECOND";S
260 CLS0
270 PRINT@202,C$;:PRINT@266,C$;:
PRINT@212,C$;:PRINT@276,C$;
280 FORTI=1TO70:NEXTTI:S=S+1
290 IF S>59 THEN S=0:M=M+1
300 IF M>59 THEN M=0:H=H+1
310 IF H>23 THENH=0
320 M1=VAL(RIGHT$(STR$(M),1)):M2
=(M-M1)/10
330 H1=VAL(RIGHT$(STR$(H),1)):H2
=(H-H1)/10
340 S1=VAL(RIGHT$(STR$(S),1)):S2
=(S-S1)/10
350 N=0:FORP=162TO290STEP32:N=N+
1:PRINT@P+4,A$(H1,N);:PRINT@P,A$
(H2,N);:NEXTP
360 N=0:FORP=172TO300STEP32:N=N+
1:PRINT@P+4,A$(M1,N);:PRINT@P,A$
(M2,N);:NEXTP
370 N=0:FORP=182TO310STEP32:N=N+
1:PRINT@P+4,A$(S1,N);:PRINT@P,A$
(S2,N);:NEXTP
380 GOTO280
```

Program Listing 1. Clock

READ THE FINE PRINT.
It's worth your time. This is good stuff.

SYSTEMS SOFTWARE

MACRO-80C

This is a **disk-based editor, macro assembler and monitor**, written for Color Computer by Andy Phelps. THIS IS IT — The ultimate programming tool!

The powerful 2-pass macro assembler features conditional assembly, local labels, include files and cross referenced symbol tables. MACRO-80C supports the complete Motorola 6809 instruction set in standard source format. There are no changes, constraints or shortcuts in the source language definition. Incorporating all of the features of our Rompack-based assembler (SDS80C), MACRO-80C contains many more useful instructions and pseudo-ops which aid the programmer and add power and flexibility.

The screen-oriented text editor is designed for efficient and easy editing of assembly language programs. The "Help Key" feature makes it simple and fun to learn to use the editor. As the editor requires no line numbers, you can use the arrow keys to position the cursor anywhere in the file. MACRO-80C allows global changes and moving/copying blocks of text. You can edit lines of assembly source which are longer than 32 characters.

DCBUG is a machine language monitor which allows examining and altering of memory, setting break points, etc.

The editor, assembler and monitor — as well as sample programs — come on one Radio Shack compatible disk. Extensive documentation included. **MACRO-80C Price: $99.95**

SOFTWARE DEVELOPMENT SYSTEM

The Micro Works Software Development System (SDS80C) is a complete 6809 editor, assembler and monitor package contained in one Color Computer program pack! Vastly superior to RAM-based assemblers/editors, the SDS80C is non-volatile, meaning that if your application program bombs, it can't destroy your editor/assembler. Plus it leaves almost all of 16K or 32K RAM free for **your** program. Since all three programs, editor, assembler and monitor are co-resident, we eliminate tedious program loading when going back and forth from editing to assembly and debugging!

The powerful screen-oriented Editor features finds, changes, moves, copys and much more. All keys have convenient auto repeat (typamatic), and since no line numbers are required, the full width of the screen may be used to generate well commented code.

The Assembler features **all** of the following: complete 6809 instruction set; conditional assembly; local labels; assembly to cassette tape or to memory; listing to screen or printer; and mnemonic error codes instead of numbers.

The versatile monitor is tailored for debugging programs generated by the Assembler and Editor. It features examine/change of memory or registers, cassette load and save, breakpoints and more. **SDS80C Price: $89.95**

MICRO WORKS COLOR FORTH

- Forth is faster to program in than Basic
- Forth is easier to learn than Assembly Language
- Forth executes in less time than Basic

Forth is a highly interactive language like Basic, with structure like Pascal and execution speed close to that of Assembly Language. The Micro Works Color Forth is a Rompack containing everything you need to run Forth on your Color Computer.

Color Forth consists of the standard FORTH Interest Group (FIG) implementation of the language plus most of FORTH-79. It has a super screen editor with split screen display. Mass storage is on cassette. Color Forth also contains a decompiler and other aids for learning the inner workings of this fascinating language. It will run on 4K, 16K, and 32K computers. Color Forth contains 10K of ROM, leaving *your* RAM for *your* programs! There are simple words to effectively use the Hi-Res Color Computer graphics, joysticks, and sound. The 112-page manual includes a glossary of the system-specific words, a full standard FIG glossary and complete source listing. COLOR FORTH ... THE BEST! From the leader in Forth, Talbot Microsystems. **Price: $109.95**

MICROTEXT: COMMUNICATIONS VIA YOUR MODEM!

Make your Color Computer an intelligent printing terminal with off-line storage! The Microtext module is just what you'll need for:

- Talking to a timeshare system or information service
- Printing out what is received as it is received
- Saving received text to cassette tape
- Re-displaying the received text even while on-line
- Communications with other computers
- Using your computer as a general-purpose 300-baud terminal
- Downloading programs from other computers

The Microtext module is a program pack containing not only firmware but a second serial port so that both your printer and modem can be connected at the same time. Microtext can be configured for any serial printer that will work with the Color Computer, even if it requires line feeds! But even if you don't have a printer, you can keep a permanent copy of your data by storing to cassette tape. Also, any Radio Shack/Centronics-compatible parallel printer may be used by adding the Micro Works' PI80C parallel interface.

For those of you with special terminal applications, Microtext has selectable parity; it sends odd, even, mark or space. With mark parity (which is default) you can send to computers requiring either seven or eight bits. All 128 ASCII codes can be sent. Exchange programs with other Color Computer users! Basic programs may be downloaded from other computers or timesharing systems.

You'll find many uses for this versatile module! Available in ROMPACK, ready-to-use, for **$59.95.**

MACHINE LANGUAGE

MONITOR TAPE: A cassette tape which allows you to directly access memory, I/O and registers with a formatted hex display. Great for machine language programming, debugging and learning. It can also send/receive RS232 at up to 9600 baud, including host system download/upload. 19 commands in all. Relocatable and reentrant. **CBUG Tape Price: $29.95**

MONITOR ROM: The same program as above, supplied in 2716 EPROM. This allows you to use the entire RAM space. And you don't need to re-load the monitor each time you use it. The EPROM plugs into the Extended Basic ROM Socket or the Romless Pak I. **CBUG ROM Price: $39.95**

SOURCE GENERATOR: This package is a disassembler which runs on the color computer and generates your own source listing of the BASIC interpreter ROM. Also included is a documentation package which gives useful ROM entry points, complete memory map, I/O hardware details and more. A 16K system is required for the use of this cassette. **80C Disassembler Price: $49.95**

BOOKS

6809 Assembly Language Programming, by Lance Leventhal, **$16.95**

TRS-80 Color Computer Graphics, by Don Inman, **$14.95**

Assembly Languege Graphics for the TRS-80 Color Computer, by Don Inman, **$14.95**

Starting Forth, by L. Brodie, **$19.95**

GAMES

Star Blaster — Blast your way through an asteroid field in this action-packed HI-Res graphics game. Available in ROMPACK; requires 16K. **Price: $39.95**

Pac Attack — Try your hand at this challenging game by Computerware, with fantastic graphics, sound and action! Cassette requires 16K. **Price: $24.95**

Haywire — Have fun zapping robots with this HI-Res game by Mark Data Products. Cassette requires 16K. **$24.95**

Dunkey Munkey — Arcade excitement awaits those who dare to conquer the Munkey! Joystick and 32K required, by Intellectronics. Cassette: **$24.95**

Colorpede — Great graphics, two-player option, and pause control in this exciting game by Intracolor Communication. Cassette requires 16K: **$29.95**

Adventure — *Black Sanctum* and *Calixto Island* by Mark Data Products. Each cassette requires 16K: **$19.95** each.

Cave Hunter — Experience vivid colors, bizarre sounds and eerie creatures in hot pursuit as you wind your way through a cave maze in search of gold treasures. This exciting HI-Res game by Mark Data Products requires 16K for cassette version. **$24.95**

Starfire — Fly around the planet defending Earthlings from being snatched up by aliens in this challenging game from Intellectronics. Cassette requires 16K: **$21.95**

Doodle Bug — Joystick-controlled Doodle Bugs must move quickly through mazes while being chased by enemy bugs in Hi-Res game by Computerware. Cassette requires 16K: **$24.95**

Astro Blast — You'll need to act fast as you protect Earth from wave after wave of alien invaders in this HI-Res game by Mark Data. Cassette requires 16K: **$24.95**

HARDWARE

PARALLEL PRINTER INTERFACE — Serial to parallel converter allows use of all standard parallel printers. PI80C plugs into the serial output port, leaving your Rompack slot free. You supply the printer cable. **PI80C Price: $69.95**

MEMORY UPGRADE KITS: Consisting of 4116 200ns., integrated circuits, with instructions for installation. **4K-16K Kit Price: $39.95. 16K-32K Kit** (requires soldering experience) **Price: $39.95.** For Rev. level E, ET, NC and TDP-100s, we carry 64K chips; upgrading is easy! Eight prime **64K chips** and instructions: **$64.95**

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gram Listing 1) in terms of keeping time.

These numbers are used in Clock as a digital display of the time, in Math (Program Listing 2) as numbers to add, and in Spanish (Program Listing 3) as numbers for which you are to type the Spanish equivalents. Line 120 creates the necessary combination of colored and dark graphic blocks for the graphic numbers. These combinations are used in lines 130–220 to place the strings into

```
10 CLS:D$=CHR$(128):DIMN$(4),M$(
19):C$=CHR$(255)
120 T$=D$+D$+C$:W$=C$+D$+D$:X$=C
$+D$+C$:Z$=C$+C$+C$
130 A$(0,1)=Z$:A$(0,2)=X$:A$(0,3
)=X$:A$(0,4)=X$:A$(0,5)=Z$
140 A$(1,1)=T$:A$(1,2)=T$:A$(1,3
)=T$:A$(1,4)=T$:A$(1,5)=T$
150 A$(2,1)=Z$:A$(2,2)=T$:A$(2,3
)=Z$:A$(2,4)=W$:A$(2,5)=Z$
160 A$(3,1)=Z$:A$(3,2)=T$:A$(3,3
)=Z$:A$(3,4)=T$:A$(3,5)=Z$
170 A$(4,1)=X$:A$(4,2)=X$:A$(4,3
)=Z$:A$(4,4)=T$:A$(4,5)=T$
180 A$(5,1)=Z$:A$(5,2)=W$:A$(5,3
)=Z$:A$(5,4)=T$:A$(5,5)=Z$
190 A$(6,1)=Z$:A$(6,2)=W$:A$(6,3
)=Z$:A$(6,4)=X$:A$(6,5)=Z$
200 A$(7,1)=Z$:A$(7,2)=T$:A$(7,3
)=T$:A$(7,4)=T$:A$(7,5)=T$
210 A$(8,1)=Z$:A$(8,2)=X$:A$(8,3
)=Z$:A$(8,4)=X$:A$(8,5)=Z$
220 A$(9,1)=Z$:A$(9,2)=X$:A$(9,3
)=Z$:A$(9,4)=T$:A$(9,5)=T$
230 DATA UNO,DOS,TRES,CUATRO,CIN
CO,SEIS,SIETE,OCHO,NUEVE,DIEZ,ON
CE,DOCE,TRECE,CATORCE,QUINCE,DIE
CISEIS,DIECISIETE,DIECIOCHO,DIEC
INUEVE
240 DATA DIEZ Y SEIS,DIEZ Y SIET
E,DIEZ Y OCHO,DIEZ Y NUEVE,VEINT
E
250 FORI=1TO19:READM$(I):NEXTI
260 FORI=16TO20:READN$(I-16):NEX
TI
270 NN=RND(20):N1=INT(NN/10):N2=
NN-N1*10:CLS0
280 IFN1=0THEN290 ELSE N=0:FORP=
141TO269STEP32:N=N+1:PRINT@P,A$(
N1,N);:NEXTP
290 N=0:FORP=145TO273STEP32:N=N+
1:PRINT@P,A$(N2,N);:NEXTP
300 PRINT@320,"TYPE SPANISH":INP
UTAN$
310 IFNN<16THENIFAN$=M$(NN)THEN3
60ELSEPRINT"IT IS ";M$(NN):GOTO3
40
320 IFNN<20THENIFAN$=M$(NN)ORAN$
=N$(NN-16)THEN360ELSEPRINT"IT IS
 ";M$(NN);" OR ";N$(NN-16):GOTO3
40
330 IFNN=20THENIFAN$=N$(4)THEN36
0ELSEPRINT"IT IS ";N$(4)
340 PRINT@480,"PRESS <SPACE BAR>
 FOR NEXT ONE";
350 IFPEEK(345)<>247THEN350ELSE2
70
360 PRINT"CORRECT":GOTO340
```

Program Listing 2. Math

```
10 CLS:D$=CHR$(128)
20 C$=CHR$(255):ST$="":FORI=1TO1
2:ST$=ST$+C$:NEXTI
120 T$=D$+D$+C$:W$=C$+D$+D$:X$=C
$+D$+C$:Z$=C$+C$+C$
130 A$(0,1)=Z$:A$(0,2)=X$:A$(0,3
)=X$:A$(0,4)=X$:A$(0,5)=Z$
140 A$(1,1)=T$:A$(1,2)=T$:A$(1,3
)=T$:A$(1,4)=T$:A$(1,5)=T$
150 A$(2,1)=Z$:A$(2,2)=T$:A$(2,3
)=Z$:A$(2,4)=W$:A$(2,5)=Z$
160 A$(3,1)=Z$:A$(3,2)=T$:A$(3,3
)=Z$:A$(3,4)=T$:A$(3,5)=Z$
170 A$(4,1)=X$:A$(4,2)=X$:A$(4,3
)=Z$:A$(4,4)=T$:A$(4,5)=T$
180 A$(5,1)=Z$:A$(5,2)=W$:A$(5,3
)=Z$:A$(5,4)=T$:A$(5,5)=Z$
190 A$(6,1)=Z$:A$(6,2)=W$:A$(6,3
)=Z$:A$(6,4)=X$:A$(6,5)=Z$
200 A$(7,1)=Z$:A$(7,2)=T$:A$(7,3
)=T$:A$(7,4)=T$:A$(7,5)=T$
210 A$(8,1)=Z$:A$(8,2)=X$:A$(8,3
)=Z$:A$(8,4)=X$:A$(8,5)=Z$
220 A$(9,1)=Z$:A$(9,2)=X$:A$(9,3
)=Z$:A$(9,4)=T$:A$(9,5)=T$
230 M=RND(499):NN=RND(499)
240 M1=INT(M/100):N1=INT(NN/100)
250 M2=INT((M-M1*100)/10)
260 N2=INT((NN-N1*100)/10)
270 M3=M-M1*100-M2*10
280 N3=NN-N1*100-N2*10:CLS0
290 N=0:FORI=12TO140STEP32:N=N+1
:PRINT@I,A$(M1,N);:PRINT@I+4,A$(
M2,N);:PRINT@I+8,A$(M3,N);:NEXTI
300 N=0:FORI=204TO332STEP32:N=N+
1:PRINT@I,A$(N1,N);:PRINT@I+4,A$
(N2,N);:PRINT@I+8,A$(N3,N);:NEXT
I
310 PRINT@396,ST$;
320 PRINT@263,C$+C$+C$;:PRINT@29
6,C$;:PRINT@232,C$;
330 TT$="":FORI=502TO494STEP-4:P
RINT@I,CHR$(126);
340 AN$=INKEY$:IFAN$=""THEN340
350 PRINT@I-32,AN$;
360 PRINT@I,CHR$(128);:TT$=TT$+A
N$:NEXTI
370 TP$="":FOR I=3 TO 1STEP-1:TP
$=TP$+MID$(TT$,I,1):NEXTI:TP=VAL
(TP$)
380 IF TP=M+NN THEN PRINT@128,"C
ORRECT";:ELSEPRINT@128,"SORRY";:
PRINT@161,"IT IS";M+NN;
390 PRINT@480,"PRESS <SPACE BAR>
 TO CONTINUE";
400 KK$=INKEY$:IFKK$<>" "THEN400
ELSE230
```

Program Listing 3. Spanish

an array. The array A$(number,row) is used to store the strings.

A number in the tens or hundreds must be broken down into its individual digits. In Math the variables M and N are two numbers to add. Lines 240–270 separate M into M1, M2, and M3, which represent the hundreds, tens, and ones, respectively. N is broken down similarly. Line 290 displays the digits for M1, M2, and M3. The other programs display the numbers by the same method.

A few comments about each program: Lines 330–360 of Math allow you to answer an addition problem from right to left so that pencil and paper are not necessary. Spanish lets you answer the numbers 16–19 by either of the two correct responses. The FOR loop in line 280 controls the speed of Clock.

With a 16K computer you could add frills to each program. Spanish could include more numbers and Spanish comments. Math could provide help for wrong answers. Clock might be given an alarm feature. ■

Address correspondence to James Wood, 424 N. Missouri, Atwood, IL 61913.

✓See List of Advertisers on page 130

BY LARRY LANDWEHR

READ THE KEYBOARD IN ASSEMBLY

Writing your own fast-paced arcade game requires Assembly-language programming, but getting your programs to understand keyboard functions is a problem in Assembly-language. PEEKing at the memory locations given in the article by Steve Saisi (*80 Micro*, March 1983, p. 278) is only useful from a Basic program.

The Basic monitor located in the computer's ROM sets these memory locations when you press a key. Using Radio Shack's EDTASM + or a similar product with its own monitor deactivates this Basic monitor. Therefore, the solution to translating keyboard commands is a small chart and a simple algorithm.

Programming in Assembly language? These two steps will enable your programs to read the keyboard.

Inside the Color Computer there are some integrated-circuit chips called peripheral-interface adapters (PIAs). PIA U8 interfaces the keyboard with the rest of the computer. The program can read the keyboard through this PIA if you perform two steps. First store a number in location 65282 (FF02 in hexadecimal). Then read location 65280 (FF00 in hex). Table 1 shows the numbers to use.

For example, to show the program that you're pressing the M key, store 233 in location FF02 (65282 decimal) and check to see if location FF00 (65280 decimal) contains 253. If it does, then the CoCo knows that you've pressed the M key. That is it. Now your program can read the keyboard for your games.

Program Listing 1 is an Assembly program that fills the screen with a less-than sign or a greater-than sign depending on whether you've pressed the left or the right arrow key, respectively. The

System Requirements

16K RAM
Editor/Assembler

	(X)							
	254	253	251	247	239	223	191	127
254	@	A	B	C	D	E	F	G
253	H	I	J	K	L	M	N	O
251	P	Q	R	S	T	U	V	W
247	X	Y	Z	UP	DWN	LFT	RT	SPC
(Y) 247	0	1	2	3	4	5	6	7
239	8	9	:	;	,	-	.	/
223	ENT	CLR						

