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Ahoy!

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DEPARTMENTS

FEATURES

*Includes programs: *Three-Voice Player, One-Voice Player, Broken Melody* (for the C-64)

**Includes program: *The Ultimate Resolution* (for the C-64)

***Includes program: *The 6510 Simulator* (for the C-64)

PROGRAMS

Cover art by James Regan; art inside screens by Javier Romero, James Regan, JoAnn Case

ISSUE NO. 18 **JUNE 1985**

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VIEW FROM THE BRIDGE

"A 'Graphics Extravaganza?' " Michael Schneider asked when I showed him this month's cover headline. "A couple of programs and a tutorial doesn't make it an 'extravaganza.' If I'm going to call it a 'graphics extravaganza,' it had darn well better be a 'graphics extravaganza.' "

Having a publisher with ethics is a constant source of difficulty, but one the shrewd editor can live with through careful planning. In this case, careful planning involved bringing along the full lineup of graphics articles in this month's *Ahoy!* One by one I laid them on his desk.

"Look, Mike," I said, "*Screen Magic* by Bob Spirko, who wrote *Alice in Adventureland* for us a few months back. It provides a joystick-controlled palette and canvas for creating color graphics on the 64, without all the complicated commands.

"And *Screen Dumping on the Commodore 64*—a real education in creating screen bit graphics. It would have to be. It was written by Professor Roger S. Macomber of the University of Cincinnati. The program he includes uses machine language to speed up the dumping of graphics to a printer.

"Dale Rupert covered screen bit graphics in this month's *Rupert Report*, too—but *The Ultimate Resolution* concentrates on the theory behind practical applications like Prof. Macomber's.

"Here's another example of how graphics theory can be put to use: J.M. Marcano's *Mapping 4.4*, which allows you to plot mathematical functions in hi-res."

Peering at me over the pile of manuscripts, Mike looked annoyed. I asked why.

"Because," he said, "you're standing here babbling when you've got a graphics extravaganza to put together!"

Gee, I thought as I left Mike's office—I didn't even get to tell him about this graphics issue's flagship piece: *Quad-Print* by Michael Beutjer. Mprton Kevelson will tell *you* all about this landmark program in his *Graphics Challenge Update* on the facing page.

Having justified our cover headline, we'll now do the same for the larger type on the cover—the *Ahoy!* logo—with the finest lineup of Commodore-related articles and programs you'll find on the newsstand this month:

- For Orson Scott Card to outdo himself would take some doing (outdoing?)—but he may have succeeded with this month's installment of *Creating Your Own Games on the VIC and 64.* In *Sing a Song of Anything,* he provides a system by which C-64 users can automatically enter music into their original game programs—as easily as typing letters! (Turn to page 18.)
- The third installment of *Commodore Roots,* Mark Andrews' assembly language programming column, peers *Under the Hood* of your computer at its microprocessor. Included is the *6510 Simulator,* a program which, while not an assembler, will show you how one works. (Turn to page 77.)
- *Duck Shoot* starts out as easy as the penny arcade version, but soon reaches a level of complexity certain to ruffle your feathers. (Turn to page 35.)
- *Towers of Hanoi* adapts the famous Tower of Brahma puzzle to the C-64 screen. (Turn to page 17.)
- Even the most expert joystickers will be thrown for a loss by *Speedy* for the unexpanded VIC 20. Its title character has a mind of his own when it comes to responding to your directions. (Turn to page 56.)
- Sheldon Leemon, author of *MACTALKS* and *Telecomputing on the IBM PC* from COMPUTE! Books, takes over at the helm of our *Ship to Shore* column this month with a technical overview of telecommunications. (Turn to page 29.)
- Also inside are Dale Rupert's *Commodares* at their most frustrating; *Scuttlebutt,* offering news in greater depth and more timely fashion than any other Commodore monthly; and *Reviews* of products like *Blue Max 2001, PROMAL,* and the Teknika MJ-10 color monitor.

Love to tell you more, but I have to run back to Mike's office. His secretary dropped a note on my desk—something about a "Graphics Super-Spectacular."

—David Allikas

GRAPHICS CHALLENGE UPDATE

By Morton Kevelson

In the October 1984 issue of *Ahoy!*, as part of a tour de force on Commodore 64 bit mapped graphics, I issued a graphics challenge to all comers. In brief, I was looking for some way to manipulate a bit mapped graphics field which exceeded the limitations of a single 320 by 200 pixel Commodore 64 high resolution display. The response has been far from overwhelming, but some results are in.

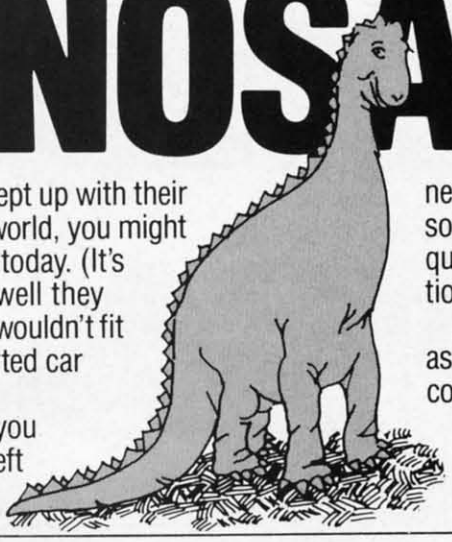
The first answer came from Inkwell Systems, with version 4.0 of *Flexidraw.* Among the enhancements to version 3.0 (reviewed in November 1984) is the ability to link multiple screens on both the monitor and the printer. This allows for printouts made up of 544 pixels wide and an unlimited number of pixels high. (Look for a detailed review of *Flexidraw* version 5.0 later this year. This will have so many enhancements to version 3.0 that it is practically a new program.)

The second response comes from Michael Beutjer, author of *Picture Perfect* from KT Software (October 1984 *Ahoy!*). For those of you who have been unable to locate this versatile Koala screen dump program, it is now being sold as *KoalaPrinter* by Koala Technologies. Mr. Beutjer has responded to my challenge by providing the *Quad-Print* program in this month's issue. The two versions of this program will allow up to four *DOODLE!* files to be linked for simultaneous printout on a Gemini 10X or a Commodore 1526 printer.

Bit mapped graphics for the 1526 printer are difficult to implement, as it does not support true graphics mode. The 1526 allows for a single custom character to be defined and printed. Thus a full bit mapped screen dump requires the image to be formed eight bytes at a time. Furthermore, each time the custom character is redefined a carriage return without linefeed must be executed before it can be printed. This is what causes bit mapped screen dumps to print so slowly on the 1526.

For advanced users, the source code listings for the *Quad-Print* programs have been included. Owners of the 1526 should take note of the listing labeled *Fast Dump Routine.* Mr. Beutjer has used a clever trick to maximize the speed of the 1526 bit map printout. The single character is not redefined unless it is found to be different from the last one. As a result, this high resolution dump for the 1526 should be the fastest available from any source. □

HOW TO AVOID BECOMING A DINOSAUR.



If dinosaurs had kept up with their rapidly changing world, you might have a pet bronto today. (It's probably just as well they didn't, since they wouldn't fit into a small imported car anyway.)

The point is, if you don't want to get left behind today, you need a computer with the latest software and accessories. No question about it. The only question is, "where do I buy it?"

Ah! We thought you'd never ask. Computer Warehouse, of course. Nice guys, great prices.

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If you can analyze trends as shrewdly as we, then you realize that player piano sales are at an all-time low. So what does a piano roll company with 85 years of experience do? Convert all that digitized music to disk, of course. That's what Q-R-S Music Rolls Inc. and Micro-W. Distributing have combined to do.

Q-R-S will make its library of over 10,000 piano rolls available, digitally encoded to run on Commodore and other popular computers. Required is an instrument such as a keyboard synthesizer (to serve as the equivalent of a player piano), equipped with a Musical Instrument Digital Interface (MIDI). Micro-W's new Commodore MIDI Interface, which plugs into the 64's user port, is the lowest-priced ($49.95) available to date. Also newly offered is the 1-2 MIDI Cable ($19.95), which connects an instrument used in the described configuration to one or two other instruments.

Micro-W. Distributing, Inc., 1342B Route 23, Butler, NJ 07405 (phone: 201-838-9027).

RE G

When you review products prior to their release, as we try to do, announcements of this type are sometimes necessary. Cardco's OuiG interface (see page 88, April), their enhanced version of the +G, has been renamed the G Wiz. (Whatever the product's capabilities, you've got to be impressed by Cardco—coming up with not one, but two cute titles for a printer interface.)

Cardco, Inc., 300 S. Topeka, Wichita, KS 67202 (phone: 316-267-3807).

10,000 piano rolls going floppy.
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DATABASE PROGRAMS

The icon-driven *E-Files 64* lets the user set up a customized database in card file format in any of three file drawers (each with a 200-record capacity). Sort and search by any user-defined field, selective printouts, and address book format with mailing labels are all possible. On disk; $20.95.

VMC Software, P.O. Box 326, Cambria Heights, NY 11411.

Designed to manage a home or small business bank account, *Mega-Base I* will scan a datafile for checks by number, company, or name, deposit listings and withdrawals, append or edit existing datafiles, auto-balance, and list a block of checks. On disk for the 64; $19.95.

Mega-Systems, P.O. Box 415, Spring House, PA 19477 (phone: 215-855-4451).

CHARACTER EDITORS

The uses of the *Chared* character editor range from creating character sets for the Greek (or any other) alphabet to designing flying saucers for game use. Hi-res and multicolor modes are supported. Two sample character sets are included. For the C-64 on tape ($19.95) or disk ($22.95).

APCAD Software, P.O. Box 2673, Ann Arbor, MI 48106.

Font Factory will read in any standard Commodore ASCII sequential disk file, automatically format it, and print the document with the typeface you select (eight are provided) in single or double width. On the same disk is *Signwriter 64,* allowing you to generate large letter signs up to 40 characters long, in characters up to 1 foot in length. Price is $29.95.

INTEGRATED SOFTWARE

If you multiply the hundreds of thousands of copies of *Lotus 1-2-3* that have been sold for the IBM PC by the program's selling price of $300-$500, it easily ranks as the best-selling computer program of all time. This success has inspired three manufacturers of C-64 software to produce their own integrated business software, wherein several programs reside simultaneously in memory, allowing data to be switched back and forth.

Vizastar, like *Lotus*, provides spreadsheet, database, and business graphics programs. Menu-driven, it allows you to open up to nine windows to view different parts of the spreadsheet simultaneously. As of this writing, the program will work only with the 1541 disk drive. Price is $119.97.

Solid State Software, 1253 Corsica Lane, Foster City, CA 94404 (phone: 415-341-5606).