```
LDB #X
STB $FF02
LDA $FF00
CMPA #Y
```

Table 1. Numbers to Store in Memory Locations

```
          ORG     9000
*READ KEYBOARD
*LEFT ARROW
START     LDB     #$DF
          STB     $FF02
          LDA     $FF00
          CMPA    #$F7
          BEQ     LEFT
*RIGHT ARROW?
          LDB     #$BF
          STB     $FF02
          LDA     $FF00
          CMPA    #$F7
          BEQ     RIGHT
*SPACE BAR?
          LDB     #$7F
          STB     $FF02
          LDA     $FF00
          CMPA    #$F7
          BEQ     EXIT
*READ KEYBOARD AGAIN
          BRA     START
*LOAD A "<" CHARACTER
LEFT      LDB     #60
          BRA     FILL
*LOAD A ">" CHARACTER
RIGHT     LDB     #62
*FILL THE SCREEN WITH A
*CHARACTER
FILL      LDX     #$400
LOOP      STB     ,X+
          CMPX    #$5FF
          BNE     LOOP
*READ KEYBOARD AGAIN
          BRA     START
*HALT PROGRAM
EXIT      SWI
          END
```

Program Listing. An Assembly Program that Can Read the Keyboard

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program consists of an infinite loop that checks to see if you've pressed the left or right arrow or the space bar. If you've pressed the space bar, the program halts. Pressing an arrow key loads a < or > into video memory.

Why does this method work? The keyboard is wired as a matrix of eight columns and eight rows. Loading location FF02 strobes a keyboard column.

The series 254, 253, 251 is 1111110, 11111101, 11111011 in binary—the position of the zero bit determines the column. Reading location FF00 reads the keyboard rows. The intersection of row and column uniquely identifies a key.

Information on PIAs can be found in Radio Shack's Color Computer service manual, but be warned that the book is rather technical and oriented toward hardware applications.

In any event, have fun with the information presented here and send me a copy of your new game. ■

Address correspondence to Larry Landwehr, P.O. Box 266, Madison, WI 53701.

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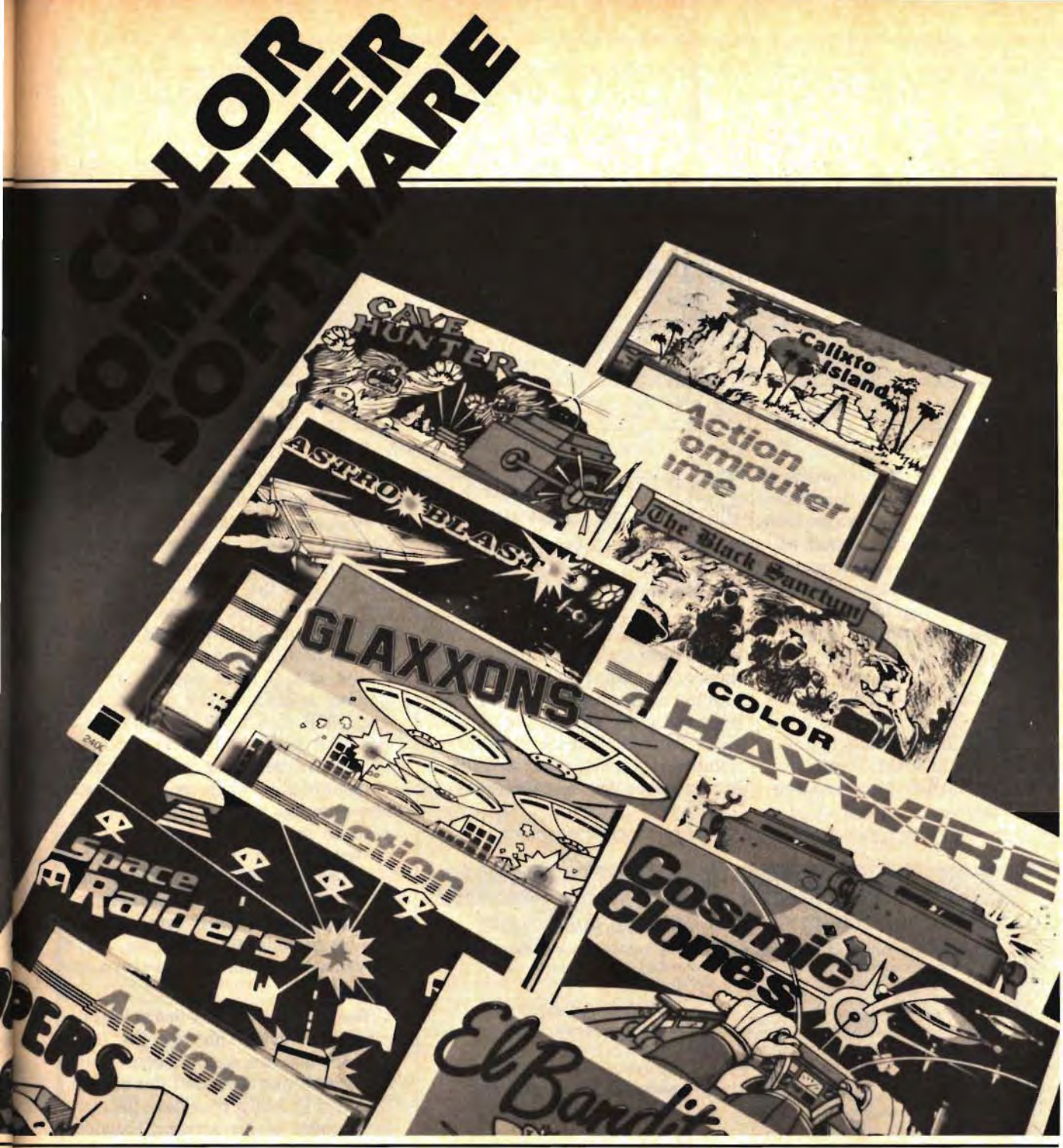

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BY HENRY C. GRACE

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This home-finance program illustrates an innovative method of reorganizing a program during run time.

Background

To understand how this program works, you must understand the structure of any Basic program that the interpreter stores in RAM. Memory locations 25 and 26 (hex 19 and 1A) combine to form a pointer to the starting address of the Basic program. This makes location of the program a simple matter of reading the address. In Extended Color Basic this address varies with the number of graphics pages set aside. Also, remember that the 6809E stores the most-significant byte (MSB) first and the least-significant byte (LSB) last.

Beginning at the starting address, the first 2 bytes in a Basic program form another address pointer. This pointer, which heads the first line in the program, indicates the address of the second program line (see Table 1). I call this the next-line indicator.

The next 2 bytes contain the line number assigned to the first program line (MSB then LSB). The interpreter positions program lines in ascending numerical order, using this line number.

Incidentally, when the interpreter scans through the program later, it expects to find the line numbers still in proper sequence. A byte containing hex 00 marks the end of a program line. You can see, therefore, that a typical program line requires 5 bytes of RAM just for administrative purposes. This is why multistatement lines save on memory use.

The structure of every line in the program is identical to line one. The Basic code for that line is stored between the line number and the end-of-line marker. Franklyn D. Miller provides a listing of these codes in his article "Extended Color Basic" (*80 Micro*, June/July 1982, p. 266).

In summary, each Basic command has a corresponding hex code of up to 3 bytes, which the interpreter stores in RAM. Along with the hex version of ASCII code for alphanumeric characters, these codes form the contents of

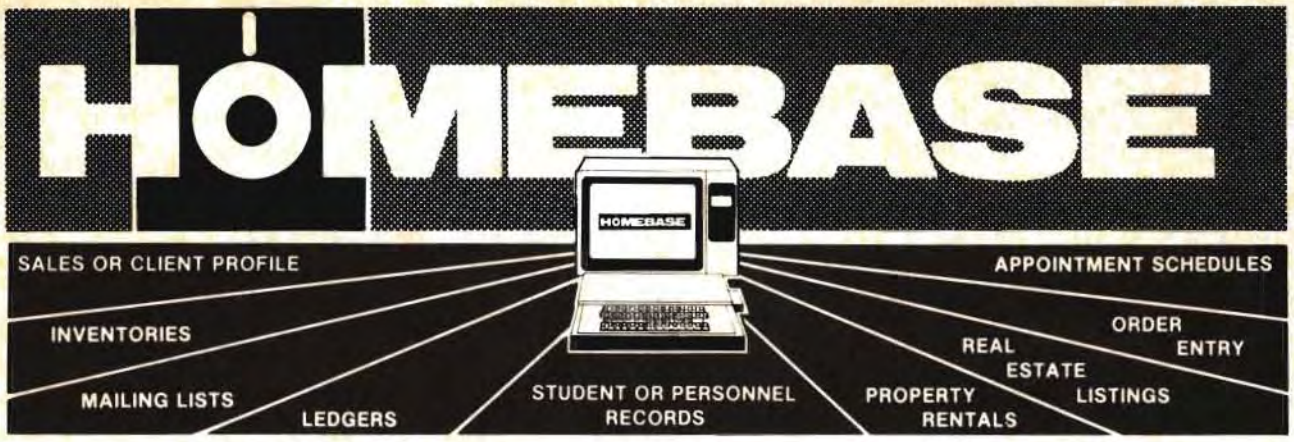
Address	Contents	Comments
:	:	
19	1E	Start-of-program address pointer
1A	01	
1B	1E	Start-of-variable table address pointer
1C	20	
:	:	
1F	1E	End-of-variable table address pointer
20	30	
:	:	
1E01	1E	Start-of-program line 1
1E02	10	Points to line 2, "next line"
1E03	00	Line No. 10
1E04	1A	
:	:	Hex program code
1E0F	00	End-of-line No. 10
1E10	1E	"Next-line" address
1E1A	1E	
1E1B	00	Line No. 20
1E1C	14	
:	:	Hex program code
1E1D	00	End-of-line No. 20
1E1E	00	End-of-program marker
1E1F	00	
1E20	45	Start-of-variable table
:	:	Table
1E30	45	End-of-variable table

Table 1. Program Structure—Extended Color Basic (PCLEAR 4)

System Requirements

16K RAM

Extended Color Basic



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Program Listing. Check and Budget Control

```
10 REM* CHECK AND BUDGET CONTROL
 *
20 REM* BY HENRY C. GRACE,JR. *
30 REM* 6 JUNE, 1982 *
40 REM
50 REM* MOVE VARIABLE TABLE TO H
IGH MEMORY *
60 POKE 27,112:POKE 28,00
70 CLS:CLEAR 200:PCLEAR 4
80 PRINT@37,"HOME FINANCES , 198
2"
90 PRINT@96,"YOU CAN ADD CHECKS,
 AND THE     PROGRAM WILL STORE
THEM AS DATA LINES AT THE END OF
 THE PROGRAM."
100 PRINT@224,"YOU CAN OBTAIN A
REPORT ON      BUDGETS BY CATEGO
RY, FOR ANY    MONTH OR TOTAL TO
 DATE."
110 PRINT@354,"PRESS <ENTER> TO
CONTINUE":INPUT Z$:CLS
120 PRINT@40,"SELECT A NUMBER"
130 PRINT@100,"1 ADD CHECKS"
140 PRINT@132,"2 REPORT MENU"
150 PRINT@200,"THEN <ENTER>":INP
UT Z
160 IF Z<1 OR Z>2 THEN PRINT "IN
VALID NO., ENTER ANOTHER" ELSE 1
80
170 GOTO 120
180 IF Z=1 THEN GOSUB4500
190 REM
200 REM* DEFINE MONTH AND BUDGET
 CATEGORY ARRAYS *
210 DIM C$(20),M$(12),T(20):CN=0
:F$="$$#####.##"
220 M$(1)="JAN":M$(2)="FEB":M$(3
)="MAR":M$(4)="APR":M$(5)="MAY":
M$(6)="JUN"
230 M$(7)="JUL":M$(8)="AUG":M$(9
)="SEP":M$(10)="OCT":M$(11)="NOV
":M$(12)="DEC"
240 C$(0)="ALL TOTALLED"
250 C$(1)="CASH"
260 C$(2)="GROCERY"
270 C$(3)="CHURCH"
280 C$(4)="MED/DENT"
290 C$(5)="PHARMACY"
300 C$(6)="HOUSE NOTE"
310 C$(7)="CAR NOTE & EXP."
320 C$(8)="INSURANCE"
330 C$(9)="INDIVIDUALS"
340 C$(10)="POWER CO."
350 C$(11)="PHONE CO."
360 C$(12)="WATER CO."
370 C$(13)="CABLE TV"
380 C$(14)="CLOTHES"
390 C$(15)="MASTERCHARGE"
400 C$(16)="SCHOOL TUITION"
410 C$(17)="GIFTS TO INDIV."
420 C$(18)="CHARITY/TAX DED."
430 C$(19)="RS,5&10,HDWE,ETC"
440 C$(20)="OTHERS"
1000 REM* REPORT MENU *
1010 CLS:PRINT@40,"SELECT A NO."
1020 PRINT@100,"1 SINGLE MONTH R
EPORT"
1030 PRINT@132,"2 TOTAL TO DATE
REPORT"
1035 PRINT@164,"3 ADD CHECKS"
1040 PRINT@196,"4 END"
1050 PRINT@228,"THEN <ENTER>":IN
PUT Z
1060 FOR I=0 TO 20:T(I)=0:NEXT
1070 ON Z GOSUB 2000,3000,4500,4
000:GOTO 1010
1980 REM
1990 REM* MONTH REPORT SUBROUTIN
E *
2000 CLS:PRINT@33,"ENTER MONTH N
O.":INPUT M1
2010 RESTORE:PRINT@97,"ENTER BUD
GET CODE (ENTER 21 FOR ALL)":INP
UT C1:IF C1<22 AND C1>=0 THEN 20
30
2020 PRINT"TRY AGAIN...":GOTO 20
10
2030 READ CN
2040 IF CN=-1 THEN 2090
2045 READ M,AM,C
2050 IF C1=21 THEN 2080
2060 IF C=C1 AND M=M1 THEN 2070
ELSE 2030
2070 T(0)=T(0)+AM:T(C)=T(C)+AM:G
OTO 2030
2080 IF M=M1 THEN 2070 ELSE 2030
2090 IF C1=21 THEN 2200
2100 CLS:PRINT@97,M$(M1):PRINT:P
RINT USING F$;T(C1);:PRINT C$(C1
):GOTO 2230
2200 I1=0:I2=10
2210 CLS:PRINT@15,M$(M1):PRINT:F
OR I=I1 TO I2:PRINT USING F$;T(I
);:PRINT "  ";:PRINT C$(I):NEXT:
IF I1=11 THEN 2230
2220 INPUT"ENTER FOR LAST 10";Z$
:I1=11:I2=20:GOTO 2210
2230 INPUT"<ENTER> WHEN DONE";Z$
:RETURN
2980 REM
2990 REM* TOTAL REPORT SUBROUTIN
E *
3000 CLS
3010 RESTORE:PRINT@33,"ENTER BUD
GET CODE NO. (ENTER 21 FOR ALL)"
:INPUT C1:IF C1<22 AND C1>=0 THE
N3030
3020 PRINT"TRY AGAIN...":GOTO 30
10
3030 READ CN
```

Listing continued

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Listing continued

```
3040 IF CN=-1 THEN 3060
3045 READ M,AM,C
3050 T(0)=T(0)+AM:T(C)=T(C)+AM:G
OTO 3030
3060 IF C1=21 THEN 3080
3070 CLS:PRINT@33,"TOTAL FOR YEA
R TO DATE":PRINT:PRINT USING F$;
T(C1);:PRINT"  ";:PRINT C$(C1):G
OTO 3110
3080 I1=0:I2=10
3090 CLS:PRINT@3,"TOTAL FOR YEAR
 TO DATE":PRINT:FOR I=I1 TO I2:P
RINT USING F$;T(I);:PRINT"  ";:P
RINTC$(I):NEXT:IF I1=11 THEN 311
0
3100 INPUT"<ENTER> FOR LAST 10";
Z$:I1=11:I2=20:GOTO 3090
3110 INPUT"<ENTER> WHEN DONE";Z$
```

Listing continued

the Basic program line in RAM.

The end of the Basic program is marked by 2 bytes containing zeros, which appear immediately after the last program line. The end-of-line marker for the last line, combined with these 2 bytes, makes 3 bytes in succession containing hex 00. Also, note that the next-line indicator for the last program line points to the first of these 2 bytes. If you add another line to the program, its next-line indicator will fill these vacant bytes and point to the new end of program.

When the interpreter encounters 2 blank bytes in a next-line pointer, it recognizes this as the end of the program. For instance, during a program LIST, the interpreter stops at this point. If you create a new last line for a program, you must follow the format. During a LIST, if the interpreter finds stray numbers where there should be blanks, it will rip randomly through the memory, printing gibberish until it runs into a couple of zeros.

Once you have entered and run a program, the interpreter creates a variable table, which tells it where to store and retrieve variables that the program uses. At run time, the interpreter positions the variable table immediately after the program. The program records the table's location by storing the address of the starting byte in memory locations 27 and 28 (hex 1B and 1C).

If you attempt to POKE information through the beginning of this table, the computer issues an error statement and stops. By altering the table address in 27 and 28, however, you can move the table out of the way. You must make this move early in a program before it uses any variable. Otherwise, you will get undefined-variable errors. Once the table is out of the way, you can extend the program without difficulty.

A good practice is to position the table in high memory. But remember, when you CSAVE a program it copies everything between the first byte of the program and the first byte of the variable table. With the variable table in high memory, you save a lot of blank space on the tape.

You can save time and tape by moving the table behind the program before you CSAVE it. In this case, you must

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Listing continued