Harmony from International Tri Micro also offers spreadsheet, database, and business graphics programs,

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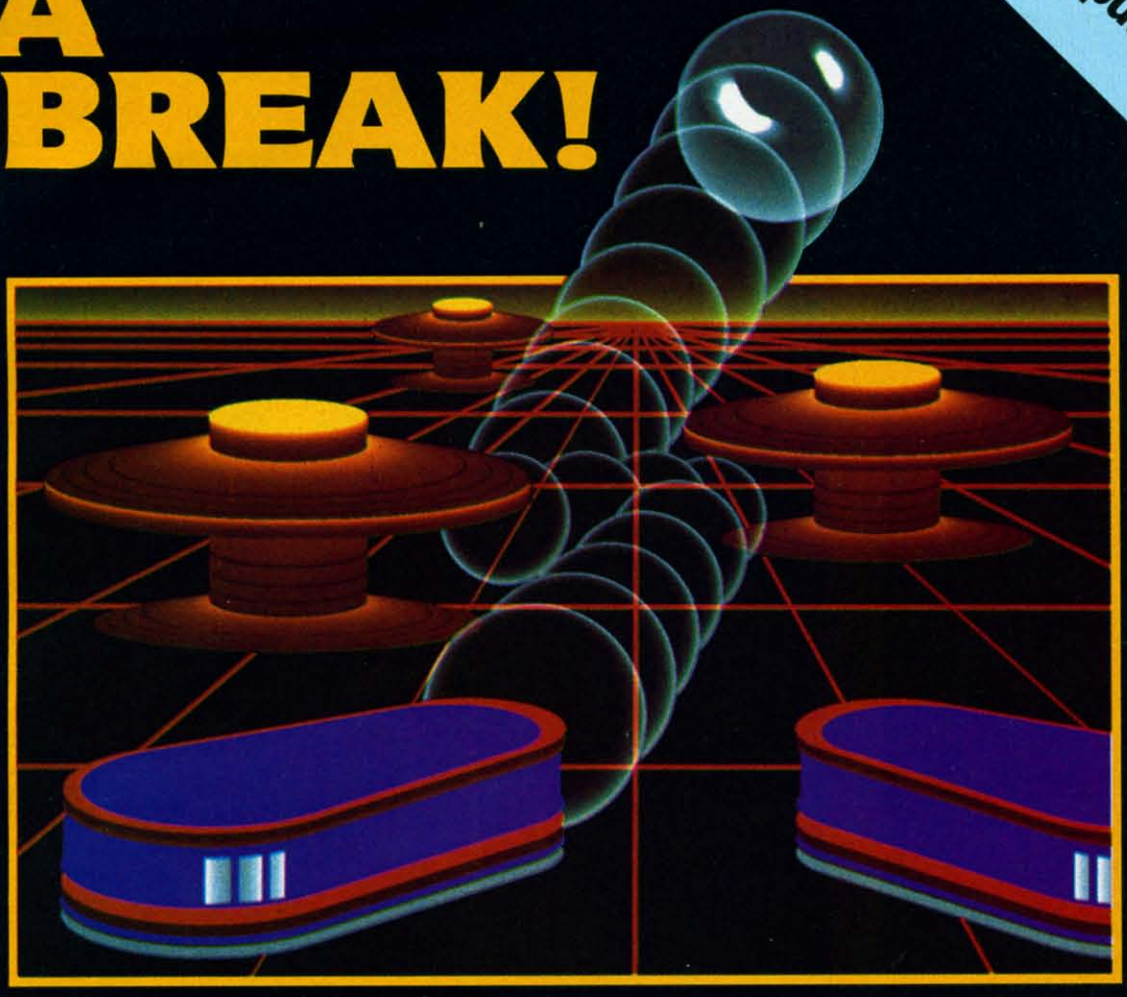

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and adds a word processor. A windowing feature allows the user to view one set of data while working with another.

International Tri Micro, 1010 N. Batavia, Suite G, Orange, CA 92667 (phone: 714-771-4038).

Softsync's *Trio* comprises word processor, spreadsheet, and database programs. The spreadsheet features 48K free memory and recalculates topologically, similarly to *Lotus 1-2-3* and *Multiplan*. On disk, with 120-page manual/tutorial; $69.95.

Softsync, Inc., 162 Madison Ave., New York, NY 10016 (phone: 212-685-2080).

NEW PRINTERS

For the individual who must own the fastest printer on the block, Sakata's SP-1500 is a safe bet at 180 characters per second. Despite its high speed, the $585.00 serial impact dot matrix printer operates at a noise level of 60 dB(A). Included are a 3K buffer, friction/tractor and reverse feed, near letter quality mode and numerous other special print features, and built-in parallel Centronics interface (serial interface optional).

Sakata U.S.A. Corporation, 651 Bonnie Lane, Elk Grove Village, IL 60007 (phone: 312-593-3211).

If speed is not important but low-cost letter-quality print is, the $295 Juki 6000 will bang out 10 characters per second from a 100-character daisy wheel in 10, 12, or 15 pitch. Included are both Centronics parallel and RS-232C serial interfaces.

Juki Industries of America, Inc., 299 Market Street, Saddle Brook, NJ 07662 (phone: 201-368-3666).

64 AND PALS

64 and Pals' disk and booklet lead the beginning user from setting up his C-64 through running various types of programs. Price: $14.95.

Abnel Company, P.O. Box 397, Grand Junction, CO 81502 (phone: 303-245-3997).

TELECOM NEWS

Through *Travelshopper,* CompuServe subscribers can now directly access TWA's PARS reservations system to determine the lowest fares and most convenient flights—as well as make an immediate reservation and have the ticket sent to their home, the airport, or a designated travel agent. Enrollment is free and includes membership in TWA's Frequent Flight Bonus program. The TWA PARS includes up-to-date information on domestic and international flights for every published airline schedule in the world.

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SP-1500: a blistering 180cps.
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Additionally, CompuServe will combine with Quick & Reilly (the nation's third largest discount brokerage firm) to offer such online services as price quotes and direct order entry for virtually every stock and option listed in the *Wall Street Journal* and current portfolio and tax records. Most important, clients can buy and sell securities 24 hours a day (with orders placed during evenings and weekends executed at the start of the following business day).

CompuServe Inc., 5000 Arlington Centre Blvd., P.O. Box 20212, Columbus, OH 43220 (phone: 614-457-8600).

Guide to Modems, an 8-page pamphlet published by Anchor Automation, defines basic modem technology and its applications and provides suggestions for product selection (with an admirable lack of mention of their own product line). Copies are available at retailers.

Anchor Automation, Inc., 6913 Valjean Ave., Van Nuys, CA 91406.

VIP Technologies has replaced its *VIP Terminal* with *VIP Terminal XL,* compatible with the C-64 and 128PC and featuring X-Modem file transfer protocol (to allow transfer of files to and from information services using same). Price: $39.95.

VIP Technologies, 132 Aero Camino, Goleta, CA 93117 (phone: 805-968-4045).

Requiring only a C-64, a 1541 disk drive, and a 1526 printer, *CAM-64* (Call Accounting Manager) allows businesses to sort outgoing calls by station/extension (up to 254), area code, common carriers, and other categories, each of which may be subdivided into number of calls, length of calls, etc. Price of autostart cartridge, software, and manual is $295.

The first two releases in MicroProse's Command Series of combat simulations, recreating some of the greatest battles of the twentieth century.
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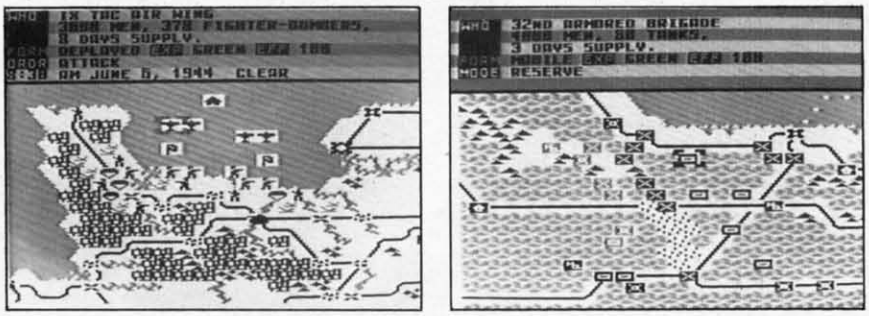


Input Systems, Inc., 15600 Palmetto Lake Drive, Miami, FL 33157 (phone: 305-253-8100).

Data Mart, Inc. will publish the *OPPS Directory of Online Personnel, Products and Services,* to be updated twice a year. Registration for the first edition is open until June 30, 1985.

Data Mart, Inc., P.O. Box 13542, New Orleans, LA 70185-3542 (phone: 504-866-0828).

NEW GAME RELEASES

MicroProse's Command Series of combat simulations puts you in charge of the great armies of the 20th century, in a variety of historical or "what if" scenarios.

The first two releases are *Crusade in Europe,* simulating the Allied struggle against Germany from D-Day to the Battle of the Bulge, and *Decision in the Desert,* recreating the battle between Rommel's Afrika Korps and the British 8th Army for control of North Africa. The next wave will include *Sword of Zion* (the Arab-Israeli Wars), *Blitzkrieg 1940* (Germany's early-WWII victories), and *Drive on Moscow* (Hitler's invasion of Russia). For the C-64; $39.95 each.

MicroProse Software, 120 Lakefront Drive, Hunt Valley, MD 21030 (phone: 301-667-1151).

Incorporating light pen technology, the Stack Light Rifle allows you to shoot'em-up from as far as 10 feet away from the screen. Included are six disk-based games: *High Noon, Glorious 12th, Shooting Gallery, Rats 'n' Cats, Escape from Alcatraz,* and *Crow Shoot.* Romaro Enterprises, North American distributor of the rifle, will release additional games to retail for under $20.00 each.

Romaro Enterprises International, P.O. Box 227, Streetsville Postal Stn., Mississauga, Ontario, Canada L5M 2B8 (phone: 416-820-5235).

Between April 1 and August 31, Datasoft will mail a $5 rebate to purchasers of *Bruce Lee, Conan, The Dallas Quest, Pac Man, Dig Dug, Pole Position, Mr. DO!, Zaxxon,* or *Letter Wizard.* Rebate coupons can be found in appropriately marked packages, or with your dealer.

Datasoft, Inc., 19808 Nordhoff Place, Chatsworth, CA 91311 (phone: 818-701-5161).

Electronic Arts will award three $1000 prizes to those registered owners of their *Adventure Construction Set* who produce the best games in the Fantasy/Medieval, Spy/Mystery, and Science Fiction categories. Copies of winning games and all other entries will be made available to registered ACS owners for the cost of disk duplication and handling. Entries must be submitted (on disk) by January 1, 1986.

Electronic Arts, 2755 Campus Drive, San Mateo, CA 94404 (phone: 415-571-7171).

LOW-COST WORD PROCESSOR

The *Pagewriter 64* word processor features an 80-column scrolling text window, onscreen command menus, and mailmerge option. A column indicator above the text lines provides a visual indication of the position of the text being entered. Available on disk ($21.95) or cassette ($18.95).