```
:RETURN
4000 END
4490 REM
4500 REM* FIND THE PRESENT LAST
DATA LINE AND BLANK IT OUT *
4510 A=PEEK(25)*256+PEEK(26)
4520 B=PEEK(A)*256+PEEK(A+1)
4530 C=PEEK(A+2)*256+PEEK(A+3)
4540 IF B=0 THEN 4560
4550 A1=A:A=B:C1=C:GOTO 4520
4560 FOR I=A1 TO A1+3:POKE I,0:N
EXT
4570 REM
4980 REM* CHECK STORAGE ROUTINE
*
4990 IF A1$="-1" THEN RETURN
5000 CLS:INPUT"ENTER CHECK NO. (
ENTER -1 AFTER LAST CHECK)";A1$
5010 IF A1$="-1" THEN 5090
5020 INPUT"ENTER MONTH OF CHECK
AS A NO.   (1=JAN;ETC.)";A2$
5030 INPUT"ENTER AMOUNT OF CHECK
          (NO COMMAS;1279.50)";
A3$
5040 INPUT"ENTER BUDGET CODE NO.
";A4$:A4=VAL(A4$):IF A4<21 AND A
4>=0 THEN 5060
5050 PRINT"INVALID CODE NO.":GOT
O 5040
5060 INPUT"DO YOU WANT TO MAKE C
ORRECTIONS BEFORE CONTINUING? (Y
/N)";B$:IF B$="Y" THEN 5000
5070 A$=A1$+","+A2$+","+A3$+","+
A4$
5080 GOTO 5100
5090 A$=A1$
5100 A=A1+4:FOR I=1 TO 25:POKE A
,32:A=A+1:NEXT
5110 A=A1+25:D=INT(A/256):D1=A-(
D*256):POKE A1,D:POKE A1+1,D1
5120 D=INT(C1/256):D1=C1-(D*256)
:POKE A1+2,D:POKE A1+3,D1:POKE A
1+4,134:A1=A1+5
5130 REM
5140 REM* FIND A$ AND CREATE A N
EW DATA LINE *
5150 FOR I=1 TO PEEK(VARPTR(A$))
:B=PEEK(256*PEEK(VARPTR(A$)+2)+P
EEK(VARPTR(A$)+3)+I-1)
5160 POKE A1,B:A1=A1+1:NEXTI
5170 REM
5180 REM* ADD ZEROS TO END OF PR
OGRAM *
5190 FOR I=A-1 TO A+3:POKE I,0:N
EXT
5200 A1=A:C1=C1+1:GOTO4990
10000 DATA-1
```

add a variable to the program to keep track of the end-of-program address. When I save this program to tape, I leave it in high memory, which means that I use the same amount of tape space each time. It takes 2.5 minutes to save and load.

Now you know how to build program lines and make room for additions to the program—but what good is that? After all, the interpreter worries about all those details when you enter program lines. The important thing is that it lays the groundwork for a program that adds DATA lines to itself.

Programming Technique

When you type a numbered program line and enter it, the Basic interpreter scans the line, byte by byte, and stores a hex-coded version of the line, in RAM. The interpreter compares the ASCII-coded characters to look-up tables, which are imbedded in the ROMs. When the interpreter recognizes a sequence, it stores the proper hex codes in the line it is building in RAM. If it encounters an unacceptable sequence, the program prints a syntax-error message.

Later, when you actually run or list the program, the interpreter locates the program and either interprets the hex code as a specific series of actions or converts them back to ASCII characters for printing. The interpreter does not care who put the code in RAM as long as it conforms to the proper format. If you add a line in proper format and numerical sequence, the interpreter treats it as one of its own.

To add a DATA line to a program, you need a line number; the data hex code, 86 (134 decimal); data to put in the line; and the address of the end-of-program marker.

You enter data for storage with INPUT lines, which store each piece of data in a separate string variable. These entries must not contain commas. You construct the DATA line contents by properly concatenating these strings into a single master string. You must insert a comma string between the data strings (see Table 2).

The program finds the master string contents with VARPTR. PEEK and POKE move the string contents into the new DATA line.

The end-of-program marker (2 bytes) becomes the next-line indicator for the new DATA line. To find this marker look up the program starting address and store it as a variable, A for instance. Since the 2 bytes starting at A locate the next program line, store the address from A and (A + 1)as another variable, B.

```
A1$ = "76"
A2$ = "2.2"
A$ = A1$ + "," + A2$
Final DATA line:
100 DATA 76,2.2
```

Table 2. Data String Concatenation

If B is zero, then the address in A is the end-of-program marker. If not, set A equal to B, stepping through the program until B equals zero. You could easily program this routine as a machine-language subroutine. I chose to leave it in Basic, at the expense of a little run time, to keep from adding DATA lines to define the subroutine. To insert the new DATA line, the program must execute the following sequence:

- Find the end-of-program address, A.
- Determine the number of bytes required, using the formula L = LEN (A$) + 6, where A$ is the master string.
- Add L and A to get the next-line address, i.e., A2 = L + A.
- POKE A2, as 2 hex bytes, into A: (A + 1).
- Determine the next appropriate line number from your program. The line number is stored as variable C.
- POKE the line number into (A + 2): (A + 3).
- POKE 134 into (A + 4).
- Locate the contents of A$ and store sequentially beginning with (A + 5).
- POKE 00 into (A2 − 1), A2, and (A2 + 1).
- Set A equal to A2 and increment the line number, i.e., C = C + I.

This completes the new DATA line, and you are ready for another.

The Program

Following brief instructions, the Program Listing offers you a choice of either entering checks or receiving a report on the various budget codes. You enter data in response to program prompts. A report-format menu allows you to choose a report for one month or the year to date. Also, you can select one budget code or a report on all the budget codes.

Lines 70–180 allocate memory for string storage, set graphics to four pages, and present the first video selections. If you use PCLEAR 1 to get more memory, you must remember to set the computer to PCLEAR 1 before loading the program from cassette. Otherwise, you will get an out-of-memory error during loading.

Lines 190–440 dimension the array variables and establish the month and budget-codes lists. This format avoids the use of DATA lines which are reserved for data.

Lines 1000–1070 present the report menu. The menu also allows you to access the check-entry routine.

Lines 2000–2230 read the DATA lines, compile the report, and present the report for the month selected.

Lines 3000–3110 prepare a similar report for the entire year to date.

The remainder of the program illustrates techniques discussed earlier. Line 60, the first action line, moves the variable table to high memory by POKEing a new address in the table pointer.

Lines 4500–4550 locate the Basic program in RAM and find the last program line. In this program the last line is always DATA − 1, which serves as an end-of-data marker for the read routines.

Line 4560 writes over the first 4 bytes of the present last line with zeros. The first DATA line that you add will replace this line. This prevents DATA − 1 from being left in the middle of the DATA lines, where it would short-circuit things.

Lines 4990–5090 request the check number, month, amount of check, and budget code. You can make corrections to the line now or later. As you enter the information, it fills the strings, and then the program compiles the master string.

Lines 5100–5120 measure off 25 bytes for the new line and fill it with spaces, 32 (hex 20) illustrating an alternative approach to measuring the precise line length with LEN(A$). You can insert up to 255 spaces for a line, but take care not to waste too much memory this way. Then POKE the next-line pointer, line number, and 134 for DATA into the correct addresses.

Lines 5150–5160 use VARPTR to find the contents of A$ and move them to the new DATA line.

Lines 5190–5200 position zeros to mark the end of the program. The program stores the new last address and increments the line number.

Lines 10000 and on are the data field. To terminate check entry, enter a − 1 for the next check number. This re-creates the DATA − 1 marker as the last line.

You might find a more efficient way of doing many of the steps in this program, but the main point was to demonstrate how you can reorganize a program while it is running. ■

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A CoCo User's Group Wants You

compiled by Celeste Wrenn

Computer clubs, called user's groups, are an important force in microcomputing. They offer members technical help and invaluable experience.

Below is a list of clubs that invite CoCo users to join. We have tried to pass on as much information about each one as possible. Space prohibited us from printing a dues amount, as many groups have family and student rates. The listing is as current as possible, but new groups are cropping up every day. Look for one in your area and give them a call or drop them a line.

If you belong to a group that does not appear on this list, send a letter to *HOT CoCo* and tell us about it. If you are thinking of starting your own club, send a letter to our Feedback section and let the readers in your area know. We also want to hear about any updates on the groups below. ■

AK	Alaska	CT	Connecticut	MA	Massachusetts	OK	Oklahoma	UT	Utah
AL	Alabama	FL	Florida	MD	Maryland	OR	Oregon	VA	Virginia
AR	Arkansas	GA	Georgia	MI	Michigan	PA	Pennsylvania	WA	Washington
AU	Australia	HO	Holland	MO	Missouri	RI	Rhode Island	WI	Wisconsin
AZ	Arizona	IA	Iowa	MX	Mexico	SC	South Carolina	WV	West Virginia
CA	California	IL	Illinois	NC	North Carolina	TN	Tennessee	UG	User Group
CD	Canada	IN	Indiana	NY	New York	TX	Texas		
CO	Colorado	KY	Kentucky	OH	Ohio	UK	United Kingdom		

List of Abbreviations

State	Group Name	Address	City	Zip	Phone	Contact Person	Number of Members	Exclusively CoCo?	Dues?	Newsletter?
AK	Alaska CoCo User's Group	816 N. Pine #2	Anchorage	99504		Rick McDannel		Y		
AL	G2C3	4307 Old Shell Road	Mobile	36608		Gerald T. Regan	60	N	Y	Y
AR	Beginning Basic Programmers	Box 424	Bentonville	72712		David Bahn	6	N	N	N
AU	Adelaide Micro User's Group	36 Sturt St.	Adelaide	5000	337-6682	R. Stevenson	225	N	Y	Y
AU	Blue Mountain Computer Club	6 Hillcrest Ave.	Faulconbridge	2776	047-512258	Eric B. Lindsay	40	N	N	Y
AZ	Dust Byters User's Group	6557-A East Calle La Paz	Tucson	85715	602-889-8244	Burt Haberman	40	N	Y	Y
AZ	CoCo User's Group	218 West Calle Margarita	Tucson	85706	602-889-82544	Steve Parkman	50	Y	N	Y
AZ	Pheonix Color Computer Club	6619 West Palo Verde Ave.	Glendale	85302	602-939-5666	Mike Huffman	48	Y	Y	Y
CA	LA Color Computer User's Group	2227 Canyon Road	Arcadia	91006	213-355-6111	Mark Randall	75	Y	Y	Y
CA	Local Color	P.O. Box 421242	San Francisco	94142		Doug Mosher	70	Y	Y	Y
CA	Silicon Valley Color Computer Club	P.O. Box 61593	Sunnyvale	94088		Shawn Jipp	98	Y	Y	Y
CA	Valley TRS-80 User's Group	19116 Nashville St.	Northridge	91326		Bill White	50	N	N	N
CA	Litton Calculator/Computer Club	5500 Canoga Ave.	Woodland Hills	91365	213-715-3663	Walt Bennet	350	N	Y	Y
CA	Forth Interest Group	P.O. Box 1105	San Carlos	94070	415-962-8653	William Ragsdale	3500	N	Y	Y
CA	Soland Micro Computer User's Group	550 Marigold	Fairfield	94533	707-422-3417	David A. Irwin	75	N	Y	Y
CA	WGBP	10 Fieldbrook Place	Moraga	94566		Tim Knight	335	N	N	N
CA	San Gabriel Valley TRS-80 User's	750 East 5th St. #75	Azusa	91702	213-969-3605	Dan Dresselhaus	150	N	Y	Y
CA	S. CA. Amateur Radio Comp. Club	962 Cheyenne	Costa Mesa	92626	714-549-8516	Fried Heyn	150	N	Y	Y
CA	San Diego TRS-80 User's Group	P.O. Box 17109	San Diego	92117	619-565-4947	Warren McKenna	70	N	Y	Y
CD	Toronto Microcomputer User's Group	P.O. Box 875 Postal St. A	Toronto,Ont.	M5W 1G3			100	N	Y	Y
CD	Interess-80	673 Clairette, Fabreville	Laval	H73 2YP	514-622-6514	Jean Guy Pare	60	N	Y	Y
CD	Vancouver Color Computer Club	3167 East 3rd Ave.	Vancouver,BC	V5M 1G3	255-4893	Ronn O'Conner	60	Y	Y	N
CD	K-W Color Computer Club	23 Hudson Circle	Kitchener, Ont.	N2B 2V7		Peter Karwowski	80	Y	Y	Y
CD	Vancouver TRS-80 User's Group	#805-1985 Woodway Pl.	Burnaby, BC	V5B 4T4	733-2558	Stan Talaczyk	40	N	Y	Y
CD	Regina Color Computer Club	26 Tweedmuir Bay	Regina, SK	S4X 2B1	306-949-3942	George Glass	30	Y	Y	N
CD	Micro-80 Computer Club of Ottawa	178 Monterey Drive	Nepean, Ont.	K2H 7A8	613-820-2170	Robert J. Whitla	160	N	Y	Y
CD	Toronto Colour Computer Club	54 Kerr Road	Toronto, Ont.	M4L 1K5		Patricia Jackson	40	Y	Y	N
CD	Regina Operaters of Microcomputers	Box 1001	Regina, SK.	S4P 3B2	522-8808	R.W. Moffat	54	N	Y	Y
CD	International CoCo Club Inc.	P.O. Box 7498	Saskatoon, SK	S7K 4L4	214-657-7834		5000	Y	Y	Y
CD	Winnipeg Micro 80 User's Group	17 Bittersweet Bay	Winnipeg, Man.	R2J 2E5	452-5978	Don Wood	90	N	Y	Y
CD	Halifax-Dartmouth CoCo User's Group	P.O. Box 572	Dartmouth, N.S.	B2Y 3Y9	902-469-3656	Roger Pocklington	50	Y	Y	N
CO	Southern Colorado Computer Club	1635 South Prairie Ave.	Pueblo	81005	303-564-3545	Lloyd Armstrong	120	N	Y	Y
CT	Connecticut Computer Society,Inc	1199 Farmington Ave.	West Hartford	06107	203-561-3659	Bruce Brown	220	N	Y	Y
CT	Procomp Computer Club	Dept. 7, 844 Vernon ST.	Manchester	06040	203-643-4072	Paul Monaco	200	N	Y	Y
CT	Fairfield County TRS-80 User Group	10 Richlee Road.	Norwalk	06851	203-866-7833	Alan Abrahmson	150	N	Y	Y

CT	TRS-80 UG of Central Connecticut	P.O. Box 1575	Hartford	06114		Henry H. Hunt	130	N	Y	Y
FL	Central Florida Computer Society	P.O. Box 8819	Maitland	32751	305-862-1329	Bill Wellman	50	N	Y	Y
FL	North Dade computer Society	17400 NE 7th Court,Box 2	N. Miami Beach	33162	305-947-7930	Steven Apple	40	N	Y	Y
FL	Tampa Bay TRS-80 User Group	1721 Greenlee Drive	Clearwater	32751		Tom Stiles	120	N	Y	Y
FL	The Color Computer Club of Sarasota	4047 Beeridge Road	Sarasota	33582	813-921-7510	Ernie Bontrager	25	Y	N	Y
GA	CSRA Computer Society	P.O. Box 784	Augusta	30903	404-733-1232	Steve Larson	50	N	Y	Y
HO	TRS-80 Gebruikers Vereniging Benelu	P.O. Box 551, 2070 An	Santpoort-Noord		31 23 384135	G. Zuiderduyn	2300	N	Y	Y
IA	Marshalltown Computer Club	1101 S. 2nd Ave.	Marshalltown	50158	515-752-5131	Donald O. Groves	25	N	N	Y
IL	Quad City Computer Club	4211 7th Ave.	Rock Island	61201	309-786-8187	John Greve	32	Y	N	N
IL	Northern IL Color Computer Club	9346 Landings Square	Des Plains	60187	312-824-1291	Kevin O'Brien	115	Y	N	N
IL	Chicago Area Comp. Hobbyists Exch.	323 S.Franklin,804,PO 176	Chicago	60611	312-935-6809		50	N	Y	Y
IN	Northeast Computer Club	P.O. Box 50252	Indianapolis	46250	317-894-7514		140	Y	Y	Y
IN	Indy Color Computer Club	P.O. Box 68702	Indianapolis	46268	317-257-3300	Mike Davis	60	Y	N	N
IN	Co*Co*M*U*G	3635 North 300 East	Marion	46952	317-662-7887	John A. Helwig	16	Y	Y	N
KY	The Radcliff Color Computer Club	287 Highland Dr.	Radcliff	40106		Bryan Harp	20	Y	Y	Y
MA	The Boston Computer Society	Three Center Plaza	Boston	02108	617-367-8080	Sunny Tarby	7000	N	Y	Y
MA	TRUGEM	61 Lake Shore RD.	Natick	01760	617-443-3327	Mathew W. Slate	60	N	Y	Y
MA	NECCUG	P.O.Box 255	Harvard	01451	617-456-8291	Chris Sweet	30	Y	N	N
MD	TBUG	102 N. Collington Ave.	Baltimore	21231	301-338-7568	J.E. Spath	50	N	Y	Y
MI	Kalamazoo Area Computer Assn.	1927 Winchell Ave.	Kalamazoo	49008	616-327-2210	Jim Johnston	20	N	Y	Y
MI	Microcomputer User's International	1804 West 18th St.	Sault St. Marie	49783	906-632-3248	Jack Decker	35	N	Y	Y
MI	Hamug	Hope College	Holland	49423		Lou Spencer	35	N	Y	Y
MI	CMTUG INC.	410 Liberty St.	Lansing	48926	517-482-2294	Dennis Bill	50	N	Y	Y
MI	Computer Shack	1691 Easen	Pontiac	48054	313-673-8700	Gordon Monnieri	100	N	Y	Y
MO	North County 80 Group	912 Ville Donna Court	Hazelwood	63042	314-739-4078	Tom Vogel	195	N	Y	Y
MX	Mexico City Color Computer Club	Laja 4230,01900,Mexico DF	Mexico City		568-78-75	Marcelo Luft	25	Y	N	N
NC	Triad Amateur Computer Society	Box 7073	Greensboro	27417	919-299-0708	Kenn Melton	195	N	Y	Y
NC	TRS-80 Users Group of Charlotte	6613 Sommerlin Plaza	Charlotte	28211	704-525-8146	Bill Hardin	44	N	Y	Y
NY	Kings Byte Inc.	1063 East 84 ST.	Brooklyn	11236	212-763-4233	Morty Libowitz	80	N	Y	Y
NY	TRS-80 UG Church Applications	P.O. Box 279	Masonville	13804	607-265-3774	Merril Cook	50	N	N	Y
NY	Central New York State TRS-80 UG	5107 Briarledge Road	Syracuse	13212	315-458-8388	Richard W. Johnston	130	N	N	Y
NY	LNW User's Group	244 Mill Road	Yaphank	11980	516-924-9229	V. Edwardson	1800	N	Y	Y
NY	Rochester S-80 Computer Club Inc.	P.O. Box 15476	Rochester	14615		Nabeel Al Salom	133	N	Y	Y
NY	User's Group	245 Mapleview Road	Cheetowaga	14225	716-832-8778	Dr. R.E. Pontera	65	N	Y	Y
OH	North Central Ohio Computer Society	P.O. Box 965	Mansfield	44901			40	N	Y	Y
OH	JC TRS-80 ACSCO	Box 28355	Columbus	43228	614-267-8554	Bill M.	120	N	Y	Y
OH	Color Computer Club	P.O. Box 478	Canfield	44406	216-788-4218	Timothy McFadden	120	Y	Y	Y
OH	Columbus and Central Ohio CoCo Club	4773 Galton Center Apt. B	Columbus	43220	614-837-3672	Bob Constanza	100	Y	Y	Y
OK	Tulsa Computer Society	P.O. Box 1133	Tulsa	74101	918-743-6831	Ray Mclain	450	N	Y	Y
OK	East Oklahoma Color Computer Club	P.O. Box 326	Tulsa	74966		Doug Moller	5	Y	N	N
OR	Micro-80 Group, TRS-80 Users	P.O. Box 1472	Eugene	97440	503-688-5847	Bob Walters	55	N	Y	Y
OR	Milwaukie TRS-80 User Group	3520 S.E. Vineyard Road	Milwaukee	97222	503-659-8842	Jim Clayton	25	N	Y	Y
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Reader's Forum

That Little Old Label Maker

The short Program Listing 1 is a neat label printer that works on the DMP-200. It has one hang-up: It doesn't let you use the comma or other punctuation used by the computer. I just use periods and pretend they are commas.

Hank Calonkey
Boone, IA 50036

Advice for CGP-115 Users

The Radio Shack Color Graphics Printer (CGP-115) uses graphics plotting routines similar to Extended Color Basic's, but there are enough differences that you will encounter some difficulties while programming. To draw a line with the CoCo and Extended Color Basic, use the command:

```
LINE(X1,Y1)-(X2,Y2)
```

The CGP-115 equivalent is a draw (D) command:

```
PRINT #-2, "D"X1","Y1","X2","Y2
```

Notice that you do not need to supply the separating semicolon between variables and characters as the CGP-115 manual describes. Often you can draw a line from the current pen position to the X1,Y1 coordinates as well as between X1,Y1, and X2,Y2 using the D (draw) command, depending on the last command the printer receives. You ask for one line and get two. To overcome this problem, the equivalent of a "blank move" command should precede the draw command:

```
PRINT #-2, "M"X1"," Y1
```

You use the quotation marks because the printer looks for its commands as strings.

Also, the operating manual does not describe a useful debugging technique when working with a graphics program that acts almost like a trace function. You execute the graphics portion of the program in the text mode, CHR$(18). This gives a line-by-line listing of the graphics commands sent to the printer along with the value of any associated variables.

Try it; you'll find it easy to spot bugs by following what the printer is trying to do.

Thomas F. Szlucha
Fairport, NY 14450

HOT CoCo *pays $25 for each submission to Reader's Forum used. In the case of duplicate submissions, we will make our selection on the basis of the earliest postmark.*

A Terrific Time Saver

Save programming time by using a couple of command syntaxes that are not documented in the Color Computer manuals. Instead of using IF...THEN GOSUB or IF...THEN GOTO, use just IF...GOSUB or IF...GOTO. The THEN is not necessary in these cases. (Some older CoCos might not support this technique.) Below is a sample program:

```
100 CLS
110 INPUT "Do you want to say hello (Y/N)";X$
120 IFX$="Y"GOSUB 200
130 END
200 ?@234, "Hello":RETURN
```

Thomas J. Revitte
Sturgis, MI 49091

Orange Screen Change

Here's a simple way to get an orange screen immediately after turning on your Color Computer:

```
POKE 360,1:POKE 361,121
```

This bypasses routines in the Basic interpreter, disabling the RETURN from SCREEN 1 to SCREEN 0.

The following routine explains and solves the problem of running a program while writing it. First, enter POKE 360,1:POKE 361,121:SCREEN0,1. Now enter:

```
10 PMODE4:SCREEN1:GOTO10
```

and press break. Finally, enter SCREEN0,N. (You will not see this on the screen.)

H. Wood
Wakefield, Yorkshire
England

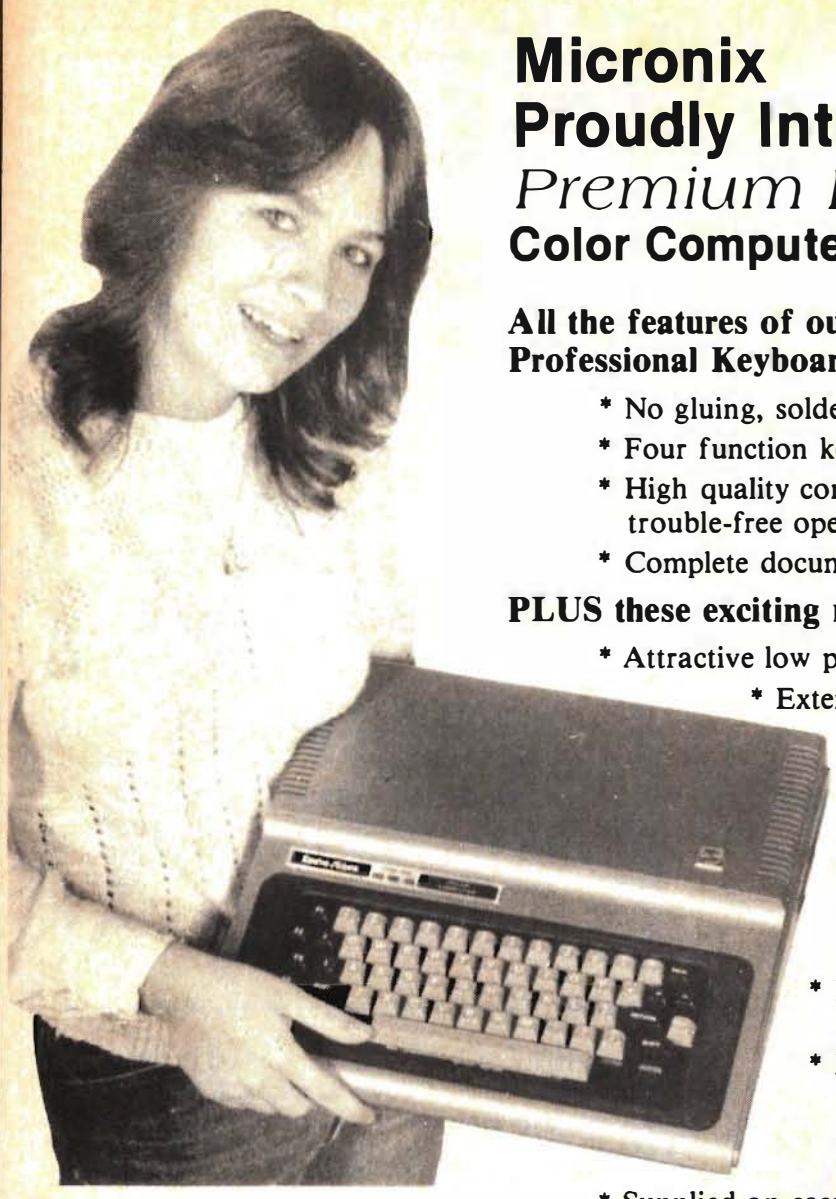
Cloning Machine Code

Do the following to copy machine-language programs:

- Load the original version.
- Type:
  PRINT PEEK(487)*256+PEEK(488) (press enter)
  PRINT PEEK(126)*256+PEEK(127)-1 (press enter)
  PRINT PEEK(157)*256+PEEK(158) (press enter)
- Put in a blank tape.
- Position tape to save program.
- Type CSAVEM"PROGRAM",A,B,C.

The numbers that the three PEEKs produce will give you the start, end, and transfer addresses, respectively.

Kenneth Kestenbaum
Spring Valley, NY 10977



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```
5 CLS
10 INPUT "LINE 1 OF 5";A$:CLS
19 PRINTA$
20 INPUT "LINE 2 OF 5";B$:CLS
29 PRINTA$:PRINTB$
30 INPUT "LINE 3 OF 5";C$:CLS
39 PRINTA$:PRINTB$:PRINTC$
40 INPUT "LINE 4 OF 5";D$:CLS
45 PRINTA$:PRINTB$:PRINTC$:PRINT
D$
50 INPUT "LINE 5 OF 5";E$:CLS
55 PRINTA$:PRINTB$:PRINTC$:PRINT
D$:PRINTE$
60 F$=""
61 PRINT:PRINT:INPUT"ABOVE IS YO
UR ADDRESS.  PRESS   <ENTER> IF
OK, OR <BREAK> TO    REDO";G$:GO
TO1000
62 PRINTA$:PRINTB$:PRINTC$:PRINT
D$:PRINTE$:PRINTF$
70 CLS:PRINT:PRINT:PRINT:PRINT:I
NPUT"PRESS <ENTER> TO PRINT LABE
L    NOW, OR <BREAK> TO REDO";I$
:GOTO200
200 '200 SERIES LINES PRINT LABE
LS ON PRINTER
210 PRINT#-2,CHR$(27)CHR$(31);A$
; TAB(45)R$
220 PRINT#-2,B$; TAB(43)S$
230 PRINT#-2,C$; TAB(43)T$
240 PRINT#-2,D$; TAB(43)U$
250 PRINT#-2,E$; TAB(43)V$
260 PRINT#-2,F$; TAB(45)F$;CHR$(
27)CHR$(32)
280 CLS:GOTO70
1000 'THIS SERIES OF LINES PRINT
S YOUR RETURN ADDRESS LABEL ON T
HE RIGHT HALF OF SHEET, AT SAME
TIME AS THE ADDRESSEE LABEL IS P
RINTED.
1010 CLS:INPUT"RETURN LINE #1";R
$:CLS:PRINTR$
1020 INPUT"RETURN LINE #2";S$:CL
S:PRINTR$:PRINTS$
1030 INPUT"RETURN LINE#3";T$:CLS
:PRINTR$:PRINTS$:PRINTT$
1040 INPUT "RETURN LINE #4";U$:C
LS:PRINTR$:PRINTS$:PRINTT$:PRINT
U$
1050 INPUT "RETURN LINE #5";V$:C
LS:PRINTR$:PRINTS$:PRINTT$:PRINT
U$:PRINTV$:PRINTF$
1070 PRINT:PRINT:INPUT"ABOVE IS
YOUR RETURN ADDRESS.   IF OK PRE
SS <ENTER>, IF NOT     PRESS <BR
EAK>.";W$:GOTO70
```

Program Listing 1. Label Printer

Extra Graphics Modes Discovered

PMODEs 0–4 of Extended Color Basic implement only five of many possible settings of the SAM and VDG chips. After experimenting with these settings, I found two graphics modes not described in either *Getting Started with Color Basic* or Motorola's pamphlets.

I also discovered a simple method that allows Basic support for both these two new modes and the three full graphics modes listed in *Getting Started*, but not supported by Extended Basic. This method will give you 10 graphics modes from Extended Basic rather than five.

The two graphics modes are a 64-by-96, four-color mode and a 64-by-192, four-color mode. Program Listings 2 and 3 implement these modes by first executing a PMODE command to set the VDG chip and start of screen memory, then POKEing the SAM (65314) into the respective modes. When using these modes, all X values should be divided by two and all H/W ratios in CIRCLE commands should be doubled. For instance, CIRCLE (64,96),20,2,2 will result in a round circle drawn at the middle of the screen.

It is the PMODE command, executed just before the new modes are set, which allows Basic to support them. This command not only sets the VDG and the start of screen memory, it also sets Extended Basic's flags in system RAM. These flags act as references for the graphics commands and must be set for the commands to work correctly. It is by a similar method that Extended Basic support of the 64-by-64C and 128-by-64 modes is made possible. However, in the case of these modes the VDG must be reset. In the 64-by-68 and 128-by-64R modes the Basic bytes-per-line flag must also be reset. Program Listings 4, 5, and 6 set the 64-by-64C, 128-by-64R, and 128-by-64C modes, respectively.

Keith Campbell
Salem, VA 24153

```
1 REM 64 X 96 COLOR GRAPHICS MOD
E
2 REM BY KEITH CAMPBELL
3 REM MAY 10,1983
10 PMODE 1,1:SCREEN 1
20 POKE 65314,128: REM COLOR SET
 0
30 REM FOR COLOR SET 1; POKE 643
14,136
35 CIRCLE (64,96),40,2,2
50 GOTO 50
```

Program Listing 2. The 64-by-96, Four-Color Mode

```
1 REM 64 X 192 COLOR GRAPHICS MO
DE
2 REM BY KEITH CAMPBELL
3 REM MAY 10, 1983
10 PMODE 3,1: SCREEN 1
20 POKE 65314,128: REM COLOR SET
 0
30 REM FOR COLOR SET 1; POKE 653
14,136
40 CIRCLE (64,96),40,2,2
50 GOTO 50
```

Program Listing 3. The 64-by-192, Four-Color Mode

```
1 REM BASIC SUPPORT FOR 64 X 64C
MODE
2 REM BY KEITH CAMPBELL
10 PMODE 1,1: PCLS: SCREEN 1
20 POKE 65473,0: POKE 65474,0: P
OKE 65476,0:REM SET VDG
30 POKE 185,16: REM SET BASIC FL
AG
40 POKE 65314,128: REM ACTS AS S
CREEN COMMAND
50 REM FOR COLOR SET/POKE 65314,
136
60 CIRCLE(64,64),20,3
70 GOTO 70
80 REM ALL X VALUES MUST BE DIVI
DED BY 2
90 REM ALL Y VALUES MUST BE MULT
IPLIED BY .66
```

Program Listing 4. The 64-by-64C Mode

```
1 REM BASIC SUPPORT FOR 128*64 C
OLOR MODE
2 REM BY KEITH CAMPELL
10 PMODE 1,1:PCLS 2: SCREEN1
20 POKE 65472,0: POKE 65475,0:PO
KE 65476,0:REM SET THE VDG CHIP
30 POKE 65314,160:REM COLOR SET
0
40 REM FOR COLOR SET 1 POKE 6431
4,168
50 CIRCLE(128,64),20,3,.66
60 GOTO60
70 REM Y VALUES SHOULD BE MULTIP
LED BY .66
80 REM CIRCLE RATIOS SHOULD BE M
ULTIPLIED BY .66
```

Program Listing 5. The 128-by-64R Mode

```
1 REM BASIC SUPPORT FOR 128 X 64
 RESOLUTION
2 REM KEITH CAMPBELL
10 PMODE 0,1:PCLS:SCREEN 1
20 POKE 65473,0: POKE 65474,0:PO
KE 65476,0
30 POKE 185,16
40 POKE 65314,148:REM COLOR SET
0
50 REM FOR COLOR 1 POKE 65314,15
6
60 CIRCLE(128,64),20,,.66
70 GOTO 70
80 REM CIRCLE RATIOS SHOULD BE S
CALED TO 2/3'S(.66) THEIR VALUE
90 REM Y VALUES SHOULD BE MULTIP
LIED BY .66
```

Program Listing 6. The 128-by-64C Mode

See List of Advertisers on page 130

Doctor ASCII

Q. I am writing to you in regard to two articles—"40K Color Basic" (*80 Micro*, May 1983, p. 212) and "64K Modification" (*HOT CoCo*, July 1983, p. 44).

First, I have a 32K CoCo, which I bought in March 1982. It has the E board. There are no unconnected pins to the right of U10. I found six resistors between U10 and the jumper marked "4K–16K." One of those resistors rests in location R83 (between U10 and C44), but I have been unable to find any markings on it or the other five resistors that tell what ohmage they are.

They are black and about 4.5 mm in length. There are three pins to the right of them. The upmost (toward the back of the machine) is marked "4K," the center one is unmarked, and the forward one is "16K." A plastic jumper connects the 16K resistor to the center pin. I left that area untouched.

The only problem I had was the breaking off of two pins on the S02, causing me to solder on what was left on the chip.

In the article "40K Color Basic," part of the article at the beginning of page 214 seems missing. Second, the article stated that the "newer E and F boards only reset the MC6809."

With mine, if I press the reset button, I find myself back in 32K Extended Basic and must reexecute the 64K-Mod program. Have I left out something?

In one article you referred to memory map 0 and in the other memory map 1. How many memory maps are there, how are they changed, and where are they?

I have a mini-assembler, disassembler, debugger, and the Sigmon monitor program. When I exit from it, the machine seems to perform a reset, crashing the 64K back to 32K. Have you any idea as to the reset address so I can change it to an RTS?

Which is the cartridge-select pin? I have been using POKE 65315,54, but it has been said to be dangerous.

Charlie Clark, Jr.
Eldorado, TX 76936

A. There was a misprint in the article "64K Modification" concerning those with 32K E boards. The first sentence under "Installing E Boards" should have read: "If you already have an E board with 32K, start with step 1 below" *not* "start with the next paragraph." Sorry for the confusion, but someone in editing thought that the paragraph was too long and split it.

The part missing from the "40K Color Basic" article was the discussion of diode CR2 on a D board. I have removed this diode from my D-board machine, so now when I push the reset, the SAM chip is not reset when I run the 40K Basic discussed in the article. You could install a switch in line with the diode, which would give you the option of having it either way.

The 64K-Mod program does not modify Basic's reset routine after it is copied into RAM, so when you cause a jump to the reset routine, you are back to 32K. The ROM routine in version 1.1 that resets the SAM allows the diode to be removed. If you do not want to lose 64K when using Sigmon, try adding the following Assembly-language code via Sigmon while in 64K:

```
ORG     $A017
JMP     $A074
ORG     $A055
FCB     $0D
ORG     $A070
FCB     $12
FCB     $12
ORG     $A0FC
RTI
```

Memory map 0 is the state that the CoCo is in when you first turn it on. You have RAM from $0000 to $7FFF and ROM capability from $8000 to $FEFF with the remaining portion for vectors and I/O. Memory map 1 is the state where you have RAM from $0000 to $FEFF with the top 256 bytes reserved for vectors, I/O, and possibly a small boot ROM for FLEX or OS-9. You can switch from memory map 0 to memory map 1 by POKEing $FFDF with a zero. If you are using ROM-resident code when this is done, however, you will crash your system.

With a Radio Shack ROM pack facing you, the cartridge-select pin is the set of lands on your left (one on top and one on the bottom of the connector). They are adjacent to the shorter power-supply land. The upper and lower ones might short together, so putting a piece of tape on either or both will do the trick.

Q. I own a CoCo without Extended Basic. I want to program in hi-res (256 by 192) graphics. The book *Getting Started with Color Basic* doesn't say much about hi-res graphics and what it does tell you is not very clear.

Curtis Frazier
Enterprise, AL 36330

A. There was an article entitled "POKE a Color Computer" on page 392 of the December 1980 *80 Microcomputing* on the subject. Reston has published two books on the subject, both by Don Inman. They are entitled *TRS-80 Color Computer Graphics* and *Assembly-Language Graphics.*

To get you started, I'll give a brief discussion on the subject. I assume that your machine is a 16K standard Basic CoCo. A 4K machine does not have enough RAM. The 256-by-192 graphics mode requires 6,144 bytes, or approx-

imately 6K of RAM, for the exclusive use of the display. Program Listing 1 uses hi-res without Extended Basic. It draws a line as the statement LINE(0,0) – (191,191),PSET would in Extended Basic.

Lines 40–100 program SAM chip to relocate the display screen to the area above 10239. This must be done because your normal display screen only has 512 bytes available before it interferes with Basic.

In order to program the SAM, divide 10,240 by 512, giving 20. Convert 20 to a 7-bit binary number yielding 0010100. Starting with the rightmost bit, POKE the addresses 65478–65491. There are 14 of these. If the first bit is zero, POKE the even address of the first pair, 65478, with a zero; if it is one, then POKE the odd address, 65479, with a zero. Successively work through these 14 addresses, POKEing only seven of them.

Lines 120–140 give the appropriate POKEs to program the SAM for hi-res.