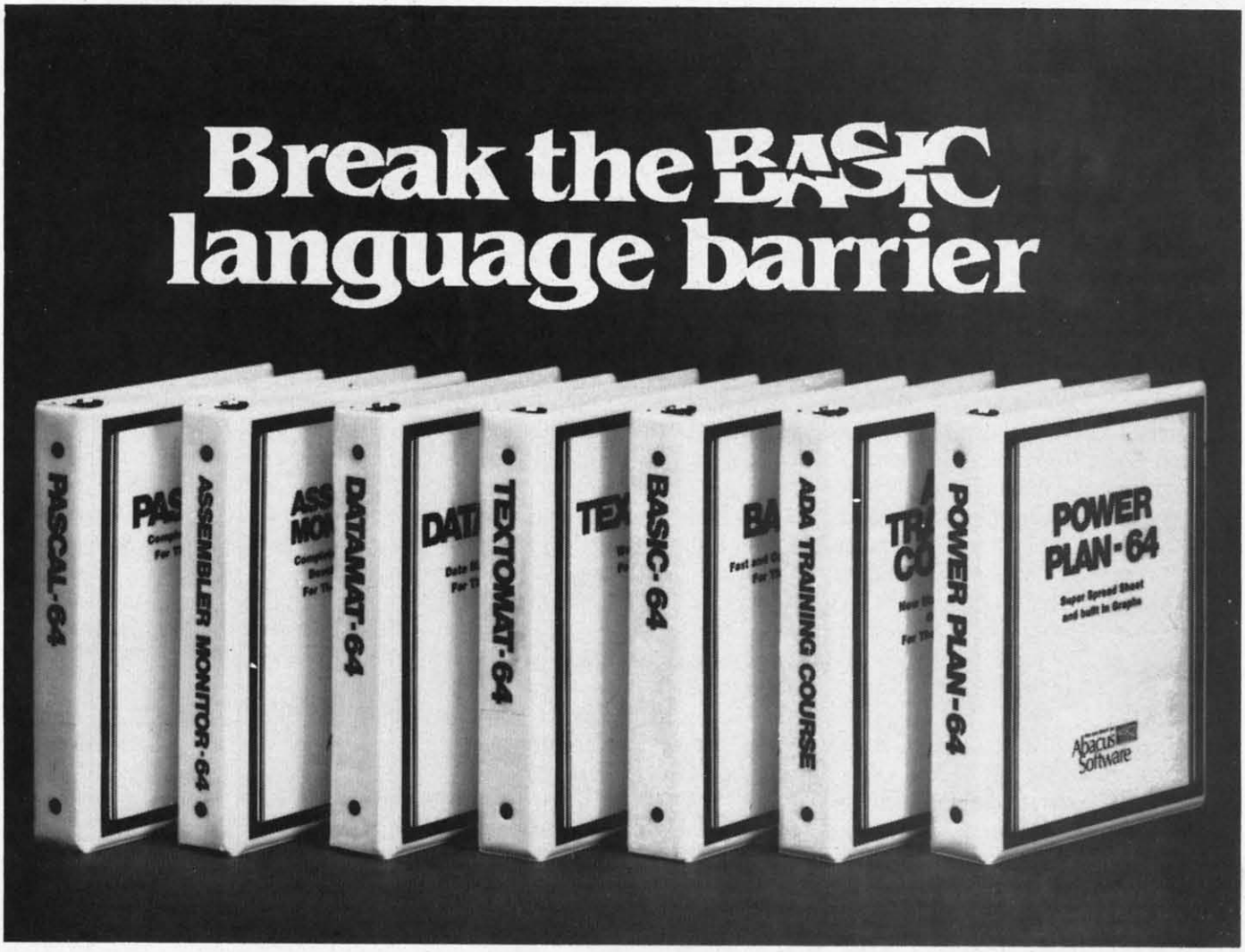
VMC Software, P.O. Box 326, Cambria Heights, NY 11411.

COMMODORE USER SUPPORT

Good news for Commodore user groups: the formation of Commodore World, a program designed to provide a direct link between Commodore and user groups around the world. Organizations approved for membership receive suggestions for organization, advertising support, and pre-release product news through the program's *Input/Output* newsletter.

Groups wishing to join should contact the User Group Coordinator at Commodore (215-431-9100); they will receive an application, sample by-laws, color advertising posters, and the first issue of the newsletter. Approved groups will receive an access code to the Commodore World section of Commodore's telecommunications network, additional posters,

Break the BASIC language barrier



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bulk shipments of the monthly newsletter, product brochures, and—far-fetched as it sounds—a "reliable" telephone contact at Commodore.

Commodore Business Machines, Inc., 1200 Wilson Drive, West Chester, PA 19380.

EDUCATIONAL PROGRAMS

The *Keyboard Chord/Scale Master* sharpens the user's keyboard abilities through a variety of sight and sound reinforcements. *Chord Display* and *Scale Display* let the user view and hear the most common chords and scales. *Chord Review* and *Scale Review* include drill, quiz, and compete options. The *Compare* mode requires comparison of one chord with another in the same or a different key signature. For the C-64; $39.95 plus $1.50 postage (MI residents add 4% sales tax).

Valhala Software, 205 E. Hazelhurst, Ferndale, MI 48220.

Kidbit Software has enhanced two previous VIC releases and combined them on one disk for the 64. The *Same/Not Same Game* lets children build a spaceship by telling the Central Computer which shapes, colors, directions, or letters are different from the others in the group. *Alpha-Bee Sequence* requires children to supply missing letters of the alphabet to a forgetful bee. $26.95.

Kidbit Software, 7001 Sunkist Drive, Oakland, CA 94605 (phone: 415-638-1243).

The *Chipwits* are 16 robots which children must help through 49 different mazes. They do this by programming the robots to move, feel, see, smell, remember, and more. For the C-64; $29.00-$39.00.

Epyx, Inc., 1043 Kiel Court, Sunnyvale, CA 94089 (phone: 408-745-0700).

Wurble incorporates vocabulary and spelling training into a computer board game for ages 10 up. The game editor allows for hundreds of rule variations.

Sher-Tek, P.O. Box 6808, Stn. "J", Ottawa, Ontario, Canada K2A 3Z4.

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Same/Not Same Game: *for ages 3 to 7.*
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teacher's guide, *The Investor's Challenge* is designed for use with Blue Chip Software's *Millionaire* stock market simulation, *Tycoon* commodity market simulation, and *Baron* real estate simulation. Price is $6.95.

Blue Chip Software, Inc., 6744 Eton Avenue, Canoga Park, CA 91303 (phone: 818-346-0730).

SOUNDCHASER 64

Passport MusicSoftware's $199.00 Soundchaser 64 is the first four-octave music keyboard for use with the 64. Included is software that transforms the 49-note music system into a full nine octave range, as well as allowing the user to create a variety of instrument sounds for either a monophonic or polyphonic keyboard. The keyboard can be used with Passport's *Macmusic* ($49.95), which provides a visually oriented music composition system.

Passport also distributes a line of *Computer Sheet Music,* allowing a student to play at his own pace while the onscreen notes he plays correctly change in color.

Passport Designs, Inc., 625 Miramontes Street, Suite 103, Half Moon Bay, CA 94019 (phone: 415-726-0280).

MASTERDISK CHANGE

In February's *Scuttlebutt* we announced *Masterdisk*, which composes a master catalog of your disk library. Since then, Integrated-Software has discovered that the 4-minute backup program included on the disk was pirated from a copyrighted German program. Taking its place will be *Copy 18,* which will copy track 18 (the disk directory) from any disk and make modifications.

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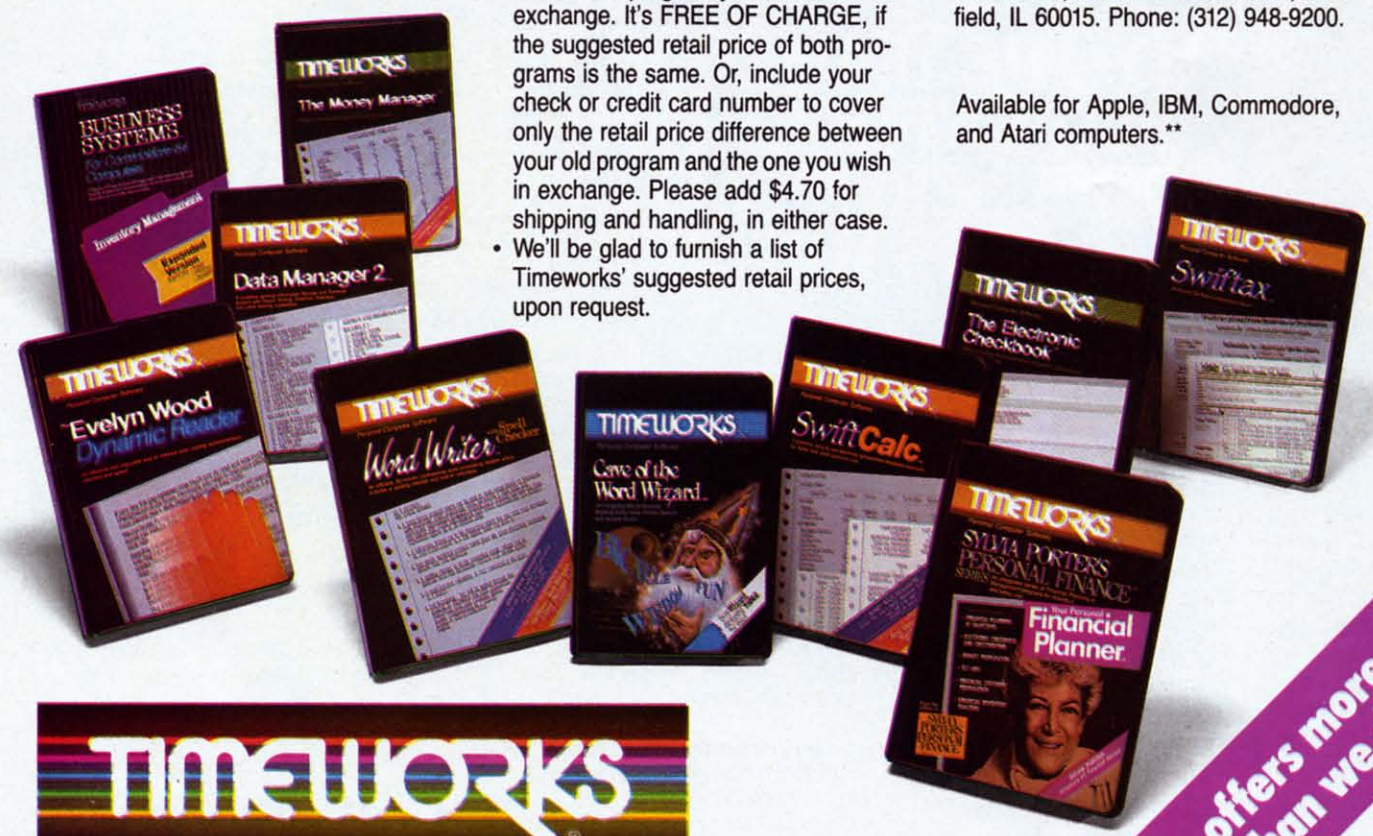

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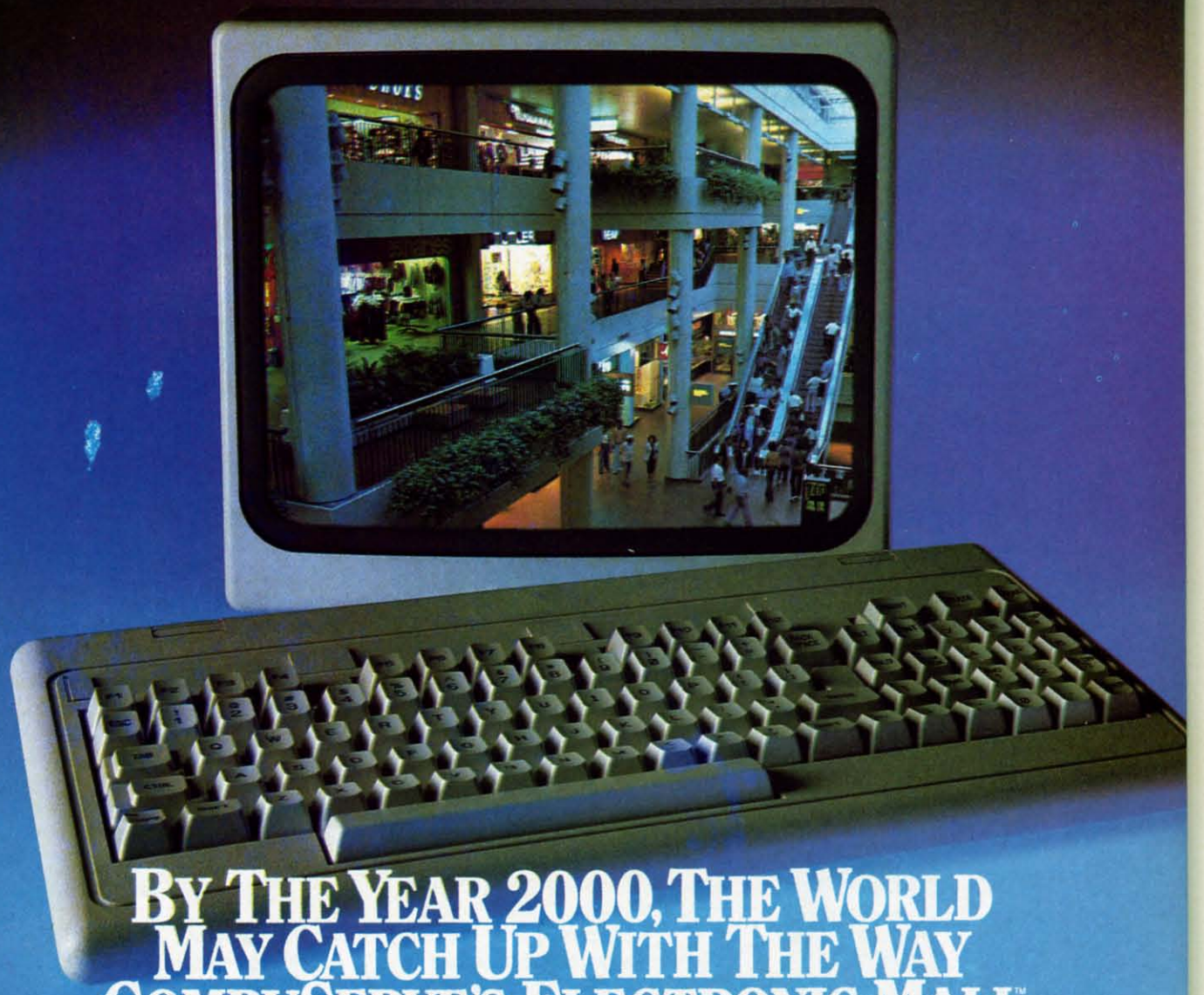

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Integrated-Software Systems, P.O. Box 1801, Ames, IA 50010 (phone: 515-233-2992).