Line 160 programs the VDG for color set 0 (black/green) and hi-res.

Lines 180–210 clear the screen to black. Line 190 displays a moving cursor performing this feat.

Lines 220–370 draw the line. Each byte on the screen corresponds to eight pixels in the display. A pixel is a dot that is either green or black. The first byte (10240) corresponds to the first eight pixels in the first of 192 rows in the display. For a width of 256 pixels, 32 bytes are necessary for each row. Line 260 calculates the byte you must POKE to turn a particular pixel in row R and column C. Line 290 calculates the bit of the byte that you must alter. Lines 270 and 300–330 are necessary because standard Basic lacks exponentiation.

Lines 350–360 display the pixel by updating the appropriate byte.

Line 390 makes the program compatible with Extended Basic. If anyone has Extended Basic, you must PCLEAR1 before running this program.

After running the program, press the reset button to restore the normal display screen.

```
10 REM MAKE ROOM FOR A DISPLAY
 BEGINNING AT 10240
20 CLEAR 200,10239
30 REM PROGRAM THE SAM TO START
THE SCREEN DISPLAY AT 10240
40 POKE 65478,0
50 POKE 65480,0
60 POKE 65483,0
70 POKE 65484,0
80 POKE 65487,0
90 POKE 65488,0
100 POKE 65490,0
110 REM PROGRAM THE SAM FOR A 25
6 X 192 DISPLAY
120 POKE 65477,0
130 POKE 65475,0
140 POKE 65472,0
150 REM PROGRAM THE VDG FOR A
256 X 192 GREEN & BLACK DISPLAY
USE 255 INSTEAD OF 247 FOR A
WHITE AND BLACK DISPLAY
160 POKE 65314,247
170 REM CLEAR THE DISPLAY TO
BLACK - THE POKE M,255 IS TO LET
YOU KNOW THE PROGRAM HAS NOT
DIED - IT MAY BE OMITTED
180 FOR M=10239 TO 16383
190 POKEM,255
200 POKE M,0
210 NEXT M
220 REM START DRAWING THE LINE
230 FOR R=0 TO 191
240 C=R
250 REM FIND THE CORRECT BYTE
260 B=10240+32*R+INT(C/8)
270 RP=1
280 REM FIND THE CORRECT BIT
290 P=7-(C-8*INT(C/8))
300 IF P=0 THEN 350
310 FOR I=1 TO P
320 RP=RP*2
330 NEXTI
340 REM DISPLAY THE UPDATED
PIXEL
350 V=RP OR PEEK(B)
360 POKE B,V
370 NEXT R
380 REM MAINTAIN THE DISPLAY
390 GOTO 390
```

Program Listing 1. Hi-Res Graphics Demo Without Extended Basic

Q. I own a 48K TRS-80 Model III and a 32K Color Computer. My Model III has two internal drives, but I do not yet have one for the CoCo.

I am told that it is possible to buy external disk drives and by interchanging the connecting cables, use them with either computer. The local Radio Shack dealer said this was probably right, but that he cannot sell the CoCo controller without the drive. Since I use both computers extensively, I would like to upgrade disk capacity on both and save on the expense.

While on the subject of drives, I've noticed several ads for the slim-style drive. Since my computer work area is rapidly becoming overcrowded, will any of these drives pose a problem, assuming that I can accomplish the above situation?

Larry Taylor
Huber Heights, OH 45475

A. External drives for your Model III are interchangeable with drives for the CoCo. Ask your Radio Shack dealer to order these replacement parts: disk-controller PC board #AX-9060, $107.77, and the plastic cover #AZ-6839, $2.43. These two parts are what you need for a CoCo disk controller. This, along with a two-drive cable, will give you the option of having a four-drive Model III or a two-drive CoCo.

The advantage of the so-called slim-line drives is that two will fit in a single drive case. They are currently selling at

premium prices. If one is Model III compatible, it should also work with the CoCo.

Q. As a new owner of a CoCo, I find one thing above all that bothers me: the black border displayed during the list mode. I can get rid of it in the graphics mode with appropriate PMODE selections, but it is always there in the list.

The screen would be much easier to look at without the border. It would seem that with either programming or physical modification, this could be removed.

John C. Burke
San Francisco, CA 94122

A. There are a number of commercial software solutions to your problem. These programs use the high-resolution capability of the CoCo to generate both upper- and lowercase characters on either a green or white screen. The only serious problem that would confront you with one of these is that you would be left with only about 7K of RAM for your Basic programs. If you do not have a disk system and 7K would be a problem, Snake Mountain Software, P.O. Box 5722, Raleigh, NC 27650, offers such a program in a ROM pack for $34.95.

Q. I have a 64K Color Computer with one Tandon drive and a Radio Shack controller. My problem first occurred about a week after I plugged in the controller, but it subsequently has occurred with the controller unplugged.

The computer seems to turn itself off. The screen goes to regular TV snow and I lose all keyboard communication. Sometimes it happens after several hours of use and sometimes right after I turn it on. Turning the computer on and off will eventually get the computer up again, but once it blinks out, it usually happens several times before the computer will work properly for any length of time.

Elizabeth Kahn
Baltimore, MD 21212

A. First, check the obvious: the TV cable, connectors, and switchbox. If they check out and you are willing to open the machine, do the following: In anticipation of this recurring, remove the screws that hold the top cover on your machine. When the problem recurs follow the checkout procedure for a "dead" computer in the Radio Shack reference manual, under Section IV—Troubleshooting. You will need a voltmeter.

If you don't want to do this yourself, have it checked out by a Radio Shack technician.

Q. I have a 16K CoCo with Extended Basic and an LP VII. There are a couple of programs or codes that I would like to use: a program to print a complete LP VII character set and a routine to print boldface characters on the LP VII.

Also, can I get the large and small smiling or frowning faces on my TV set?

Bob Hall
Butler, PA 16001

```
10 CLS
20 GOSUB9000
30 PRINT"   FACES READY - HIT <S
> FOR A     SMILE OR <F> FOR A F
ROWN."
40 A$=INKEY$:IF A$=""THEN 40
50 IF LEFT$(A$,1)="S" THEN PMODE
1,1:SCREEN1,0 ELSE IF LEFT$(A$,1
)="F" THEN PMODE1,3: SCREEN1,1 E
LSE SCREEN0,0
60 GOTO40
9000 FORP=1TO3 STEP 2
9010 PMODE1,P
9020 PCLS3
9030 CIRCLE(128,96),85,2
9040 PAINT(128,96),2,2
9050 CIRCLE(74,64),12,3
9060 PAINT(74,64),3,3
9070 CIRCLE(182,64),12,3
9080 PAINT(182,64),3,3
9090 CIRCLE(128,96),14,4
9100 PAINT(128,96),4,4
9110 IF P=1 THEN CIRCLE(128,80),
80,4,1,.15,.35 ELSE CIRCLE (128,
195),70,4,1,.65,.85
9120 NEXTP
9130 RETURN
```

Program Listing 2. Routine to Draw a Face

A. The LP VII uses the 7-bit ASCII code. The printable part of this code corresponds to the numbers 32–127. A simple loop such as FOR I=32 TO 127: PRINT#-2, CHR$(I);: NEXTI should do the trick. The LP VII does not recognize the backspace character or the reverse linefeed character, either of which could be used to doublestrike a character.

The next best thing would be to generate these characters by printing them using two-dot-wide strokes using the LP VII's graphics mode. This technique, however, would be very difficult to use with a machine-language word processor.

Generating faces on the CoCo is simple in one of the high-resolution graphics modes. All you need is the CIRCLE and PAINT commands. You could use the SCREEN command to switch between faces—e.g., put a smile on pages 1–2 and a frown on pages 3–4.

I've written Program Listing 2 to show how it might be done. It draws the faces in a subroutine that starts with line 9000. After returning from the subroutine, line 50 selects the proper screen depending upon whether you've pressed S or F in line 40.

```
10 CLS
20 INPUT"1=LT.GREEN,2=M.GREEN,3=
FR.GREEN,4=DK.GREEN";X
30 ON X GOSUB60,100,170,240
40 CLS
50 GOTO20
60 PMODE4:SCREEN1,0
70 PCLS1
80 A$=INKEY$:IFA$=""THEN80
90 RETURN
100 PMODE4:SCREEN1,0
110 PCLS
120 FORI=0TO254STEP2
130 LINE(I,0)-(I,191),PSET
140 NEXT
150 A$=INKEY$:IFA$=""THEN150
160 RETURN
170 PMODE4:SCREEN1,0
180 PCLS
190 FORI=1TO255STEP2
200 LINE(I,0)-(I,191),PSET
210 NEXT
220 A$=INKEY$:IFA$=""THEN220
230 RETURN
240 PMODE4,1:SCREEN1,0
250 PCLS0
260 A$=INKEY$:IFA$=""THEN260
270 RETURN
```

Program Listing 3. Demo for SCREEN1,0 Enhanced Color Set

```
10 CLS
20 INPUT"1=WHITE,2=RED,3=BLUE,4=
BLACK";X
30 ON X GOSUB60,100,170,240
40 CLS
50 GOTO20
60 PMODE4:SCREEN1,1
70 PCLS1
80 A$=INKEY$:IFA$=""THEN80
90 RETURN
100 PMODE4:SCREEN1,1
110 PCLS
120 FORI=0TO254STEP2
130 LINE(I,0)-(I,191),PSET
140 NEXT
150 A$=INKEY$:IFA$=""THEN150
160 RETURN
170 PMODE4:SCREEN1,1
180 PCLS
190 FORI=1TO255STEP2
200 LINE(I,0)-(I,191),PSET
210 NEXT
220 A$=INKEY$:IFA$=""THEN220
230 RETURN
240 PMODE4,1:SCREEN1,1
250 PCLS0
260 A$=INKEY$:IFA$=""THEN260
270 RETURN
```

Program Listing 4. Demo for SCREEN1,1 Enhanced Color Set

Q. I heard that by switching between PMODE2 and 4, you could get more than two colors on the screen in PMODE4. Is this possible? How is it done?

I have some friends with Commodore-64s and they are always poking fun at the looks of my 64K modified CoCo. Is their machine really better?

Matthew Edwards
Frostburg, MD 21532

A. According to the Radio Shack manual, you have two colors available in PMODE4. In the SCREEN1,0 mode, you have dark green and light green, and in the SCREEN1,1 mode, you have black and white. It is also possible to display "phantom" colors in these modes, giving you a total of four in each. This is done by printing only odd or even stripes against a dark background, fooling the TV into displaying extra colors.

This will give you the additional colors medium green (even) and frosted green (odd) with SCREEN1,0, and red (odd) and blue (even) with SCREEN1,1.

I have included Program Listings 3 and 4 to illustrate the two enhanced color sets. A strange phenomenon occurs with these colors. There seems to be no reliable way to predict which of the two phantom colors will appear corresponding to odd or even. Radio Shack's graphics adventure game, Sands of Egypt, which uses these colors, advises the player to hit the reset button until the colors correspond to what the author intended.

As for whether the Commodore or CoCo is better, ask your friends to run a benchmark program on both. The CoCo is faster. Show them Extended Basic. Ask to see their "smart" terminal program. Last time I checked, they had none. Ask why Commodore uses the 6809 (same as CoCo) in their top-of-the-line Super Pet if it is not better.

You can also get rid of that ugly 4K-, 16K-, or 32K-RAM ID button and let the world know you have 64K by ordering Radio Shack part #AHC2240, $1.85.

Did you know that there is a beautiful shiny black CoCo hiding underneath that ugly silver paint? I used elbow grease and Rain Dance liquid car wax to do mine. I have heard that isopropyl alcohol will also do the trick.

There are keyboard upgrades available, too. Show them FLEX if you have it, or a real word processor; the 64 has nothing comparable. Best of all, ask what their total systems cost! ■

Got a problem with your Color Computer? Ask Doctor ASCII to solve it. Write to Doctor ASCII, HOT CoCo, *Pine St., Peterborough, NH 03458.*

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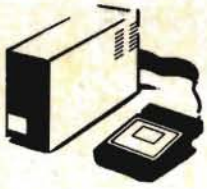

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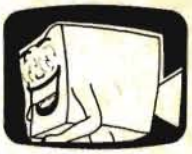

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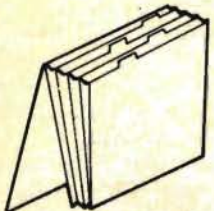

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PRODUCT NEWS

edited by Mark E. Reynolds

The information used in the Product News section is supplied through manufacturers' press releases. *HOT CoCo* has not tested or reviewed these products and cannot guarantee any manufacturer's claim.

Down to the Sea In Computers

Fire One is a 3-D game in which you get a captain's-eye view from the window of your submarine as you attempt to navigate through enemy-infested waters. The object of play is to elude the enemy hazards and score as many points as possible by destroying enemy craft.

Fire One comes complete with 3-D glasses and requires 16K, Extended Color Basic, and joysticks. It sells for $24.95 from DanGar Enterprises, 16471 Rio Nido Road, Guerneville, CA 95446, 707-869-3420.

Reader Service ✓556

Use Color Disks On Other TRS-80s

Now you can use your Color Computer disks in a TRS-80 Model I, III, or 4. CIII is a software package that makes CoCo disks compatible with other TRS-80s.

You simply insert the CIII disk into any two-drive Model I, III, or 4 and select the files you wish to transfer. It's compatible with most TRS-80 operating systems.

CIII sells for $24.95 from Computer Shack, 1691 Eason, Pontiac, MI 48054, 313-673-8700.

Reader Service ✓558

Become a BBS Sysop!

Now you, too, can become a bulletin-board system operator with the Color-80 BBS version 2.0.

This system offers 8-bit, low-resolution picture transmissions, upload and download sections, and the option of sending private or public messages.

It has a picture utility for making low-resolution pictures, an automatic mail check, and daily and permanent user logs. The main program is written in Basic so that you can easily customize it to meet your specialized needs.

The Color-80 BBS requires a 64K CoCo, Radio Shack DOS with two or more disk drives, and a Hayes Smartmodem. It comes on two disks for $115 from Silicon Rainbow Products. It's sold by Spectrum Projects, 93-15 86th Drive, Woodhaven, NY 11421, 212-441-2807 (voice), 212-441- 3755 (BBS).

Reader Service ✓559

Screen Formatter

Rainbow Writer is a general-purpose screen formatter that lets you use 12 different character sizes to create screen displays from 64-by-24 character sets to 16 by 8.

This program includes screen features such as underline, subscript, superscript, and scroll protect. You can also attain four-color artifacts in PMODE 4.

You can incorporate Rainbow Writer into your own Basic or machine-language programs. It sells for $29.95 on tape and $32.95 on disk from Rainbow Connection Software, 3514 6th Place NW, Rochester, MN 55901.

Reader Service ✓557

Fill Nebuchadnezzar's Shoes

Valhalla Enterprises has released two new programs for the CoCo.

● Babylon is an adventure-type game in which you are the governor of the city of Babylon. Your duty then is to manage the city's assets and military against all the hazards that beset it.

The game includes 10 difficulty levels and requires 16K Color Basic. It costs $12.50.

● Electronic Graph is a function-graphing program. You can set the scale of the graph and overlay as many functions as you wish, using low-, medium-, or high-resolution graphics.

You can enter any function and don't need to recode the program—you won't get syntax errors. And you can print out your graphs on a Line Printer VII or similar printer.

Electronic Graph requires 16K and Extended Color Basic. It costs $14.56.

Both programs are shipped on tape. They're available from Valhalla Enterprises, Dept. HCR, P.O. Box 243, Sumner, WA 98390.

Reader Service ✓561

The Kodak Instagraphic CRT Imaging Outfit

CoCo Accountant

Universal Data Research Inc. has recently released an integrated accounting system for a 64K CoCo that operates under FLEX DOS. The system includes five main accounting packages: Accounts Payable, Accounts Receivable, General Ledger, Inventory, and Payroll.

Each of the accounting packages is menu driven, and each creates and maintains its own data files, which eliminates reentering information. You can generate reports from menu choices in each program or through the UDRI Data-Base Manager.

Along with 64K RAM and FLEX DOS, the integrated accounting system requires the Technical Systems Consultants' Extended Color Basic and at least two disk drives. It's also best if you have a printer to generate reports.

Each of the accounting packages sells for $295. You'll receive approximately a 30-percent discount if you buy all five packages at once. For more information, contact Universal Data Research Inc., 2457 Wehrle Drive, Buffalo, NY 14221.

Reader Service ✓570

Photograph Your Display

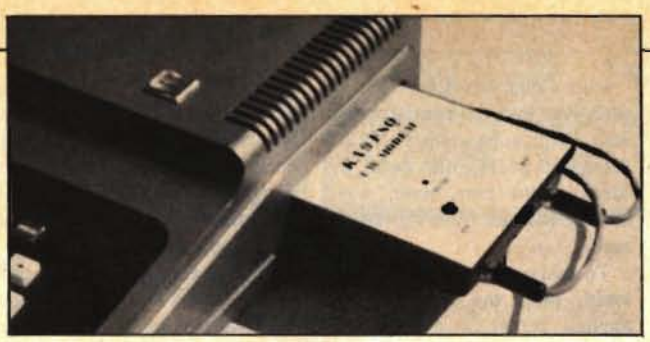
Getting a decent picture of a screen display has long been a problem for most everyone who tried, except the professional, of course. But now Kodak has introduced its Instagraphic, a CRT-imaging outfit that lets anyone make instant color prints of any still 12- or 13-inch screen display.

The outfit comes with a cone, to which the camera is attached. To take a picture, place the unit over the screen. This eliminates ambient light and holds the lens the correct distance from the screen. The Instagraphic camera does the rest.

You don't even need to focus or set the exposure. Simply push and hold the exposure button for a few seconds. When you release the shutter, the instant color print pops out of the camera.

The camera comes with a close-up lens for a sharp focus. You can also use the Kodak Wratten filter to color balance for the phosphor in a particular video display terminal.

Kodak's Instagraphic color print film is also something new. Each print emerges from the camera in the usual form, but one hour after you've taken it, you can peel the print from its backing, giving you a thin, flexible, 3½-by-4-inch picture.



The KA9FSQ CW Modem Interface

The Instagraphic imaging outfit includes a Kodak Instagraphic camera with close-up lens; two packages of Instagraphic color print film; an Instagraphic CRT cone, Model 12; an instruction manual; a filter; and brackets for adapting a 35-mm single-lens reflex camera to the cone.

The suggested retail price of this outfit is $195. For more information, contact Eastman Kodak Company, 343 State St., Rochester, NY 14650.

Reader Service ✓568

CoCo Morse Code

The KA9FSQ CW Modem interface changes the RX tone into a digital pulse, making it possible for ham-radio operators to transmit or receive Morse code on the Color Computer.

An LED is mounted on the unit for a visual indication that you're locked on the signal.

Instead of using a mechanical relay for TX, the KA9FSQ CW Modem uses an optoisolator to keep keying voltages away from the computer and give a clean digital pulse to the transmitter.