VCR TITLE GENERATOR

The *Video Title Editor* lets C-64 or VIC 20 users incorporate title screens into their video tapes without the need for a camera, second VCR, or high-priced character generator. Included are over 20 displays for birthdays, weddings, vacations, and more. Customized displays can also be designed. Price is $29.95, on either cassette or disk.

Videoware, 19777 W. 12 Mile Rd., Suite 180, Southfield, MI 48076 (phone: 313-626-7208).

HANDICAPPING PROGRAM

The *Racing Analysis Program Package* includes *Thoroughbred, Harness,* and *Bet Return* programs which make predictions based on past performance data. About five minutes are required to enter the data for each race. For the 64 or VIC 20, on cassette or disk; $29.95 plus $2.00 postage from Software Exchange, P.O. Box 5382, W. Bloomfield, MI 48033 (phone: 313-626-7208).

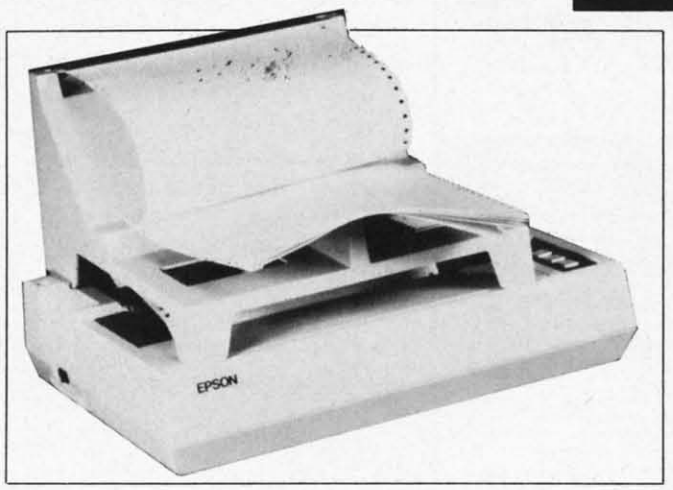
WILL WRITING SOFTWARE

By simply recording your answers to a series of questions, the *Willwriter* disk/software package generates and prints a will (good in every state except Louisiana) and provides you with information on signing and witnessing. You may update your will an unlimited number of times. For the C-64; $39.95.

Nolo Press, 950 Parker St., Berkeley, CA 94710.

ASTRONOMY SOFTWARE

For readers who thought Commodore's *Sky Travel* went where no program had gone before, a list of 45 astronomical software programs has been published by the non-profit Astronomical Society of the Pacific. A list of reference books is also included. Send a $1.00 donation to cover postage and handling to A.S.P. Computer List, 1290 24th Ave., San Francisco, CA 94122 (phone: 415-661-8660).



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Buddy Products, 1350 South Leavitt St., Chicago, IL 60608 (phone: 312-733-6400).

FAST LOAD LOWDOWN

From the research lab of *Ahoy!* writer Cheryl Peterson comes the following addendum to last month's examination of Fast Load from Epyx: Commodore computers interfaced to a printer through certain parallel boxes will not be able to use the program's quick copy function. A technical support person at Epyx explained that Fast Load requires all the data lines, rendering it unoperation-

al with certain interfaces. Two of the primary offenders, unfortunately, are also two of the most popular: Cardco and the (Orange Micro) Grappler.

The documentation also fails to point out that a Commodore 1541 must be used; Fast Load will not work with an MSD, Indus GT, etc. Finally, don't misunderstand Epyx' claim that the program will work with most copy-protected software. It will run most copy-protected software. It will not copy it.

Epyx, 1043 Kiel Court, Sunnyvale, CA 94089 (phone: 418-745-0700).

BOOK RELEASES

The *Computerfacts* series from Howard W. Sams & Co., Inc., reveals the inner workings of Commodore hardware with wiring diagrams, photos, disassembly instructions, parts lists, troubleshooting techniques, and other repair data. Available for the C-64, C-16, Plus/4, VIC 20, 1525 printer, 1701 monitor, or 1541 disk drive; $19.95 each.

Also newly released, the *Commodore 64 Troubleshooting and Repair Guide* covers proper diagnostic techniques and lists specific malfunctions in trouble charts organized by com-

Computerfacts ***series: diagnostic aid.***
READER SERVICE NO. 297

puter subsystem. List price is $18.95.

Finally from Sams, *Commodore 64 for Kids from 8 to 80* works hands-on with the new user to create simple programs. Numerous illustrations are included. Price is $12.95.

A catalog of 347 book titles is available from Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis, IN 46268 (phone: 1-800-428-SAMS or 317-298-5400).

Four new C-64 publications from Prentice-Hall:

Easy Interfacing Projects for the Commodore 64 ($10.95) provides dozens, ranging from mechanical actuators to analog-to-digital convertors.

Multiplan for the Commodore 64 ($14.95) offers a tutorial and over a dozen home and business applications (with listings).

With an emphasis on graphics generation, *Advanced Machine Code Programming for the Commodore 64* ($12.95) explains how to tap into the 64's 6502/6501 microprocessor.

More BASIC Is Child's Play, Commodore edition ($19.95) picks up where its precursor left off, teaching children as young as 7 to program. Prentice-Hall, Englewood Cliffs, NJ 07632 (phone: 201-592-2640).

Einstein's Beginner's Guide to the Commodore 64 ($7.95) provides a general introduction to computer use and programming. Harcourt Brace Jovanovich, 1250 Sixth Ave., San Diego, CA 92101 (phone: 619-231-6616).

Understanding Microprocessors ($14.95) covers software, programming concepts, assembly language, and applications of 4-, 8-, and 16-bit microcomputers. Texas Instruments Inc., P.O. Box 225474, M/S 8218, Dallas, TX 75265 (phone: 214-997-3926).

IT WRITES THE SONGS

Cantus, the Music Improviser purports to be the first microcomputer program that invents its own music. Instead of notes, the user enters choices for tempo, harmony, rhythm, counterpoint, voice range, and tone color, from which *Cantus* creates three-voice improvisations which play continuously with no repetition. Each set of choices becomes a "patch" which can be saved and later recalled. Price is $54.00 plus $2.00 postage and handling.

Algo-Rhythm Software, 176 Mineola Blvd., Mineola, NY 11501 (phone: 800-645-4441 or 516-294-7590).

TOWERS OF HANOI

FOR THE C-64

At the time of creation, the god Brahma placed sixty-four rings, ranging from smallest to largest, on the first of three golden towers in the temple of Benares. He enjoined his priests with the task of moving the rings, being careful never to place a larger ring atop a smaller, until the rings were placed in like manner on another tower. When this has been accomplished, in about six hundred billion years, the universe will come to an end. Such, at least, is the legend.

Actually, Edouard Lucas, who invented the Tower of Brahma puzzle, devised this story to popularize his creation. The puzzle has been a favorite for several generations. Now you can try your skill on a less formidable (though equally challenging) version using your Commodore 64. You may select to attempt from two to eight rings. Each additional ring represents a doubling in difficulty. To move two rings requires three moves; three rings, seven moves; four rings, fifteen moves; eight rings, two hundred fifty-five moves. The number of moves is determined by the formula 2 ↑ (number of rings)−1. Assuming the priests of Brahma moved one ring each second, it would require (2 ↑ 64)=1 seconds, or about six billion centuries, before the smallest ring would be placed on top of the tower.

With up to four rings, the puzzle is fairly easy to solve. After that, though, you must plan your moves carefully in order to complete it in the minimum number of moves. To end the puzzle, press 'f1'. Also, if you become completely baffled, again press 'f1' and you will be asked 'Computer Solution (Y/N)?'. Answer 'Y' and the puzzle will reset and solve itself. The rings will begin to magically float across the screen and position themselves from one tower to the next until the final orientation is achieved.

The three towers and their base are built from keyboard character graphics in lines 2150-2240. Each ring is a sprite defined within lines 1990-2050. The DATA lines for each sprite show a way of conserving memory. The interpreter automatically READs a value of zero if a value is not entered. Another handy (though seldom used) command in the program is FRE(0). Normally, this function is used to calculate the amount of free RAM available for a program and its variables. In a program which creates and manipulates strings such as *Towers*, it performs a more valuable service. String values created during the course of a program run are stored in upper memory one beneath another until space is depleted. At this point, the process of garbage collection begins and may take several minutes, during which time the program stops and the keyboard is dead. Using a statement such as CT=FRE(0) forces an immediate garbage collection. Since this is done on each move, the number of strings that have accumulated is small and the process is instantaneous. □

SEE PROGRAM LISTING ON PAGE III

BY DANIEL MILLER

Sing a Song of A

Do
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Do you want to put a song into your program? Here's a routine that lets you type in the standard musical notes—and turns them into music automatically.

James Regan

CREATING YOUR OWN GAMES ON THE VIC AND 64

When the Commodore 64 first came out, one of its most touted features was the music capability. I had programmed on the Atari, and naturally I was a little skeptical about the 64's three voices—didn't the Atari have *four*?

Then I heard what the 64 could do with sound envelopes and waveforms, and I was willing to forgive the missing voice for the great improvement in quality.

Trouble was, all that wonderful sound was locked away from the BASIC user in a series of POKEs. They didn't give Commodore BASIC a SOUND statement comparable to the Atari's, which set the pitch, the distortion, and the volume in a single fast statement.

Instead, you have to set up the sound envelope and general volume in advance, and then *each time* you want to change the pitch or sound a new note, you have to:

1. Set *two* frequency registers *for each voice.*
2. Gate each voice open to begin its tone.
3. Gate each voice closed to stop.

Since every single one of these steps is a POKE, a notoriously slow command in Commodore BASIC, starting and stopping a single three-note chord takes *twelve* POKEs and far, far too much time.

About a year ago, I got a PCjr and, despite that machine's many drawbacks, I saw for the first time what a humane music program system could be.

Don't misunderstand—the Commodore 64 still has far and away the best sound chip on the market. The SID hasn't been matched by anybody.

But the PCjr has a mini-language for playing music. All you do is set up a string that contains the letters for the musical scale—C, D, E, F, G, A, and B—along with instructions about sharps and flats, octave changes, and the duration of the note, and BASIC plays the string. It even does it in the background, so that your program can go on long before the music's over.