To use the modem, plug the cartridge into the ROM-pack slot and connect two cables, one from your XMTR, and one from your RCVR. Turn the computer on, CLOAD the program, run it, and you're ready to go.

The KA9FSQ CW Modem costs $50. For more information, contact Mitronix, 5953 N. Teutonia Ave., Milwaukee, WI 53209. Ask about their circular listing programs that support the modem.

Reader Service ✓567

But on Which Side of the Road Do They Drive?

The popular American arcade game, Frogger, is now available in England for the Dragon-32. In this game, you attempt to direct a frog safely across a busy highway.

There are also five other programs for the Dragon: Shuttle, a space-shuttle simulator; Composer, a four-voice music synthesizer; Morocco Grand Prix, a car-race game; Teletutor, four educational programs; and Cuthbert Goes Walkabout (with a name like that, he'd better watch about where he walks).

For more information, contact Microdeal Ltd., 41 Truro Road, St. Austell, Cornwall PL25 5JE, England. Tel.: 0726 67676.

Reader Service ✓552.

The Mad Balloonist

In Balloon Attack, a mad balloonist drops bombs on unwary pedestrians. It's written in the high-resolution PMODE 3 and contains routines for sound, graphics, color, joystick commands, and interrupt handling.

The manufacturer, Computer Shack, offers those of you learning machine language the option of buying a commented printout of the source code with the game. With the disk version, you can load the source code into the Micro Works Assembler and reassemble portions of it yourself.

Balloon Attack sells for $21.95 on cassette and $23.95 on disk. The cassette version with commented code costs $31.95, and the disk version with commented code and source code is $35.95. For more information contact Computer Shack, 1691 Eason, Pontiac, MI 48054, 313-673-8700.

Reader Service ✓553

Encrypt Your Disks

Here are two new packages from Sugar Software:

- Piratector is a disk-based, applications development system with which you can protect your disk software against piracy.

The system encrypts your machine-language or Basic program to prevent them from being listed or disassembled.

If you have two or more disk drives, you can automatically generate protected copies from your master. Piratector initializes disks, copies all files from master to target, and protects up to five programs on a target disk. It sells for $99.95.

- TIMSMAIL is a mailing-list manager that provides TIMS readable files.

It's designed for an 80-column printer and will print either continuous or single sheets. You can select the fields or records to print, and print several sizes of labels, up to three across.

TIMSMAIL offers fast machine-language search, sort (three fields), and delete routines. It sells for $19.95.

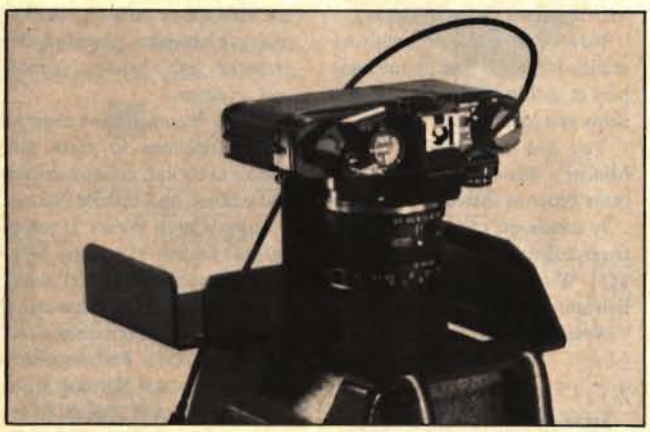
Both of these programs come from Sugar Software, 2153 Leah Lane, Reynoldsburg, OH 43068, 614-861-0565.

Reader Service ✓560

Renew Fabric Printer Ribbons

If you're throwing out your printer ribbons simply because the ink is gone or dried out, even though the fabric is still in good shape, you may fine Le Ribbonizer a worthwhile investment.

Le Ribbonizer is a motor-driven, fabric-ribbon renewer that applies ink to used ribbons. With it, you can reink ribbons from 10-20 times, depending on the type of ribbon. There are different models of Le Ribbonizer to meet the peculiarities of different



The Kodak Instagraphics with 35-mm Camera

brands of printers.

To date, Le Ribbonizer renews ribbons in black ink only and sells for $39.95, plus $2.50 postage (higher in Alaska, Hawaii, and Canada). For more information, contact Ben Torres Ribbon Service, Box 1727, Redlands, CA 92373.

Reader Service ✓569

Single Disk Mailing Program

CoCo Mail is a mailing-list program that stores information for up to 200 clients.

It saves name, address, special code, and customer information in records of up to 256 characters. The system prints standard 15/16-inch mailing labels, two across or singly, and sorts them by city, state, zip, or special code.

You can also build files of special groups of clients by moving specified files from one disk to another.

CoCo Mail, on disk with a manual and binder, sells for $59.95. It requires at least 16K and one disk drive. For more information, contact Eighty Computer Services, 4811 Wickford Green, Suite 11, Sylvania, OH 43560.

Reader Service ✓550

Play Ball!

Baseball Math is designed to test and improve your math skills as you compete against other players.

Players can decide the number of points necessary to win the game and the difficulty of the questions. Correct answers are home runs, and incorrect or late answers are strikes.

There are three innings per game, and you are allowed three strikes per inning. Therefore, a total of nine strikes for any player ends the game.

There are four games in this series: addition, subtraction, multiplication, and division. Each program sells for $29.95, plus $3 postage, from Edugames, P.O. Box 1421, Bellflower, CA 90706.

Reader Service ✓551

"Stand Aside, Mr. Potato Head"

Once upon a time, kids used to make funny faces with a castoff potato and some plastic face parts.

Now Childish Software brings such play into the computer age with Face, a program in which youngsters create new faces by choosing the eyes, nose, ears, mouth, and hair from a group of each.

To make a selection, children simply press any key when the moving cursor is beside their choice. The computer even speaks the name of each category as you choose it.

Face is a machine-language program and requires at least 16K. It sells for $21.95 from Childish Software, P.O. Box 985, Norcross, GA 30071.

Reader Service ✓554

Four Games

Mr. R's Software has released four new software packages for the CoCo.

- Bugger ($14.95) is an arcade game in which you are a bug trapped in a spider's-web maze. You must find and eat all the tidbits while avoiding the six spiders.
- Jail ($16.95) consists of six educational word games in which you enter your own word lists. You then try to logically determine the given word, or unscramble the scrambled word.
- Murder ($14.95) is an adventure game in which you must enter the hazardous, 20-room McDermott mansion and solve the McDermott murder.
- 2FER ($9.95) is two low-resolution graphic games for the price of one. In the first, you must pilot a balloon over the mountain and land between the trees. The second, Copy Cat, is a Simon-type game.

For more information on any of these games, contact Mr. R's Software, 68 Kelly Road, South Windsor, CT 06074, 203-644-1817.

Reader Service ✓555

Here's a Man Who Leads a Life of Danger

Here's a game for the Indiana Jones in all of us. Danger Ranger must go through different levels and collect keys that unlock secret treasures.

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On the second level, Danger Ranger encounters floating skulls that chase him across shifting platforms. And worst of all, he must dodge the bane of New England—acid raindrops. (Somebody call the Secretary of the Interior!)

This machine-language program requires 16K and a joystick. It's available for $19.95 on tape from Screenplay, 500 Eastowne Office Park, Suite 212, Chapel Hill, NC 27514, 800-334-5470.

Reader Service ✓562

An Electronic Worksheet

Elite-Calc is an electronic worksheet that automatically adjusts itself to your CoCo's memory.

It offers individual cell formulas, has full cell-editing capability, sorts in ascending or descending order, and allows you to copy blocks of cells.

You can enter up to 255 characters of text and set columns to individual widths. You can also move, insert, delete, or hide rows or columns.

Elite-Calc lets you justify cell contents right or left or replicate one cell to fill a row or column with selectable formula adjustment.

This program is written in machine language and requires Extended Color Basic and at least 16K. It is available on disk or tape for $44.95 from Elite Software, Box 11224, Pittsburgh, PA 15238, 412-795-8492.

Reader Service ✓563

List Phone Numbers On Your MC-10

Phone Minder is a phone-list program for Radio Shack's new MC-10 Micro Color Computer.

Now you can store approximately 80 names and phone numbers at a time. The program also helps you locate and alter files.

You can also modify Phone Minder's Basic program to keep other types of lists.

It comes on cassette for $6.95 from Eighty Computer Services, 4811 Wickford Green, Suite 11, Sylvania, OH 43560.

Reader Service ✓564

Interface Extension

If you're tired of fumbling around, switching all those cables and plugs behind your Color Computer, you may be pleased to hear about the Spectrum Control Center, an interface box that you can mount anywhere.

It offers a switch-selected printer/modem port that allows you to connect both at the same time, but individually select one or the other.

It offers a cassette switch for those of you who don't own CTR-80 or CCR-81 cassette recorders. This lets you rewind or fast-forward tape without unplugging the cables.

The Spectrum Control Center also features an LED power indicator that lets you know when the CoCo is on or off.

It sells for $99.95, plus $3 shipping, from Spectrum Projects, 93-15 86th Drive, Woodhaven, NY 11421, 212-441-2807 (voice), 212-441-3755 (BBS).

Reader Service ✓565

CoCo Word Processor

Super Color Writer II version 3.0 is a word processor that offers eight different high-resolution lowercase displays with descenders. It will work on any size Color Computer, but is best on a 64K machine, in which the ROM-pack version leaves 60K memory available, and the tape and disk versions leave 51K.

This word processor has complete editing commands, including the locate-and-change function, line insert, multiple simultaneous block manipulations, seven delete functions, and full cursor control.

Super Color Writer II version 3.0 offers a format window so that you can see an exact duplication of the text to be printed, including true page breaks, page numbers, centered text, headers, footers, and columns.

It also features three programmable functions to allow autophrase insertion, column creation and editing, and textfile linking.

Super Color Writer II version 3.0 sells for $69.95 on tape, $89.95 on ROM pack, and $99.95 on disk. The tape and disk versions require 32K. You can purchase the manual only for $15. For more information, contact Softlaw Corp., 9072 Lyndale Ave. South, Minneapolis, MN 55420, 800-227-2737.

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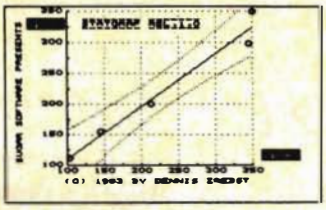
STATGRAF



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- *calcu ate, display, and print regression statistics and tests of s gnificance;
- *superimpose frame, regression line, 95% confidence limits, grid;
- *works easily with common machine language screen print programs (not supplied);
- *same program works with either tape or disk;

Requires 32K Extended Basic; supplied on disk or tape.

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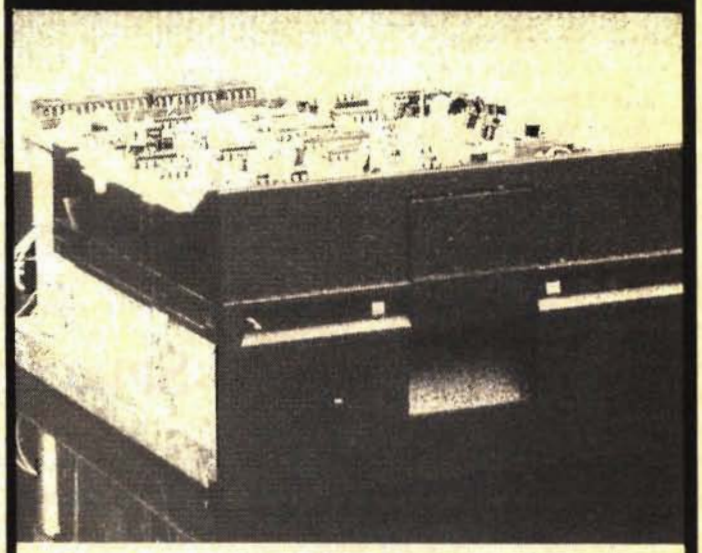

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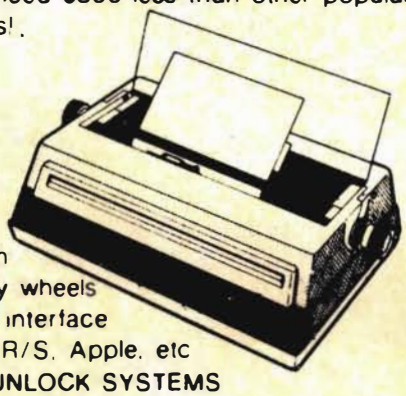

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Graphically Speaking

String Art and Spirographs

by Delmar E. Searls

In my first column (June, p. 126) I presented a short program that drew a string-art design (see Fig. 1) based on connecting each vertex of a polygon with all of the other vertices. This program had one drawback; it relied on a large number of blank moves. In fact, the number of blank moves was as great as the number of drawn lines.

On the PMODE4 graphics screen this is a minor problem, but on a plotter it wastes a tremendous amount of time.

This month I present you with an alternate program that requires a bare minimum of blank moves and a program that simulates a Spirograph toy.

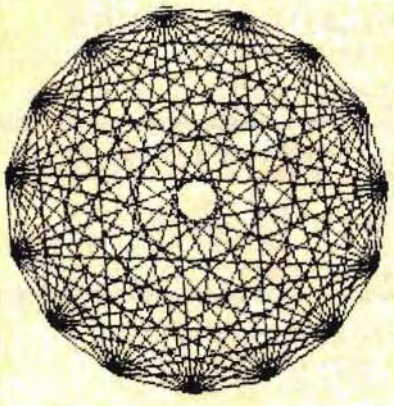

Fig. 1. A common string-art project consists of joining each vertex of a regular polygon with all of the other vertices. This was drawn by Listing 1 with the screen display printed on a LP VII printer.

System Requirements

16K RAM
Extended Color Basic

String-Art Design—A Demonstration

Place on a sheet of paper seven dots, evenly spaced. Number these dots 1–7 (see Fig. 2a). Place your pen or pencil at dot 1. As you perform the following steps, do not lift your pencil off the paper. Connect the dots in the following sequence: 1–2–3–4–5–6–7–1. Connecting every dot in order forms a polygon having, in this case, seven sides (see Fig. 2b).

Now connect every second vertex:

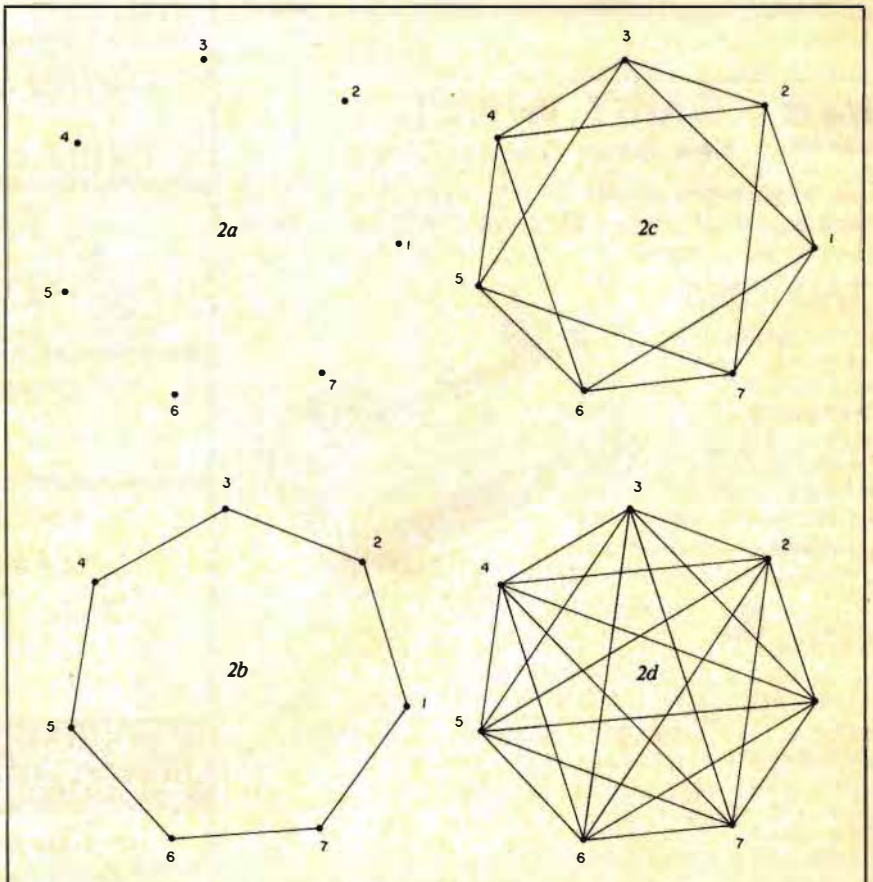

Fig. 2(a–d). These four figures demonstrate the string-art design for a seven-sided polygon.

1-3-5-7-2-4-6-1. Your drawing now looks like Fig. 2c. Finally, connect every third dot: 1-4-7-3-6-2-5-1. This completes the string-art design (see Fig. 2d). Notice that in the final draft each vertex serves as the endpoint of six line segments. In general, if the polygon has N sides, then each vertex will be on N – 1 line segments.

The main point of this little exercise is that you drew the entire project without once lifting the pencil from the paper. The only blank move required was the initial move to the first dot.

In general, the number of dot sequences is given by INT(N/2) where INT is the integer function. Thus, our seven-sided example required INT(7/2) or three dot sequences (every vertex, every second vertex, and every third vertex). I incorporated this formula into Program Listing 1.

Enter this program and run it, letting the number of sides (and thus the number of vertices) be 11. Run it four more times using five, seven, 13, and 17 vertices. Observe the results. Now run the program again and let the number of sides be eight. The program does not give the correct results. In fact, it works correctly only if the number of sides is prime. (Prime numbers have no divisors other than one and the number itself: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, and so on.)

Figure 3 illustrates string-art design using an octagon. To connect every second vertex, you must use two short dot sequences with a blank move between. When connecting every fourth dot, four short dot sequences are required and, as before, a blank move comes between each short sequence and the next.

Notice that two and four are factors (divisors) of eight. In general, if I is a factor of NS (the number of vertices), then connecting every Ith dot requires

```
0 PI=3.141592:GOSUB1:GOTO1000
1 INPUT"SCALE FACTOR <1.25>";SF:
PMODE4,1:PCLS:IF SF=0 THEN SF=1.
25
2 X0=128:Y0=96:X=0:Y=0:M=-1:GOSU
B10:RETURN
7 :
8 REM **** PLOT SUBROUTINE ****
9 :
10 XX=INT(SF*X+.5):YY=INT(Y+.5):
IFABS(M)=2THENSX=SX+XX:SY=SY-YY:
GOTO12
11 SX=X0+XX:SY=Y0-YY
12 IFSX<0THENSX=0ELSEIFSX>255THE
NSX=255
13 IFSY<0THENSY=0ELSEIFSY>191THE
NSY=191
14 P$=STR$(SX)+","+STR$(SY):IFM>
0THENDRAW"M"+P$ELSEDRAW"BM"+P$
15 IFM=-3THENX0=SX:Y0=SY
16 RETURN
997 :
998 REM **** A SIMPLE STRING ART
 PROGRAM ****
999 :
1000 INPUT "NUMBER OF SIDES";NS
1010 INPUT "VALUE OF R <95)";R:I
F R=0 THEN R=95
1020 SCREEN1,1
1027 :
1028 REMARK   STORE COORDINATES
OF VERTICES (THE DOTS)
1029 :
1030 DIM X(NS),Y(NS)
1040 A=0:DA=2*PI/NS
1050 FOR I=1 TO NS
1060 :  X(I)=R*COS(A):Y(I)=R*SIN
(A)
1070 :  A=A+DA
1080 NEXT I
1087 :
1088 REMARK   SET VERTEX COUNTER
 AND BLANK MOVE TO FIRST DOT
1090 C=1:X=X(1):Y=Y(1):M=-1:GOSU
B 10
1097 :
1098 REMARK   ENTER MAIN LOOP
1099 :
1100 FOR I=1 TO INT(NS/2)
1127 :
1128 :  REMARK   DRAW THE DOT SE
QUENCE FOR EACH VALUE OF I.
1129 :
1130 :  FOR J=1 TO NS:GOSUB 1400
:NEXT J
1250 NEXT I
1257 :
1258 REMARK   STOP PROGRAM TO AL
LOW USER TO VIEW RESULT.
1259 :
1260 GOTO 1260
1394 REMARK **** END OF MAIN PRO
RAM ****
1395 :
1397 REMARK   INCREMENT THE VERT
EX COUNTER TO POINT AT THE NEXT
DOT.
1398 REMARK   MAKE SURE THE COUN
TER IS POINTING AT A DOT NUMBERE
D 1 TO NS.
1399 :
1400 C=C+I:IF C>NS THEN C=C-NS
1407 :
1408 REMARK   DRAW A LINE TO VER
TEX C
1409 :
1410 X=X(C):Y=Y(C):M=1:GOSUB10
1420 RETURN
```

Program Listing 1. This draws a familiar string-art design based on any polygon whose number of sides is prime. Only one blank move is required.

I dot sequences with a blank move between each dot sequence and the next. Furthermore, the number of dots in each sequence will be NS/I.

Unfortunately, there is another complication. Draw 10 evenly spaced dots and connect every fourth dot, starting with the first. You'll discover that you return to the first dot after hitting a total of only five dots (1–5–9–3–7–1). You must draw a second dot sequence (2–6–10–4–8–2) in order to complete this part of the drawing.

Even though four is not a factor of 10, it still takes more than one dot sequence to connect every fourth dot, because four and 10 have a common factor—two. In fact, two is the highest common factor (or the greatest common divisor). This leads to a second, more general, conclusion:

If G is the greatest common divisor of I and NS, then it will require G dot sequences to connect every Ith dot. Furthermore, each dot sequence will include NS/G dots.

For example, suppose NS equals 28 and you are connecting every eighth dot. Four is the greatest common divisor (G) of eight and 28. Thus, it will require four dot sequences to connect every eighth dot and each dot sequence will include seven dots. (If I is a factor of NS, then I is the greatest common divisor (G = I) and you obtain the previous result as a special case of this more general conclusion. For example, if NS equals 12 and I equals 4, then the greatest common divisor is also four and it will require four dot sequences of three dots each in order to connect every fourth dot.)

Program Listing 2 uses this formula to draw the string-art design for any value of NS. You can add the necessary lines to those in Listing 1 and save some typing. Line 1090 is different in Listing 2 than in Listing 1. This is the only line that you need to alter.

Line 1110 of Program Listing 2 calls a subroutine (1300–1330), which finds the greatest common divisor of I and NS and returns it as F2. If this result is greater than one, the program drops to line 1150. In the special case where I is exactly half of NS, the program drops to line 1210.

Lines 1160–1200 draw the correct number of dot sequences as necessary, and lines 1210–1250 handle the special case where the lines are simply diameters through the middle of the figure. In this case, it is not necessary to return to the initial dot before going to the next dot sequence. Doing so would only draw the same line twice. The subroutine in lines 1400–1420 handles the drawn lines, while the subroutine in lines 1500–1520 handles the blank moves.

The logic this program uses is ideally suited for a plotter because it requires a bare minimum of blank moves when drawing a figure. As a bonus for those of you who have the Radio Shack Color Graphic Printer, which acts like a plotter, I have included Program Listing 3. While the numbering of program lines is different, the program is essentially identical to lines 1000–1520 in Listing 2. The SCREEN 1,1 command has been replaced by commands to set up the plotter, and the GOSUB 10 commands have been replaced by the appropriate plotter commands.

You should note one other change. When calculating coordinates for use by the Color Graphic Printer it is important to convert them to rounded-off integers (see line 80 in Listing 3). If you don't do so, you'll be disappointed with the results. An example of the Color Graphic Printer output is given in Fig. 4.

Fig. 3. The string-art design for an octagon reveals some complications compared to the seven-sided polygon of Fig. 2d. You cannot connect every second vertex in just one operation. It requires two. Likewise, it requires four dot sequences to connect every fourth vertex.

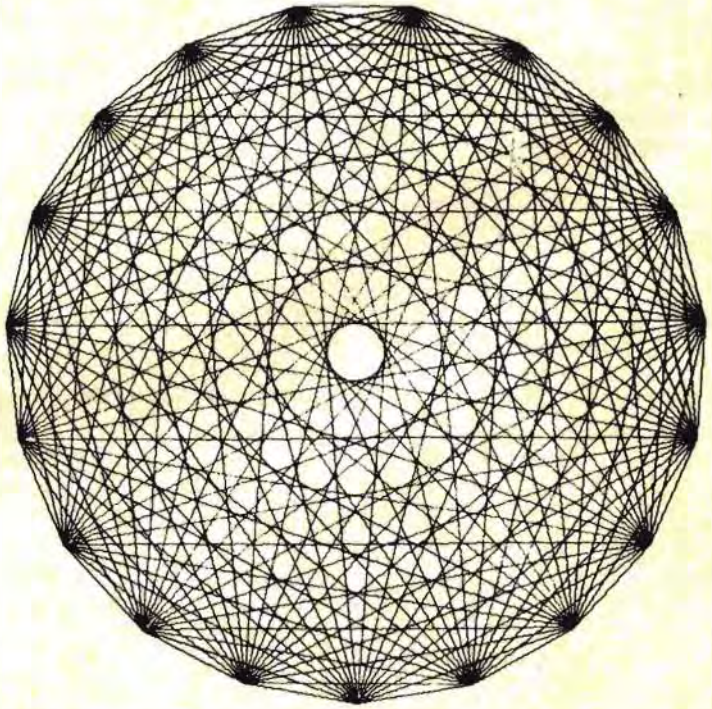

Fig. 4. An example of the output from Listing 3. Since the Color Graphic Printer has a higher resolution than the PMODE4 display, the designs look more delicate.

Spirogrf

Spirogrf (Program Listing 4) was inspired by the Spirograph toy. If you're not familiar with a Spirograph, it consists of two parts: an outer ring of plastic, the inner circumference of which has teeth pointing inward, and a separate, smaller inner disk with teeth pointing outward. To create graphics with the toy you place a pencil or pen in one of the small holes in the disk of the smaller ring and rotate it. The meshing of the teeth prevents slippage.

As the smaller disk and pen move along the inner circumference of the ring, a pattern is drawn. By changing the size of the disk and by varying the location of the pen within a disk, you can draw a large variety of designs.

Figure 5 illustrates this concept and provides some of the mathematical background for Spirogrf. As the center of the disk moves in the normal positive direction (counterclockwise), the pencil hole moves in the opposite direction (clockwise). Consequently, the angle from the positive X direction to the pencil hole is designated – A2. The trigonometric functions of negative angles can be easily expressed in terms of the corresponding positive angles as shown in Fig. 6.

I had to express angle A2 in Spirogrf in terms of angle A1. This is how I did it. I took the geometric formula S = RA, where S is the arc length along a portion of a circle, R is the radius of the circle, and A is the central angle in radians (Fig. 7) and expanded it. With this formula as a foundation, the large circle (Fig. 5) became S1 = R1*A1, while the disk became S2 = R2*A2.

```
0 PI=3.141592:GOSUB1:GOTO1000
1 INPUT"SCALE FACTOR <1.25>";SF:
PMODE4,1:PCLS:IF SF=0 THEN SF=1.
25
2 X0=128:Y0=96:X=0:Y=0:M=-1:GOSU
B10:RETURN
10 XX=INT(SF*X+.5):YY=INT(Y+.5):
IFABS(M)=2THENSX=SX+XX:SY=SY-YY:
GOTO12
11 SX=X0+XX:SY=Y0-YY
12 IFSX<0THENSX=0ELSEIFSX>255THE
NSX=255
13 IFSY<0THENSY=0ELSEIFSY>191THE
NSY=191
14 P$=STR$(SX)+","+STR$(SY):IFM>
0THENDRAW"M"+P$ELSEDRAW"BM"+P$
15 IFM=-3THENX0=SX:Y0=SY
16 RETURN
20 :
21 '****************************
22 '*                          *
23 '*  THIS PROGRAM DRAWS A    *
24 '*  POPULAR STRING ART      *
25 '*  DESIGN USING A BARE     *
26 '*  MINIMUM OF BLANK MOVES. *
27 '*  THE LOGIC USED IS       *
28 '*  IDEALLY SUITED FOR USE  *
29 '*  ON A PLOTTER.           *
30 '*                          *
31 '****************************
32 :
1000 INPUT "NUMBER OF SIDES";NS
1010 INPUT "VALUE OF R <95)";R:I
F R=0 THEN R=95
1020 SCREEN1,1
1030 DIM X(NS),Y(NS)
1040 A=0:DA=2*PI/NS
1050 FOR I=1 TO NS
1060 :  X(I)=R*COS(A):Y(I)=R*SIN
(A)
1070 :  A=A+DA
1080 NEXT I
1090 C=1:GOSUB 1510
1100 FOR I=1 TO INT(NS/2)
1110 :  F1=NS:F2=I:GOSUB 1300
1120 :  IF F2<>1 THEN 1150
1130 :    FOR J=1 TO NS:GOSUB 14
00:NEXT J
1140 :  GOTO 1250
1150 :  IF I=NS/2 THEN 1210
1160 :  FOR J=1 TO F2
1170 :    FOR K=1 TO NS/F2:GOSUB
 1400:NEXT K
1180 :  IF J=F2 THEN 1190 ELSE G
OSUB 1500
1190 :  NEXT J
1200 :  GOTO1250
1210 :  FOR J=1 TO I
1220 :    GOSUB 1400
1230 :    IF J=I THEN 1240 ELSE
GOSUB 1500
1240 :  NEXT J
1250 NEXT I
1260 GOTO 1260
1297 :
1298 REM **** END OF MAIN PROGRA
M ****
1299 :
1300 IF F1>=F2 THEN F1=F1-F2:GOT
O 1300
1310 IF F1=0 THEN 1330
1320 T=F1:F1=F2:F2=T:GOTO 1300
1330 RETURN
1399 :
1400 C=C+I:IF C>NS THEN C=C-NS
1410 X=X(C):Y=Y(C):M=1:GOSUB10
1420 RETURN
1499 :
1500 C=C+1:IF C>NS THEN C=C-NS
1510 X=X(C):Y=Y(C):M=-1:GOSUB10
1520 RETURN
```

Program Listing 2. This draws a string-art design using any number of vertices. The logic requires a bare minimum of blank moves.

Since the teeth prevent slippage, these two distances should be equal:

S2 = S1
R2*A2 = R1*A1
A2 = R1*A1/R2
A2 = (R1/R2)*A1

In Listing 4 the value R1/R2 is designated A0 in line 1110 and the size of A2 is calculated in line 1170.

There is one other problem that I needed to consider. How would the program know when it had finished a pattern? If I used an IF...THEN test following the drawing of each line segment to determine if the endpoint of that segment corresponded to the initial starting point of the design, the overall execution time would have been increased. I used a different approach.

The pencil hole returns to its initial position the first time that both A1 and A2 are multiples of 360 degrees (or 2*PI radians). Suppose that A1 = K*360 where K is an integer. You've just seen that A2 = (R2/R1)* A1, and thus A2 = (R2/R1)*K*360. Consequently, A2 will be a multiple of 360 (and thus the pencil hole returns to its initial position) the first time that (R2/R1)*K is an integer. This occurs when K is equal to R2 divided by the greatest common divisor (GCD) of R1 and R2.

The subroutine in lines 1500–1550 performs the task of finding the greatest common divisor of R1 and

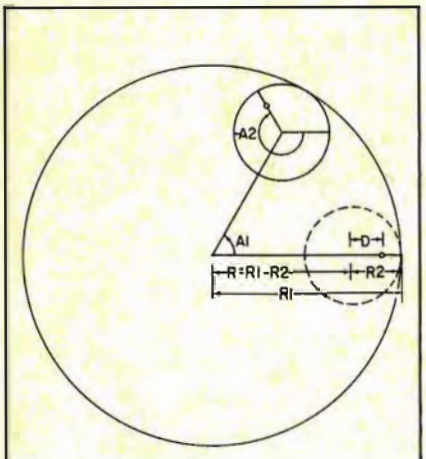

*Fig. 5. Spirogrf is based on a child's toy, which involves a disk (of radius R2) rolling along the inner edge of a larger ring (of radius R1). There are holes in the small disk for inserting a pencil, which draws a design as the disk rolls. As the center of the disk moves counterclockwise (through an angle of A1), the pencil hole moves about that center in a clockwise fashion (−A2). The center of the large ring is considered to be the origin. The center of the disk is then given by CX = (R1 − R2)*COS(A1) and CY = (R1 − R2)*SIN(A1). Relative to the center of the disk, the pencil hole is given by PX = D*COS(−A2) and PY = D*SIN(−A2). This leads to the final result for the coordinates of the pencil hole relative to the origin X = CX + PX and Y = CY + PY.*

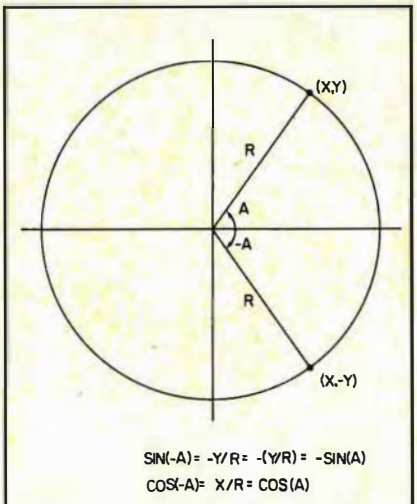

Fig. 6. Spirogrf finds the sine and cosine of negative angles. By using the definition of the trigonometric functions and a little geometry, trigonometric functions of negative angles can be easily calculated using the corresponding positive angles.

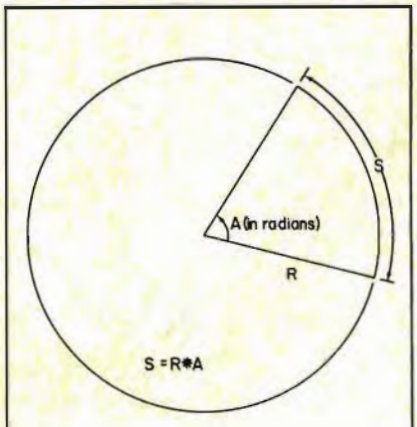

Fig. 7. The arc length measured along a sector of a circle can be found by multiplying the radius by the central angle (measured in radians).

Fig. 8. A Spirogrf Design Drawn on the Screen and Then Printed Using the LP VII Printer

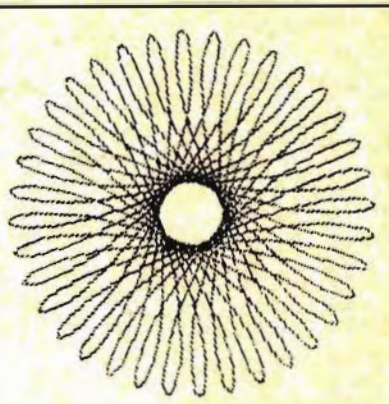

Fig. 9. A Spirogrf Design Drawn in PMODE4

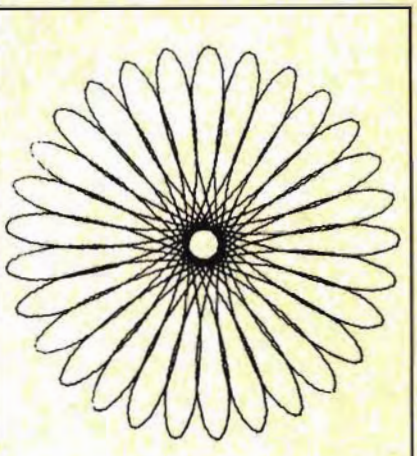

Fig. 10. A Spirogrf Design Created Using the Color Graphic Printer and Listing 5

```
1 REM **** STRING ART DESIGN FOR
 THE COLOR GRAPHIC PRINTER ****
2 :
3 :
10 PI=3.141592
19 :
20 INPUT "NUMBER OF SIDES";NS
30 INPUT "VALUE OF R";R
39 :
40 PRINT#-2,CHR$(17);CHR$(18);"M
240,-240":PRINT#-2,"I"
49 :
50 DIM X(NS),Y(NS)
60 A=0:DA=2*PI/NS
69 :
70 FOR I=1 TO NS
80 :  X(I)=INT(R*COS(A)+.5):Y(I)
=INT(R*SIN(A)+.5)
90 :  A=A+DA
100 NEXT I
109 :
110 C=1:GOSUB 3010
120 FOR I=1 TO INT(NS/2)
130 :  F1=NS:F2=I:GOSUB1000
140 :  IF F2<>1 THEN 170
150 :    FOR J=1 TO NS:GOSUB 200
0:NEXT J
160 :  GOTO 270
170 :  IF I=NS/2 THEN 230
180 :  FOR J=1 TO F2
190 :    FOR K=1 TO NS/F2:GOSUB
2000:NEXT K
200 :    IF J=F2 THEN 210 ELSE G
OSUB 3000
210 :  NEXT J
220 :  GOTO270
230 :  FOR J=1 TO I
240 :    GOSUB 2000
250 :    IF J=I THEN 260 ELSE GO
SUB 3000
260 :  NEXT J
270 NEXT I
280 END
999 :
1000 IF F1>=F2 THEN F1=F1-F2:GOT
O 1000
1010 IF F1=0 THEN 1030
1020 T=F1:F1=F2:F2=T:GOTO 1000
1030 RETURN
1999 :
2000 C=C+I:IF C>NS THEN C=C-NS
2010 X=X(C):Y=Y(C):PRINT#-2,"D";
X;",";Y
2020 RETURN
2999 :
3000 C=C+1:IF C>NS THEN C=C-NS
3010 X=X(C):Y=Y(C):PRINT#-2,"M";
X;",";Y
3020 RETURN
```

Program Listing 3.