All this seemed to me to be one more proof of the terrible conspiracy of the computer manufacturers. Take it from me, they all get together once a year and have a meeting like this:

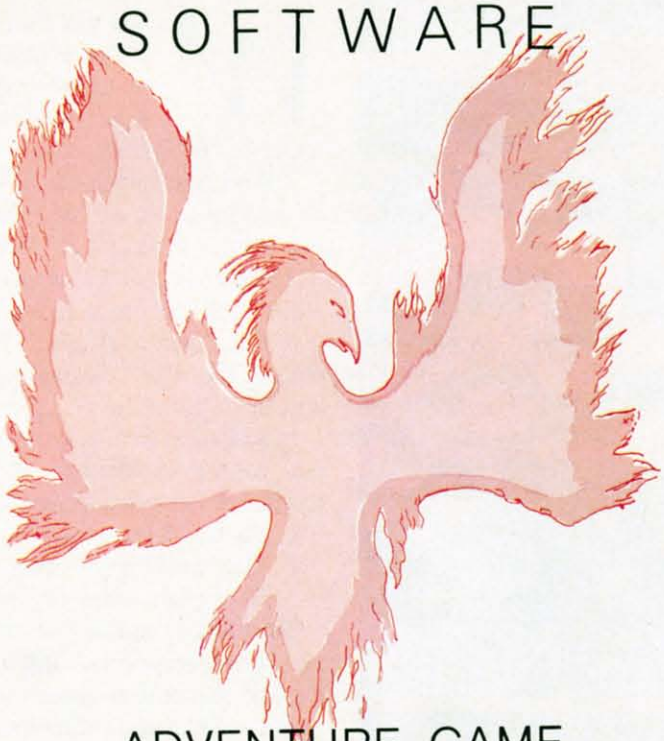
COMMODORE: Look, we've got the best sound chip on the market in our new computer. You guys can't compete with it.

ATARI: That's OK—as long as you make your screen display all fuzzy and leave us as the only computer with a decent TV display, we'll let you have better sound.

IBM: You can have sound, Commodore, and you can have video, Atari. What we'll do is put superb sound and graphics commands into our BASIC. Real easy-to-program stuff. Atari, you can have a SOUND statement, but don't make it too easy to use. And you, Commodore, you can't do *anything* for them. Just a bunch of POKEs.

By Orson Scott Card

Phoenix Red
SOFTWARE



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THE ALL-PURPOSE MUSIC ROUTINE

Are you going to sit still for that kind of collusion? Am I? Not a chance.

Instead, in this month's column I bring you Card's All-Purpose Music Player. To use this routine, you save it and then load it in at the beginning of your programming session. It uses up line 10, lines 60-70, and lines 9000-9990. Then you write your program around it. Put your movement routine in lines 20-50, for instance, and your main loop at 100. Program, in other words, just like normal.

Whenever you want to play a tune—or part of a tune—have your program GOSUB 60, and a phrase of the tune will play.

STRINGING ALONG

Best of all, to enter the melody, you don't have to calculate all the frequency values for the notes you're using, or set up a bunch of DATA statements. Instead, you enter each phrase of the music as a string, using the standard musical alphabet—the scale C, D, E, F, G, A, and B.

This means that you can transfer a song more or less directly from sheet music or, if you're good at music, right out of your head. All you have to do is divide the melody into a series of usable chunks, called "phrases." Each phrase can be as long as 255 characters, but for sheer practicality you'll probably break the music up into much shorter phrases.

The note strings are set up starting at line 9500 in all three versions of the program included here (*Three-Voice Player, One-Voice Player,* and *Broken Melody*).

Line 9500 tells how many voices you're going to use, minus 1. That means that for three voices, you type EV%=2; for two voices, you type EV%=1. (*One-Voice Player* has no line 9500, since only one voice is possible with this version of the routine. This allows it to be streamlined, and the music can play much faster.)

In line 9510, the variable ES% is set to the number of phrases in the song, minus 1. That means that if your song has 9 phrases, you will type ES%=8.

Starting at line 9520, the actual music strings are set up. There are three string types for each phrase:

Duration. MD$(PH) sets the duration for each note in the phrase. This is the same for all three voices—the three voices must each execute exactly the same number of notes (or rests) per phrase. The duration string consists of numerals from 0 to 9. 0 is the shortest duration, and 9 is the longest. By changing, say, the fifth number in the MD$(PH) string, you change how long the fifth note of that phrase will sound.

(These duration numbers are used as an index into a duration array, DU%( ), which is set up at lines 9200 and 9210. If you want to change how long a duration 1 lasts, just change the second number in the DATA statement in line 9210.)

Melody. ME$(PH,VC) sets the pitch or frequency for each note in the phrase, with a separate string for each of the three voices. The notation is very simple. To play the note A, type A. To play the note B, type B, and so on.

To play sharps, type the letter while holding down SHIFT. For instance, to play F-sharp, hold down SHIFT and then type F. A graphics character will appear in the string.

To play flats, type the letter while holding down the COMMODORE logo key. To play B-flat, hold down COMMODORE and then type B. Again, a graphics character will appear in the string.

To make the voice silent for one note, type the @ sign.

Octave. MV$(PH,VC) sets the octave in which the note will be played. There are eight possible octaves, from 0 (the lowest notes) to 7 (the highest notes). Each position in the MV$(PH,VC) string corresponds to that voice's note in the melody string.

In other words, the octave string MV$( ) determines which octave a note will be in, and the melody string ME$( ) tells which note within that octave will be played.

If several notes in a row are in the same octave, you only have to enter the octave number for the first note, and then enter spaces for the subsequent notes. Thereafter, for that voice, you need only enter octave numbers when the octave changes.

Each octave consists of the notes from C up to the next B. That means that if your melody string consisted of an F-major scale, played in voice 0, and you wanted the scale to play very quickly, your strings would be typed like this:

```
Duration:  MD$(PH)="00000000"
Melody:    ME$(PH,0)="FGABCDEF"
Octave:    MV$(PH,0)="4       5       "
```

Notice that there are the same number of characters in each string in the same phrase. (The B would actually be a B-flat, and you would type COMMODORE-B.) The octave changes when the scale goes up from B-flat to C. In other words, C is the lowest note of each octave.

(You can cheat, however, and type C-flat, which gets you a B in the next octave down without changing octaves. Likewise, you can type B-sharp and get the C from the next octave up. But why bother?)

PLAYING AROUND

This is really all you need to know to use this routine. All three programs use the same fundamental routine, with only a few changes, so once you've typed in one, it will be relatively easy to make the changes for the other programs (*One-Voice Player* has the most differences).

To use the routine, all you need to do is type in your own songs—setting the values of EV%, ES%, and the duration, melody, and octave strings for every phrase and voice. Then whenever your program executes GOSUB 60, the routine will play the next musical phrase.

There are other changes you can make, however. Lines 62 and 68 can be altered by REMing one and executing the other, to switch from normal to staccato; or you can REM them both and get a legato sound (or nothing at all, depending on your ADSR envelope).

You can also experiment with different duration values at 9210. One limitation, though, is that you can't get any faster than 0. Since this is a BASIC program, not machine language, and we're still using those POKEs, there's a limit to how fast you can go. The ideal music system uses machine language routines during the vertical blank interrupt—but this is a teaching column, not a software column, and so we'll stick with BASIC.

You can also change the elements of the ADSR enveloped by altering lines 9020, 9030, 9040, and 9050; and you can change the waveforms in line 9070. Next month I'll get into much more detail about how waveforms and envelopes are used, and we'll experiment with some sound effects; for now, though, you can make your own experiments by changing one or two parameters at a time.

The three programs show some of the things you can do. *Three-Voice Player* plays *God Save the King (My Country, 'Tis of Thee)* using a stately organ tone. *One-Voice Player* plays The Mexican Hat Dance at top speed, with a harpsichordlike hammered-string sound. *Broken Melody* plays *I'm on My Way* (from the musical *Paint Your Wagon* by Alan Jay Lerner and Frederick Loewe), using a fife sound for the melody line and a plucked-violin sound for the accompaniment.

Have Patience. When using the three programs, remember that in order to make the running time for the music very quick, most of the work is done during the execution of the setup routine at 9000. Especially time-consuming is the conversion of the strings from musical notes to values that music routine can use efficiently. A song as long and complex as the one in *Broken Melody* takes a couple of minutes to be ready. If we were working in machine language, this wouldn't be necessary, but the long setup time is the price we pay for being able to enter the music as musical notes and still have it play relatively quickly.

HOW SHOULD YOUR GAME USE MUSIC?

Obviously, this routine can't be used for background music, though that's one of the best uses for music in a game. If you've ever sung along with a video game (*Xevious, Gyruss,* and *Elevator Action* are particularly musical, I've noticed), you know that background music can set the tempo and mood, getting more intense as the player gets further along in the game.

But even when the music has to take place in the foreground, stopping everything else, the phrases of a song can be very useful. For instance, in a quiz game, instead

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The search is over. We hae reduced the field to a single printer that meets all our goals (and more). The printer is the GP-550 from Seikosha, a division of Seiko. We ran this printer through our battery of tests and it came out shining. This printer *can* do it all. Standard draft printing up to a respectable (and honest) 86 characters per second, and with a very readable 9 (horizontal) by 8 (vertical) character matrix. At this rate, you will get an average 30 line letter printed in only 28 seconds.

"NLQ" Mode

One of our highest concerns was about print quality and readability. The GP-550 has a print mode termed Near Letter Quality printing (NLQ mode). This is where the GP-550 outshines all the competition. Hands down! The character matrix in NLQ mode is a very dense 9 (horizontal) by 16 (vertical). This equates to 14,400 addressable dots per square inch. Now we're talking *quality* printing. You can even do graphics in the high resolution mode. The results are the best we've ever seen. The only other printers currently available having resolution this high go for $500 and more *without* the interface or cable needed to hook up to your computer.

Features That Won't Quit

With the GP-550 your computer can now print 40, 48, 68, 80, 96, or 136 characters per line. You can print in ANY of 18 font styles. You not only have the standard Pica, Elite, Condensed and Italics, but also true Superscripts and Subscripts. Never again will you have to worry about how to print H_2O or X^2. This fantastic machine will do it automatically, through easy software commands right from your keyboard. All fonts have true descenders.

One of the fonts we like best is "Proportional" because it looks most like typesetting. The spacing for thin characters like "i" and "l" are given less space which "tightens" the word making reading easier and faster. This is only one example of the careful planning put into the GP-550.

Do you sometimes want to emphasize a word? It's easy, just use **bold** (double strike) to make the words stand out. Or, if you wish to be even more emphatic, underline the words. Or do **both.** You may also wish to "headline" a title. Each basic font has a corresponding elongated (double-wide) version. You can combine any of these modes to make the variation almost endless. Do you wnat to express something that you can't do with words? Use graphics with your text — even on the same line.

You can now do virtually any line spacing you want. You may select 6, 8, 7½ or 12 lines per inch. PLUS you have variable line spacing of 1.2 lines per inch to infinity (no space at all) and 97 other software selectable settings in between. You control line spacing on a dot-by-dot basis. If you've ever had a letter or other document that was just a few lines too long to fit a page, you can see how handy this feature is. Simply reduce the line spacing slightly and ... VOILA! The letter now fits on one page.

Forms? Yes! Your Letterhead? Of Course!

Do you print forms? No problem. This unit will do them all. Any form up to 10 inches wide. The tractors are adjustable from 4½ to 10 inches. Yes, you can also use single sheets. Plain typing paper, your letterhed, short memo forms, anything you choose. Any size under 10" in width. Multiple copies? Absolutely! Put forms or individual sheets with carbons (up to 3 deep), and the last copy will be as readable as the first. Spread sheets with many columns? Of course! Just go to condensed mode printing and print a full 136 columns wide. Forget expensive wide-carriage printers and changing to wide carriage paper. You can no do it all on a standard 8½" page.

Consistent Print Quality

Most printers have a continuous loop ribbon cartridge or a single spool ribbon which gives nice dark printing when new, but quickly starts to fade after a while. To keep the printers' output looking consistently dark, the ribbons must be changed more often than is healthy for the pocketbok. The GP-550 solves this problem completely by using a replaceable, inexpensive ink cassette which is separately replaceable from the actual ribbon. It keeps the ribbon loaded with ink at all times. You only replace the ribbon when it truly wears out, not when it starts to run low on ink. Just another example of the superb engineering applied to the GP-550. (When you finally do wear out your ribbon, replacement cost is only $10.95. Ink cassette replacement cost is only $5.95, both postpaid.)

The Best Part

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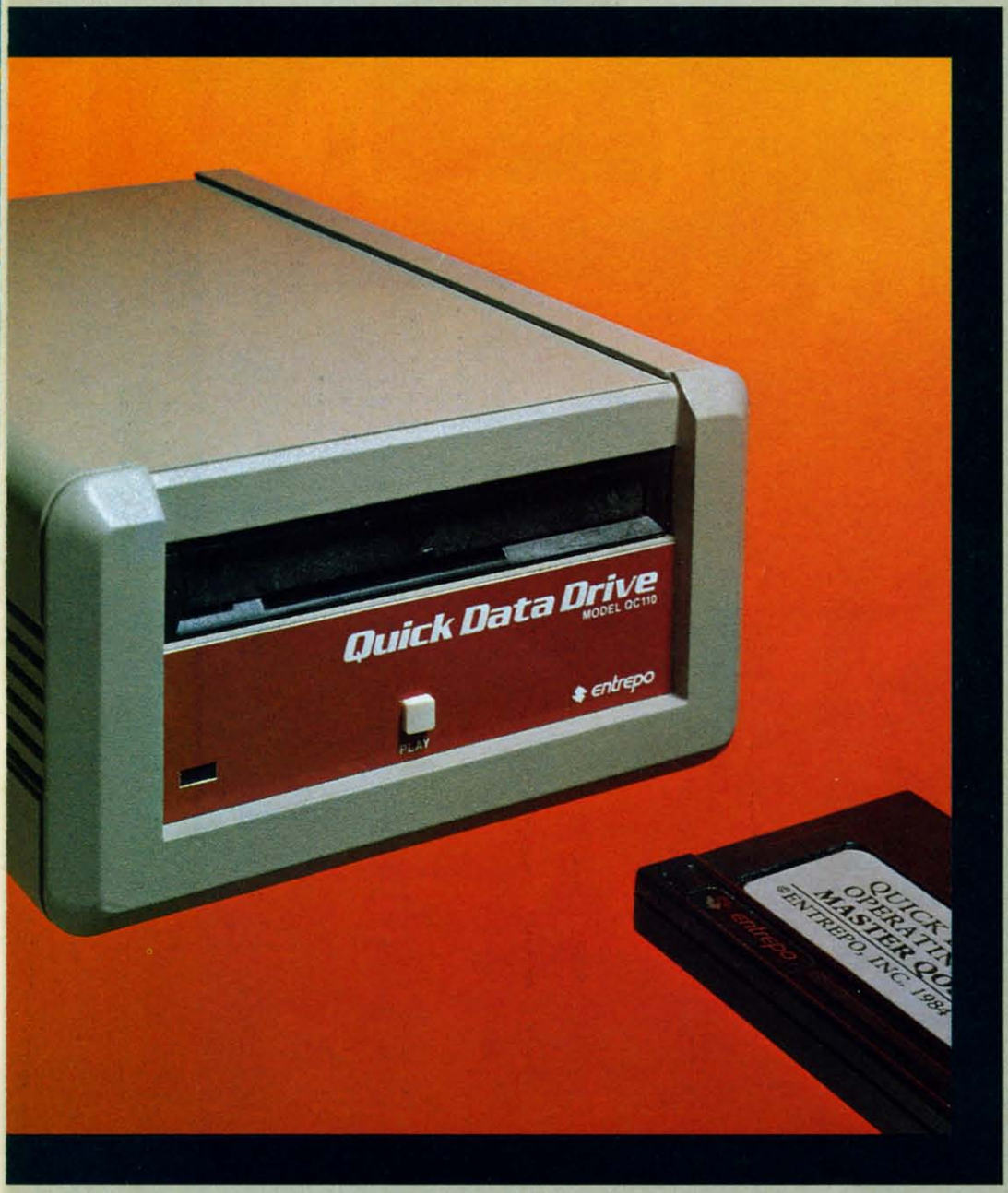

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of the incessant "beep" for wrong and "ding-dong" for right answers, you can play one phrase of a song as the question is asked, and then play the next phrase when the player gets the right answer. But for a wrong answer, the song is left dangling—which will certainly increase the player's desire to get the answer right and finish the stupid melody!

Songs are also useful while players are reading instructions, checking scores, consulting maps, and so on.

And there's no rule that says the phrases have to be pieces from the same song. You can have a dozen different songs, and play different ones at different times. Just set the value of PH to the number of the phrase you want to play, and then GOSUB 60—the phrase you called for will be the one that plays. (If you don't specify a value for PH, the next phrase in numerical order will always play next.)

Broken Melody is designed to show how a tune can be broken up into pieces, with the different phrases played only if and when the player gives certain input. The other two programs play continuously until the player presses SHIFT. *Broken Melody*, however, waits for the player to press SHIFT before playing anything, and stops to wait for another keypress between phrases. Pressing any key besides SHIFT, COMMODORE, and CONTROL will end the program.

If you hold down a key during a song, you'll notice that the song slows down. This is because the timing for the music is done with FOR-NEXT loops, and when you press a key it causes an interrupt that uses up processor time; this cuts down the number of repetitions of the FOR-NEXT loop per second, which makes the notes last longer and slows down the song.

DECIPHERING THE ROUTINE

For your ease in understanding how the program works, here is a list of the variables and what they are used for:

ME$*(phrase, voice)* or ME$*(phrase)*: After the conversion routine at 9900, this variable contains both the pitch and octave code numbers in ASCII form, for use as an index into the pitch value tables in PI%( ).

MV$*(phrase, voice)* or MV$*(phrase)*: Used only during the conversion routine at 9900; its information is contained thereafter in ME$.

MD$*(phrase)*: Contains the duration values; the VAL( ) function retrieves the values for use as an index into the duration table DU%( ).

ES%: The number of phrases in the song, minus 1.

EV%: The number of voices in the song, minus 1.

PI%*(code*,0) and PI%*(code*,1): The pitch table, consisting of the low byte and high byte, respectively, for the frequencies corresponding to the musical scale. The code is derived from the ME$ string using the MID$( ) and ASC( ) functions. The PI%( ) values are POKEd into the frequency registers.

FR*(voice*,0) and FR*(voice*,1): The address of the two frequency registers for each voice. Voice 0, for instance, is at 54272 and 54273, so those are the values of FR(0,0) and FR(0,1).

G%*(voice)*: The gate value. POKEing this into the gate register causes that voice to begin to sound. The gate value also determines the waveform (see line 9070).

UG%*(voice)*: The ungate value. POKEing this into the gate register causes the sound of that voice to stop.

GR*(voice)*: The address of the gate register for each voice.

DU%*(code)*: The duration table. Each of the ten possible durations (0-9) consist of the number of times the empty loop at line 67 should be repeated. The code is derived from the MD$ string using the MID$( ) and VAL( ) functions.

VC: The current voice number. This is used whenever the program cycles through the voices; it is the counter variable in a FOR VC=0 TO 1 loop.

PH: The current phrase number. This is automatically incremented (increased by 1) each time the routine is executed, but your program can set this variable independently and take the phrases in any order.

N: The current note number. This is the counter variable in the loop FOR N=1 TO LEN(MD$(PH)) at line 60; it is used with the MID$( ) function as the index into the ME$ and DU$ strings.

AT%, DY%, SN%, RE%, WF%: These variables are used in setting up the envelopes and waveforms; they are

not used after the music is initialized at 9000, so they can be used again in your own program.

X%, Y%, V$, A$, I: These variables are used as placeholders and counters at various times during the program. They are never used after the music is initialized at 9000, so they can be used again in your own program.

Line by line, here's what's happening in the sound routine at 60-70.

60 Begin a loop through every character in the duration and melody strings.

61 Begin a loop through each of the three voices.

62 Un-gate the sounds left over from the last note. (REM this line if you're using the line at 68.)

63 Begin a loop through the two frequency registers for each voice.

64 POKE the pitch values—PI%( )—into the frequency registers—FR( ). (Remember that a rest ("@") in the original tune produces the PI% value of 0 in both registers, which makes the voice silent for the duration of the note.)

65 Close the VC and I loops. (The N loop is still open.)

66 Open a new VC loop, only this time backward, to gate the voices open. This causes the new pitches to play. Close the loop.

67 Execute the duration loop.

68 Open a new VC loop to gate off the sound. This line is REMed; remove the REM and cause the line to be executed if you want clearly separated, staccato sounds.

69 Close the N loop. When the loop runs out, add 1 to PH so the next time through the loop, the next phrase will play—unless the main program has changed the value of PH in the meantime. (Note that if PH is higher than ES%, the total number of phrases, it is set back to 0.)

70 Gate off all the voices. This only executes after the phrase is over. Then RETURN from this subroutine to the main program.

Next month, in addition to examining sound envelopes on the 64 and emulating them with a machine language routine on the VIC, I'll provide a machine language music routine for each computer.

DISCOVERING AMERICA

Even though this isn't a review column, every now and then I find a commercial game that is so good I have to tell somebody—and you are the somebody I tell.

Seven Cities of Gold (distributed by Electronic Arts; created by Ozark Software, underpriced whatever it costs) manages to do what I thought was impossible: it has all the story excitement of a text adventure, yet it's entirely controlled by a joystick and it all happens graphically on the screen.

You are an explorer, sent forth by the King of Spain to reach the Indies. Like Columbus, you have a happy accident—you find a New World waiting to be discovered, explored, exploited, and converted.

The authors have done a remarkable job of giving us the experience of discovery. There is no map, at first—but as you sail along the coast or lead a band of men into the wilderness, a map is automatically drawn. You ordinarily see only the small area surrounding you; press the button, and you can see a considerably larger portion of the map. Only when you're safely home in Spain, however, can you see the entire map of all your discoveries. (You can also cheat by pressing D when you're back home; even the undiscovered lands are displayed then, but you get no more credit for discovering anything.)

In the New World, you discover major, medium, and minor rivers, and such exotica as "A land of high mountains" or "A land of lush jungles." Each new discovery adds to your reputation as an explorer—it is counted into your score.

But you don't run these expeditions out of love of discovery alone. They're expensive, and you have to make the investor's money back, particularly since the investor is the King of Spain. So you have to get gold. The simplest way is to discover a gold mine and ransack it—but there aren't many signposts saying "This way to the free gold."

Instead, you have to deal with the natives. And here is where *Seven Cities of Gold* stands head and shoulders above any other adventure game I've played. Your expedition brings along a certain amount of trade goods. When you discover a city or a village, you can trade for food or whatever gold the natives have. However, it isn't just a matter of simple barter. The natives don't necessarily

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With a personal computer and an hour-and-a-half a day, you can make more money faster than you ever thought possible. It all hinges on one great idea.

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You can take advantage of this situation . . . make money in virtually any aspect of the personal computer field. But if you want to make the really big bucks, you need to offer something unique. Something extra special. You need to have one great idea.

Your one great idea. I've got it.

Hello, my name is Larry Carter. Until recently I was the owner of just one business—Carter Spray Finishing Corporation. I built my company up through the years but expansion didn't come easy. There were always problems, long hours of hard work, weekends at the office.

The only good thing was the payoff. I lived in a plush apartment, drove a Cadillac Eldorado, wore expensive clothes. Still, my life was wrapped up in my business. I had a gorgeous beachhouse but hardly ever went there. Liked to go skeet shooting but rarely picked up my hand-crafted gun. I found it almost impossible to tear myself away from work.