A version of Listing 2 for the Color Graphic Printer

✓See List of Advertisers on page 130

R2. In line 1120, I and J are set equal to R1 and R2, respectively, and the subroutine is called. The GCD is assigned to the variable G in line 1540. The value of K=R2/GCD is calculated in line 1130 and multiplied by 50 because each cycle is represented by drawing 50 short line segments. The value of N in line 1130 is the total number of short line segments needed to complete the design.

The scale factor in line 1030 lets you adjust the size of the design without altering the values input for R1 and R2. Notice the use of default values in lines 1000, 1030, and 1040. For my machine the color codes are as follows: one equals black, two equals blue, three equals red, and four equals white (though sometimes the red and the blue are switched).

This program can be a lot of fun. Play with it and see what you come up with. The program also lets you draw multiple designs on the screen. In order to clear the screen, press break and type RUN. If you are constructing a display with several nonoverlapping designs, you can erase a design by redrawing it using color code one (black).

Figure 8 is a printout of a screen display drawn by Listing 4. Photos 1 and 2 are examples of displays as they appear on the television screen. If you want a higher resolution (Fig. 9 and

```
0 PI=3.141592:GOSUB1:GOTO1000
1 INPUT"SCALE FACTOR <1.25>";SF:
PMODE4,1:PCLS:IF SF=0 THEN SF=1.
25
2 X0=128:Y0=96:X=0:Y=0:M=-1:GOSU
B10:RETURN
7 :
8 REM **** PLOT SUBROUTINE ****
9 :
10 XX=INT(SF*X+.5):YY=INT(Y+.5):
IFABS(M)=2THENSX=SX+XX:SY=SY-YY:
GOTO12
11 SX=X0+XX:SY=Y0-YY
12 IFSX<0THENSX=0ELSEIFSX>255THE
NSX=255
13 IFSY<0THENSY=0ELSEIFSY>191THE
NSY=191
14 P$=STR$(SX)+","+STR$(SY):IFM>
0THENDRAW"M"+P$ELSEDRAW"BM"+P$
15 IFM=-3THENX0=SX:Y0=SY
16 RETURN
990 :
991 '**************************
992 '*                        *
993 '*        SPIROGRF        *
994 '*                        *
995 '**************************
996 :
1000 CLS:INPUT "RADIUS OF CIRCLE
 <90>";R1:IF R1=0 THEN R1=90
1010 INPUT "RADIUS OF DISK";R2
1020 INPUT "DISTANCE FROM CENTER
 OF DISK TO HOLE";D
1030 INPUT "SCALE FACTOR <1>";S:
IF S=0 THEN S=1
1040 INPUT "COLOR CODE <2>";C:IF
 C=0 THEN C=2
1050 PMODE4,1:SCREEN1,1:PMODE3,1
:COLOR C
1060 GOSUB 1100:   REMARK   THIS
 SUBROUTINE DRAWS THE DESIGN
1070 A$=INKEY$:IF A$=""THEN 1070
1080 GOTO 1000
1090 :
1091 REMARK   THE REMAINING LINE
S FORM A SUBROUTINE THAT DRAWS
1092 REMARK   THE DESIGN.
1093 :
1100 D=D*S:R=(R1-R2)*S:A1=0:DA=2
*PI/50
1110 A0=R1/R2
1120 I=R1:J=R2:GOSUB 1500 :  REM
   FIND GREATEST COMMON DIVISOR
OF R1 AND R2.
1130 N=50*R2/G
1140 X=R+D:Y=0:M=-1:GOSUB10 :  R
EM   BLANK MOVE TO FIRST POINT
1147 :
1148 REMARK   ENTER MAIN DRAWING
 LOOP.
1149 :
1150 FOR I=1 TO N
1160 :  A1=A1+DA :  REM   ADD IN
CREMENT TO A1
1170 :  A2=A1*A0 :  REM   FIND S
ECOND ANGLE
1177 :
1178 :  REMARK   FIND COORDINATE
S AND DRAW TO NEXT POINT.
1179 :
1180 :  X=R*COS(A1)+D*COS(A2):Y=
R*SIN(A1)-D*SIN(A2):M=1:GOSUB10
1190 NEXT I
1200 RETURN
1496 :
1497 REMARK   THIS SUBROUTINE FI
NDS THE GREATEST COMMON DIVISOR
OF R1
1498 REMARK   AND R2 AND RETURNS
 THE VALUE AS VARIABLE G.
1499 :
1500 IFI<J THEN T=I:I=J:J=T
1510 IFI>=J THEN I=I-J:GOTO1510
1520 IF I=0 THEN 1540
1530 T=I:I=J:J=T:GOTO1510
1540 G=J
1550 RETURN
```

Program Listing 4. Spirogrf

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```
1 REM **** SPIROGRF FOR THE COLO
R GRAPHIC PRINTER ****
2 :
3 :
10 PI=3.141592
19 :
20 PRINT#-2,CHR$(17):PRINT#-2,CH
R$(18);"M240,-240":PRINT#-2,"I"
29 :
30 INPUT "RADIUS OF CIRCLE <90>"
;R1:IF R1=0 THEN R1=90
40 INPUT "RADIUS OF DISK";R2
50 INPUT "DISTANCE FROM CENTER O
F DISK TO HOLE";D
60 INPUT "SCALE FACTOR <1>";S:IF
 S=0 THEN S=1
70 INPUT "COLOR CODE <0>";C
79 :
80 PRINT#-2,"C";C
90 GOSUB 1000
99 :
100 A$=INKEY$:IF A$=""THEN 100
110 GOTO 30
998 :
999 :
1000 D=D*S:R=(R1-R2)*S:A1=0:DA=2
*PI/50
1010 A0=R1/R2
1020 I=R1:J=R2:GOSUB 2000
1030 N=50*R2/G
1040 X=R+D:Y=0:PRINT#-2,"M";X;",
";Y
1050 FOR I=1 TO N
1060 :  A1=A1+DA
1070 :  A2=A1*A0
1080 :  X=R*COS(A1)+D*COS(A2):Y=
R*SIN(A1)-D*SIN(A2)
1090 :  X=INT(X+.5):Y=INT(Y+.5)
1100 :  PRINT#-2,"D";X;",";Y
1110 NEXT I
1120 RETURN
1999 :
2000 IFI<J THEN T=I:I=J:J=T
2010 IFI>=J THEN I=I-J:GOTO2010
2020 IF I=0 THEN 2040
2030 T=I:I=J:J=T:GOTO2010
2040 G=J
2050 RETURN
```

Program Listing 5. Spirogrf for the Color Graphic Printer

Photo 3), then alter the program to use PMODE4 graphics. You can also alter the program to allow changing the initial angle (A1). This angle is set equal to zero in line 1100, but you can use an INPUT command to enter any value you wish. This permits designs such as that shown in Photo 4.

Program Listing 5 is a version of Spirogrf written for the Color Graphic Printer. The higher resolution of the plotter results in more delicate designs (see Fig. 10). You also have four different colors to work with.

Looking Ahead

In December's column I'll look at graphing polar equations. These equations use polar coordinates (R,A), where R is the length of the line joining a given point and the origin, and A is the angle from the positive X axis to this line. These equations are graphed on a polar coordinate grid that consists of a series of concentric circles with evenly spaced lines radiating out from the center. As you shall see, some very exotic patterns can be created. ■

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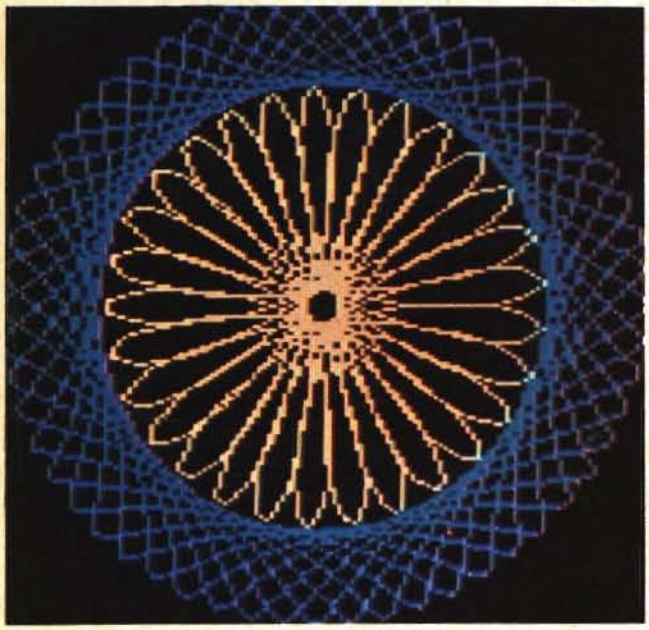


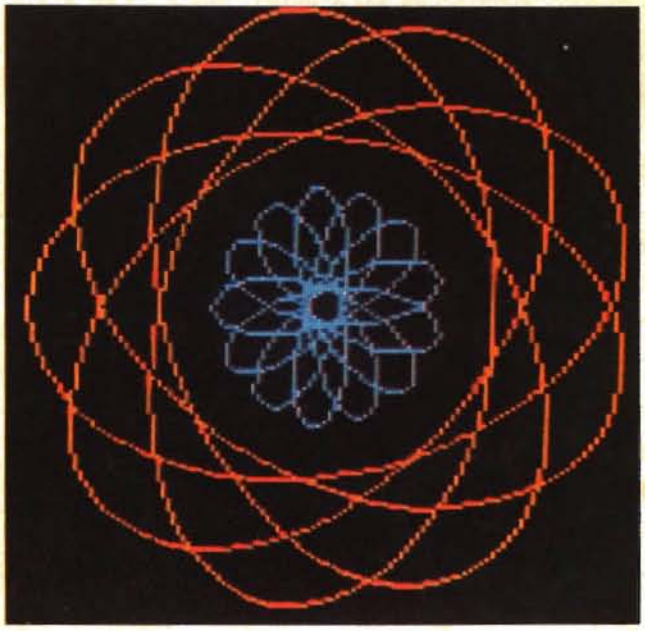


Photo 1 and 2. The colors show up vividly against the black background in these designs drawn by Spirogrf.

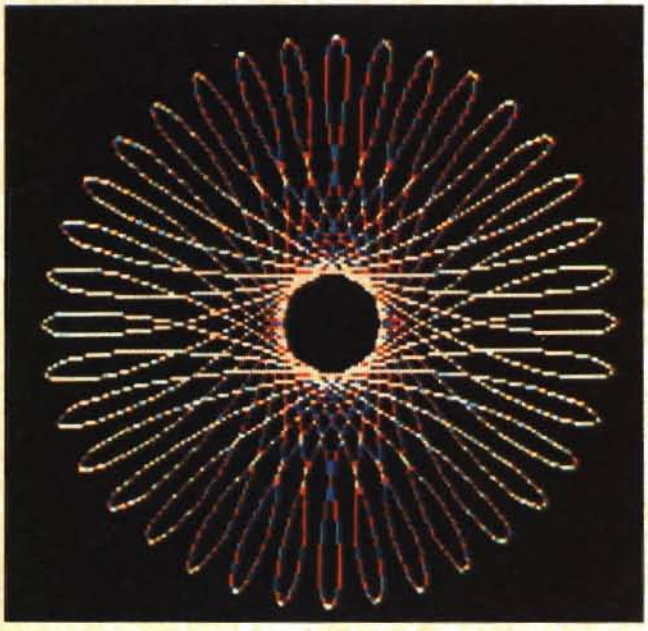


Photo 3. A PMODE4 Graphics Screen

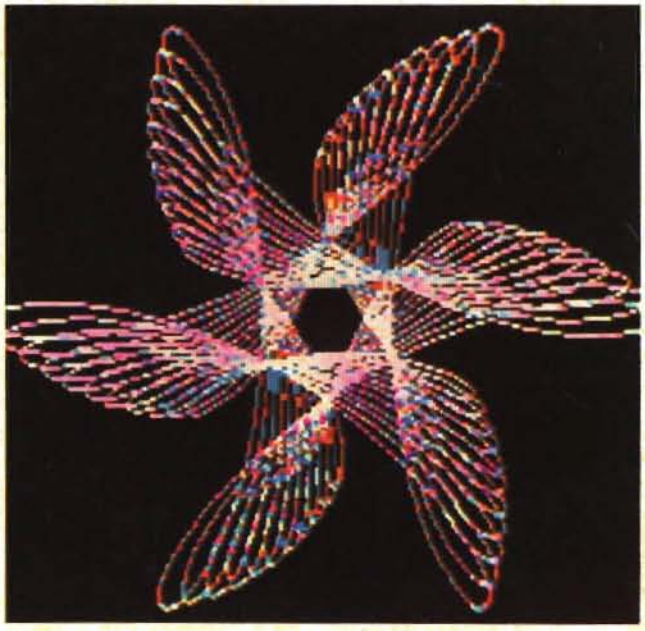
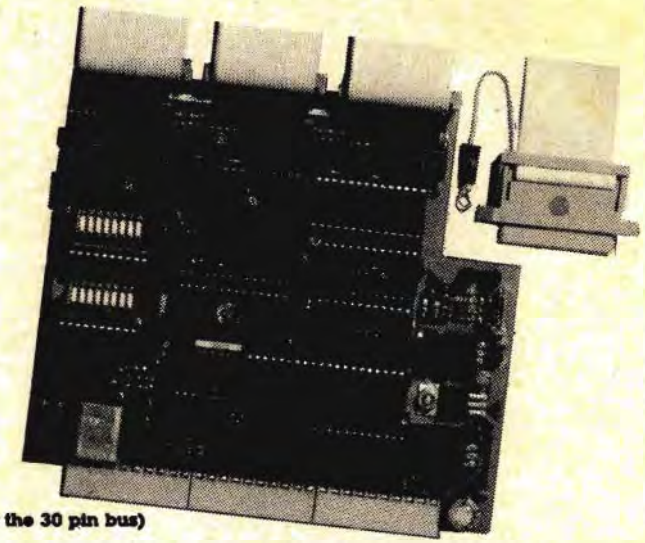


Photo 4. Design Using Different Values

Intelligent Serial I/O Processor Board #11



(for the 30 pin bus)

The GIMIX Intelligent Three-port RS-232C Serial Interface can significantly increase the throughput of a multi-user system. By buffering data transfers between users and the system, and preprocessing the data, it reduces the number of interrupts to the host CPU, allowing the host more time for other processing tasks.

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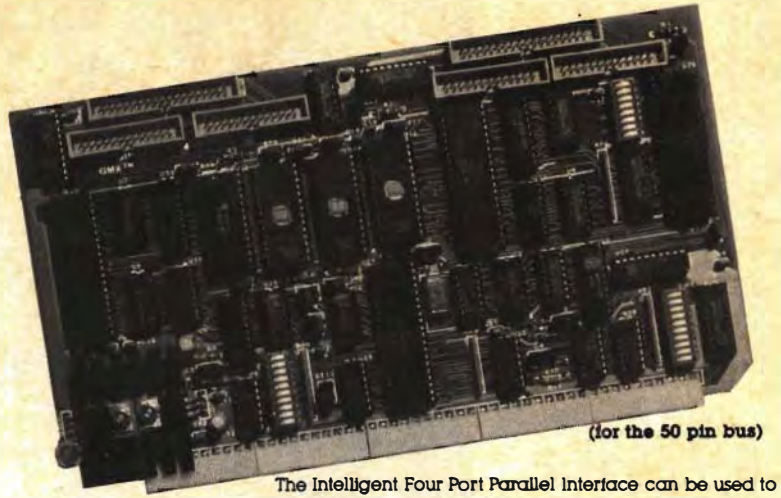
- Independent on-board 2MHz. 68B09 CPU
- Up to 20K of on-board memory (EPROM and RAM)
- Buffered data transfer between host and on-board CPUs using a Z8038 FIO with 128 byte bi-directional FIFO buffer and mailbox message capabilities.
- Three RS-232C serial I/O ports (6551As) with software selectable baud rates, word length, stop bits, and parity.
- Each port has five "handshake" lines for modem control applications.
- The on-board 6809 can be reset by the host processor.
- Compatible with memory-to-memory DMA transfers to/from the GMX 6809 CPU III.
- Sense switches and status LEDs that can be used to select software options and indicate board status.
- Separate 26-pin cable connections for each port.

Appropriate on-board firmware and operating system drivers are required. Uses up to three #95 cable sets (DB-25S connectors).

OS-9 firmware and drivers for the Intelligent 3-port Serial Interface

The OS-9 firmware and drivers enhance the performance of multi-user systems, while providing functions equivalent to the standard ACIA type drivers normally used for terminals and serial printers. Input line editing functions (backspace, echo, line dup and repeat, etc.) are handled by the I/O board, rather than the host, allowing the host more time for other processing tasks. The host is only interrupted when a complete input line (terminated by a "CR") is entered, or certain special characters are received. Input and output data are buffered on the I/O board so that the host can perform other tasks while serial data is being transmitted or received. When used with the GMX CPU III, block data transfers between the I/O board and the host use the CPUs memory-to-memory DMA to further enhance throughput. In addition to performance enhancements, features such as software selectable baud rates and transmission characteristics (number of data bits, stop bits, parity, etc.) are provided. The board also transmits "messages" to any or all I/O ports to indicate that the I/O interface is ready and "waiting for the host", and that the host is "on-line" and has opened a path to the port. Messages to individual ports can be disabled.

Intelligent Parallel I/O Processor Board #12



(for the 50 pin bus)

The Intelligent Four Port Parallel Interface can be used to improve system performance by buffering data transfers to parallel peripherals such as printers and/or by buffering and pre-processing parallel input data from keyboards, sensors, etc.

Features:

- Independent on-board 2MHz 68B09 CPU
- Up to 32K of on-board memory (EPROM and RAM)
- Buffered data transfer between host and on-board CPUs using a Z8038 FIO with 128 byte bi-directional FIFO buffer and mailbox message capabilities.
- Four fully buffered 8-bit parallel ports with handshaking and input/output latches (two 6522 VIAs). Each 6522 also has two 16-bit counter/timers and a shift register for serial data transfers.
- Software programmable direction for each bit on two of the four ports (1 per VIA), the other 2 ports can be individually programmed as 8 in or 8 out. The bi-directional handshake lines can be programmed as inputs or outputs.
- The on-board 6809 can be reset by the host processor.
- Full 20-bit address decoding; it can be addressed on any 4 byte boundary in 1M byte of address space.
- Compatible with memory-to-memory DMA transfers to/from the GMX 6809 CPU III.

Appropriate on-board firmware and operating system drivers are required. Uses up to four #95 cable sets (DB-25P connectors) or two 36-pin cable sets with Centronics compatible connectors. Centronics compatible cable sets include a back panel connector plate for the Classy Chassis. Back panel to printer cables are also available.

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