Then, a short while ago, I invested in a computer to help me run my firm. Those 50-60 hour weeks were finally getting to me.

I became fascinated by my electronic marvel and went shopping for one for my home.

That was my introduction to the vast potential of the multi-billion dollar personal computer market. My business sense got aroused. Here was an opportunity too good to miss. I knew I had to grab it. The only question was "how?"

I was sitting at my new "toy" when the light bulb went off in my head. I was sure my idea was a winner . . . couldn't wait to put it to work.

Start-up was simple as pie. And the results took me by surprise.

To a guy who always slaved for a buck, the money was almost sinful. It came in so fast and easy. And there were no backbreaking hours. No headaches.

Only then did I realize I had made a fantastic discovery. I could slow down my pace and still increase my income. That did it. No more nose-to-the-grindstone for Larry Carter.

More money, less work.

Today I am in the spray finishing business and the personal computer business. I'm a greater success than ever. And I work less than ever, too. All because of the change that occurred when I came up with my great idea.

A few trusted employees manage my spray finishing concern when I'm not there. And my home-based personal computer business—why that's not work, it's part-time fun that's paying me a handsome full-time salary.

Life's a ball. I threw a few parties at the beachhouse last summer. Go skeet shooting every chance I get. And am looking forward to some exciting vacations.

Now I'd like to share my idea with you. Because the market's too big for just Larry Carter. Because I get a kick out of helping others. And because I believe more folks should work for themselves. For as I well know, when you're self-employed, you're happier, more independent and enjoy the full reward of your own effort.

With my idea, that reward can be substantial. You can make as much as three thousand five hundred dollars—$3,500—in your first two weeks of operation. With only 1½ hours of work a day. And that's only the beginning.

Make as much as $25,000 a month.

In just 90 days, once you're established, you can make as much as $25,000 a month. **Yes, $25,000 a month!** And you'll still be working an hour-and-a-half a day.

All you need is ambition and the desire to succeed. For when you use my idea, you don't have to sell door-to-door. You don't have to bother friends or relatives.

You don't need lots of start-up capital. There's virtually no investment involved. You don't need to live near other personal computer owners. Don't need to be a programmer. My idea is based on applied business and common sense, not a knowledge of computers. There's nothing complicated about what I have to show you.

Easy-to-follow steps.

In my new book, "The Profit Potential in Your Personal Computer. The $25,000-a-Month Idea," I'll tell you how to put my concept to work. Give you all the simple-to-understand instructions. Help you start making money the day you put my plan into action.

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To make your investment even more attractive, I'm also going to send you three FREE gifts: (1) a second thought-provoking book crammed with ideas (less profitable than mine but just as creative) on how to increase your income with a personal computer, (2) an audio cassette that accompanies my book, and (3) periodic updates on material that relates to my idea.

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like having strangers—particularly armed and dangerous ones—mucking about in their towns.

When you enter a village, your expedition is represented by a single figure, however many men you have with you. If you bump into one of the many figures representing natives, that native is killed. And since they come jostling around you pretty quickly, you have to scramble to keep from bumping them. Bump one or two, and maybe you can still trade with them—kill a third, and you've got a battle on your hands.

Fortunately, you have a few things in your favor. The first time you enter a village, you can choose to amaze the natives; this makes them stand back and let you through for a second or two. Then, when you get to the center of the village, where the chief is waiting for you, you can give him gifts. (You can also give gifts to the common folk, but it gets you little more than the time of day.) When you've given the chief enough gifts, he'll trade with you.

The chief is the key to winning battles, too. I hate to tell you the defect of character that led me to discover this, but if you begin a battle by treacherously killing the chief before attacking anyone else, you win a lot more easily, with less loss of life on both sides. This means that whether you want to trade or invade, you still are better off doing as Cortez and Pizarro did—make your way to the head man before you show your guns.

After you trade with or vanquish a village, many of the natives become bearers, allowing you to carry far more gold and food than your men could carry alone. These bearers usually stay with you until you board your ship and sail away.

Word spreads among the natives, too. If you've made friends with the natives, they'll tell you about other towns and you'll see the villages without having to stumble across them—a great time-saver. But if you've been wantonly killing, the next village will be warned and will attack you immediately.

Believe me—killing everything that moves is a sure way to achieve disaster.

When you conquer a village, you can usually establish a mission there; but the natives will be hostile, and will often overthrow the garrison you left behind. However, if you have been unusually kind in your dealings with a village, the chief will voluntarily ask you to establish a mission.

In other words, the way you behave, the moral character you establish in the game, affects the way the other characters in the game respond to you. If you're bloodthirsty or careless of your men, either the natives or starvation will finish you off; if you're careful and wise—and sometimes ruthless—you'll achieve high rank when you return to Spain. The best I've done at journeyman level is Viceroy—it's hard to imagine the King giving you any higher rank! But there's an advanced game that I haven't even tried to play.

An added benefit is the world-building program. If, like me, you are familiar enough with the history of the European conquest of America that you know all the places to go to conquer great empires, then you can use the world-building option to create new continents. The program was well-designed: the invented continents are realistically laid out. And this time, you really are exploring a world that *no one* has ever seen before.

In other words, this is that rare thing: a perfect game, which is worth the price you pay for it.

The graphics are beautiful, I love the world-building, the simplicity of acting out a very complex story is amazing—but what I like best is the fact that the game responds to you on a moral level.

This is way beyond anything you've played in the arcades. Most shoot-em-up games have a kill-or-be-killed premise. When I first started playing text adventures, I tried talking to the dwarfs and other creatures in the underground caverns, but they were only interested in killing. A few text adventures—*The Lords of Karma,* the many Infocom games—have more variety, in that not everybody you meet wants you dead, but I have seen none that do what I've been asking for since I first wrote to the guys at Infocom back in 1980: I want the game to change to respond to the kind of person my player-figure reveals himself to be.

I imagined then a text adventure in which, if a player kills everything that moves, within a few turns all the creatures in the cave get together and wipe him out. That's civilization, isn't it? Ganging up on the killers?

More important, though, I wanted the adventure worlds to be peopled with characters who respond to you individually. If you show yourself to be greedy, the thieving types would gravitate to you; if you're considerate, people who need help will call on you and then help you in return; if you're generous, you'll be trusted—but you'll also be taken advantage of; if you're cowardly, you'll be bullied. Certain characters will become your friends and fellow travelers; others will be your enemies; still others will be indifferent.

Seven Cities of Gold is the first program I've seen that takes an important step in this direction. It gives gameplaying, for the first time, the moral dimension that has previously been reserved to the storytelling arts like film and theatre and fiction.

I hope this game does so well that other game designers learn from it. □

SEE PROGRAM LISTINGS ON PAGE 88

HOW MODEMS WORK

The subject of computer telecommunications completely baffles most novices. Anyone who has ever been a teenager knows how people use a telephone, but the way in which a computer communicates over the phone lines is much less obvious. After all, they don't have any arms, lips, ears, or dimes, and even if they did, what's a computer going to talk about? Complain about his disk drive, or gossip about that cute little VIC down the street? To make matters worse, telecomputing carries with it an imposing load of jargon. Just when you were beginning to understand the difference between ROM and RAM (or had given up trying), along come terms like modem, terminal, duplex mode, carrier, answer and originate modes, and parity bits. As Mr. Bill would say, "Oh Noooooooo."

Not to worry. As surely as a telecommunications system transforms electrical signals into information, this installment of *Ship to Shore* will cut through the mumbo-jumbo surrounding computer communications. We'll take a look at the equipment used in telecomputing, how it operates, and some of the terms associated with that operation.

Anyone who has used a computer knows that they communicate through input or output devices. We use input devices such as the keyboard, joystick, light pen, or game paddles when we want to send information to the computer. We use output devices such as the display screen or printer to take information from the computer. During telecommunications, the computer receives information from another computer just as it does from the keyboard, and it sends out information to another computer the same way it sends it out to the display screen. The only difference is that unlike most input/output devices, the other computer is not physically present in the same room as yours. Usually, you hook up your computer to external devices like a printer or disk drive by attaching the two with a cable. Since a telecommunications link is established over phone lines, some extra equipment is needed.

Figure 1 shows the basic elements of a telecommunications link. At either end of the link is a computer (labelled "c") connected to a phone line by a device called a modem (labelled "m", and pronounced "moe'dem"). Usually, a computer communicates to outside devices by means of electrical signals running through wires. But the phone lines which serve as the most common medium for communicating between two points are designed to carry sounds, not the tiny electrical impulses that a computer generates. That's where the modem comes in. It takes the electrical signals from your computer and turns them into sounds that can be sent over the phone lines (or MOdulates them), and takes the sounds that were sent over the phone lines from another computer/modem combination and turns them back into electrical signals (or DEModulates them). The net effect is the same as if the two computers were connected by wires, and exchanged electrical signals directly. The only difference is that sometimes if there is static on the phone line, the information may be garbled during the transmission.

Most Commodore users have modems that were made specifically for Commodore computers and plug right into the user port. But it is also possible to use general-purpose modems with the help of what is known as an RS-232 interface (the box connected to the remote computer in Figure 1, labelled "r"). The name RS-232 may sound mysterious, but actually, it stands for Recommended Standard 232. It just so happens that Standard number 232 of the Electrical Industry Association describes a standard interface to be used with telecommunications devices. Since computers use a lot of different kinds of signals internally, the electronics industry decided to define standard plug and socket connections, as well as standard electrical signal levels, so that the same telecommunications equipment will work with all different kinds of computer equipment. By buying an RS-232 interface (for about $40) that plugs into the User Port, you can make your Commodore computer send out electrical signals that are compatible with all kinds of non-Commodore modems, and other RS-232 devices as well (such as printers and speech synthesizers).

So far, we've shown what it takes to physically connect your computer (sometimes called a terminal, because it sits at the end of the line) and the remote computer (sometimes called the host, because it allows "guests" like yourself to operate its programs by remote control). But all the hardware hookup does is allow the two computers to exchange electrical signals. Before we can use this system to actually transfer information, we have to get the two computers to agree on what those signals mean. This is accomplished by the terminal software that controls the exchange.

Since computers only understand numbers, and not letters, the first task is to convert the text using a code that

By Sheldon Leemon

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the computer can understand. The most common code is called ASCII (American Standard Code for Information Interchange). In ASCII, the number 65 stands for the letter "A", 66 stands for the letter "B", 97 stands for "a", etc. Internally, your Commodore computer uses a variant of this code called PETASCII, in which 65 stands for "a", while 97 stands for "A", but your terminal program will make the conversions so that you communicate in the same standard ASCII everyone else uses.

Let's follow the process of how your computer converts text to numbers, step by step. First, the program starts with text characters that you type in. For our example, let's use the letters

```
V I C
```

The ASCII codes for these letters are:

```
86  73  67
```

These numbers are in the form of decimals, the base ten numbering system that humans use. But computers use base two, or binary numbers. They find these numbers easier to work with, because in base two, all numbers are expressed using only two digits, the "0" and the "1". Of course, it takes a lot more digits to write a number in binary. In fact, in order to write any number from 0 to 127 (as you must in order to use the 128 characters of the ASCII code), you need at least seven binary digits. The seven-digit binary equivalent of the ASCII numbers above is

```
1010110  1001001  1000011
```

As you will see later, not only are these kinds of numbers easy for the computer to work with, but they are also easy to convert into sounds.

Even though we have changed our text characters a lot so far, we're not through yet. For one thing, some telecommunications programs use an extra binary digit (or bit) for what is called parity. In the early days of telecommunications, noisy telephone lines were an obstacle to information exchange, because the noise on the line could be misinterpreted as a false signal. Some way of determining whether the data received was exactly the same as the data being sent was needed. By adding one more digit to each character, a crude form of error detection called "character parity" was implemented. The way it works is simple: if you choose EVEN parity, the extra digit is used to insure that the number of "1" digits is even, and if you choose ODD parity, the extra digit is used to insure that the number of "1" digits remains ODD. For example, using even parity, our binary representation of the letters VIC:

```
1010110  1001001  1000011
```

becomes

```
01010110  11001001  11000011
```

The receiving computer would use this parity bit as a safeguard against bad transmission. If the bits didn't add up, the computer would know that the transmission was faulty, and could ask for the character to be sent again. This kind of simple error checking really belongs more to the era of mechanical teleprinters than today's modern computers. Nowadays, very few systems use parity. When you select NO PARITY with your terminal software, the eighth bit is always changed to zero (unless you want to send special, non-ASCII characters), so that our binary code for VIC becomes

```
01010110  01001001  01000011
```

We're almost ready to ship out our data, but we still have one last manipulation to perform. We've got to add "framing" bits that show where each character begins and ends. In order to understand why, let's go over the way in which the modem translates electrical signals to sounds.

Modems use two sets of frequencies to send and receive data. These are technically known as "answer" and "originate" frequencies, but let's just call them "high" and "low" tones. One modem will send information using the high voice, and will listen for a reply which the other computer sends using the low voice. The other will use the opposite pair of tones. Two sets of tones are needed so that the modem can differentiate between tones which it is sending, and those received over the phone lines.

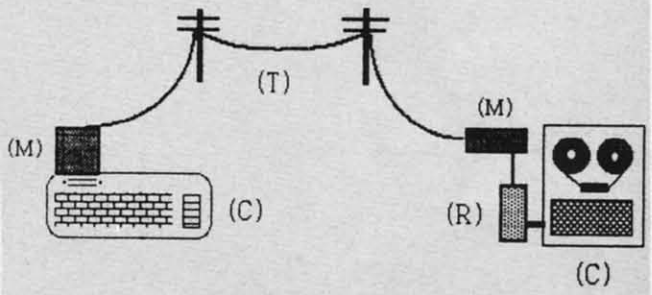

Figure 1: Telecommunications Link
M: modem T: telephone link
C : computer R: RS-232 interface

Each voice uses notes of two different frequencies, called MARK and SPACE. As you might guess from their names, MARK represents the "1" character, while SPACE represents the "0" character. By convention, the normal "quiet" state of a phone line when no data is being transmitted is a continuous MARK tone, which can be considered a constant stream of ones (this continuous tone is also called a "carrier," because the data string of ones and zeroes is superimposed upon it). To isolate our text character, which has now been converted to a stream of ones and zeroes, we "frame" it by putting a SPACE or zero character on either side of it. The zero character that comes before our text is called a start bit, while the one that comes at the end is known as a stop bit. Therefore, the binary numbers which stand for the letters VIC:

```
01010110  01001001  01000011
```

become

```
0010101100  0010010010  0010000110
```

Finally, we're ready to send this text. Here we have

a "quiet" communications line (all MARK tones, or ones, remember) just waiting for some data:

```
MMMMMMMMMMMMMMMMMMMMMMMMM
MMM
```

When we type the letters "VIC", the ASCII codes for which are

```
86  73  67
```

our computer recognizes what we typed as

```
01010110  01001001  01000011
```

and our telecommunication software adds in the start and stop bits to change it to

```
0010101100  0010010010  0010000110
```

This data is sent to the modem, which changes the zeroes and ones into the high and low sounds known as MARK and SPACE tones:

```
SSMSMSMMSS  SSMSSMSSMS  SSMSSSSMMS
```

The modem superimposes these tones over the continuous MARK tone of the "quiet" line:

```
MMMSSMSMSMMSSMMMMSSMSSMSSMSMMM
MMSSMSSSSMMSMMM
```

The receiving modem changes it back into a string of ones and zeroes again:


```
1110010101100111100100100101111100100000110111
```

The telecommunications software on the computer at the receiving end must watch this stream of characters. Because of the agreed upon convention, it knows that the first zero it sees means "Hey! The next eight bits are a character, and ninth bit had better be a zero that marks the end of the character. After you get that last zero, you'll see some ones for a while, until you get another zero that starts another character." In this way, the extraneous ones added in by the continuous drone of the "carrier" tone are stripped away, and the computer at the other end receives the characters

```
0010101100  0010010010  0010000110
```

which it displays as the letters

```
VIC
```

This may seem like a lot of work for just three letters! Fortunately, your computer and modem can handle the whole operation at a high rate of speed. What speed, you ask? The most common rate is 300 bits per second. As you have seen above, each character requires at least 10 bits, so 300 bps equals a little under 30 characters per second. Sometimes you will hear operation at 300 bps referred to as 300 baud. This unit of measurement is named after Georges Baudot, the inventor of an early teleprinter code. But it refers only to how many times per second the tones change frequency, not how many bits are sent. At 300 bps, the tones change frequency at a rate of 300 baud, so the terms may correctly be used interchangeably to describe the speed of transmission. Modems that transfer data at 1200 bps, however, only change the frequency of the tones at a rate of 600 baud, so to term them "1200 baud" modems is a mistake.

The only term left to explain is "echoplex" or "duplex" mode. This has to do more with how information is displayed on your screen than how it is transmitted. Most communications links are in what is called "full duplex" mode. This means that the remote computer actually echoes back every character that you send it, and the text that you type in at your keyboard does not appear on your screen until it is sent back from the computer on the other end. This makes it easy to spot any trouble, because if the other computer isn't receiving your text, you won't see it on your screen as you type! The other possible mode is called "half duplex." In this mode, all of the characters that you type are displayed directly on your screen. This is necessary only if the remote system isn't echoing your characters back. If it is, then you will see each character on your screen twice, once from the "local echo" and once from the "remote echo," lliikkee tthhiiss.

That about covers our painless introduction to telecomputing. If you have any questions, please send them along, and we'll try to cover them in future columns.

Sheldon Leemon
CompuServe ID 72705,1355
Source BBX878

SCREEN MAGIC

A Graphics Generator for the C-64

By Bob Spirko

The C-64 provides a variety of graphics, but producing them on the screen is no easy matter. Take for instance the procedure of placing a red, reversed heart symbol in the middle of the screen. First we use the two cursor keys to get to the location. Then we press CTRL and RVS, followed by CTRL and RED. Next we have to find the character on our keyboard...there it is. Now we press COM and S. There. Eight keys later we have our symbol on the screen. That's a lot of work for one character.

Drawing a complex picture in this manner is not something you would do for fun, but sometimes we'll write a program that demands it. Even as I wrote *Screen Magic,* I was wishing I had help.

Screen Magic takes your hands away from the keyboard and places them on that device we all love to handle: the joystick. Using only the joystick, you can choose the character that you want and print it on the screen. These include graphic characters, letters, numbers, and other symbols as well. On the screen, along with the character table, there is a palette of colors. Most of the screen, however, is your canvas. Although you can draw effectively without the keyboard, there are a number of special keys you'll want to use. I'll get to these in a minute; first let's type in the program.

It's in machine language—and it's long—but *Flankspeed* (see page 86) should eliminate all the typos. Once you've typed it in, be sure to save it before running. Then plug your joystick into port 2. Type NEW and hit RETURN. Then type SYS 49152 and press RETURN.

The screen will display a table of symbols and colors—unlike the keyboard, these are neatly grouped together for quick selection. To start, just push your joystick. First you'll have to pick a character to print. Center your cursor, which is an open box, over the symbol you want and press the fire button; the character will be tucked away in a tiny buffer. Then move to the palette and select a color in the same way. Now go to the right side of the screen and hit the joystick button; your character will be printed. You can, of course, hold down the button and draw a string of characters as you move across the screen. Keep in mind that your cursor picks up letters and colors when it's in the symbol table, but outside of the table, it prints them.

As you move about the screen you may find the cursor speed too slow or too fast. To change it, press V and you'll be asked to enter a number. The fastest is 0 and the slowest is 9. You can also use the cursor keys to maneuver around, and the space bar to pick up or drop a character. Use DEL (or print a space) to erase a character, and CLR to clean your canvas. Some characters, such as letters and numbers, have no reverse case displayed in the symbol table, but you can toggle reverse by pressing 9 (press RVS without holding the CTRL key down). When you've finished drawing, press X to exit to BASIC.

Now for those special keys I mentioned. After drawing your picture, you may find that it is not centered on the screen. If this is the case, you can scroll your canvas to the right by pressing f1. Similarly, use f2, f3, and f4 to scroll left, down, and up. To change the background color, press f5. No doubt you'll want to save some of your creations; if so, press f8 and you'll be asked for a file name. Once entered it'll be stored (disk only) for later retrieval. To LOAD it, press f7.

Often you might want to draw a symmetrical figure, such as a border. Tap the back arrow and you'll be in the symmetry mode. Whatever you draw on the left side of your canvas will be duplicated on the right. If your cursor is on the right side of the screen, no duplication takes place. Press the back arrow again to turn off the symmetry mode.

The keys I like most are A and SHIFT-A. Let's say you want to draw a line with hearts and diamonds so that the first character is a heart, the second a diamond, the third a heart, and so on, alternating down the line. If you already have a heart in your buffer, toggle key A. The heart will be transposed to another buffer. Now move your cursor over the diamond and press the fire button. With both characters stashed away, you can now print alternating symbols. Each time one character is printed, the buffers are switched so that the next character to be printed is different. To turn off alternating characters, hit A again. Toggle SHIFT-A to alternate colors.

Here's a rundown on the commands:

f1 : scroll right	f8	: save to disk
f2 : scroll left	←	: symmetry mode
f3 : scroll down	A	: alternate characters
f4 : scroll up	SHIFT A	: alternate colors
f5 : change bkgrd. color	V	: cursor velocity
f7 : load from disk	X	: exit to BASIC

When loading *Screen Magic* back in, you'll have to do so with a ",1":

```
LOAD"SCREEN MAGIC",8,1
```

as it is all ML. When the cursor returns to the screen, type SYS 49152, then RETURN. This will activate the program. ☐ ***SEE PROGRAM LISTING ON PAGE 102***

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DUCK SHOOT

ARCADE ACTION

for the C-64

By Bob Blackmer

Duck Shoot is a colorful arcade-style shooting gallery, inspired by the old carnival game. You simply aim your gun sights at the ducks on the screen and fire.

Shooting down ten ducks will put you in a timed target round, consisting of a series of targets that appear on the screen for brief periods. The higher your score, the faster the required reaction time. If four ducks in a row get by, the game ends and your score and the high score are displayed.

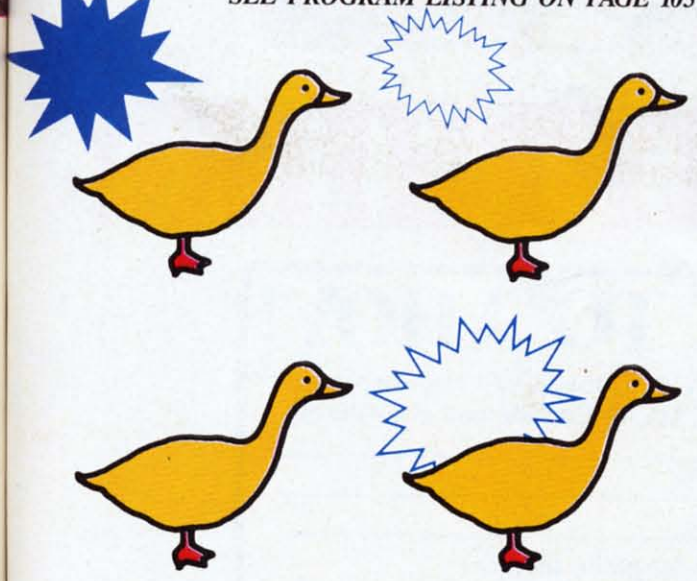
The duck's speed will increase as you progress through the rounds.

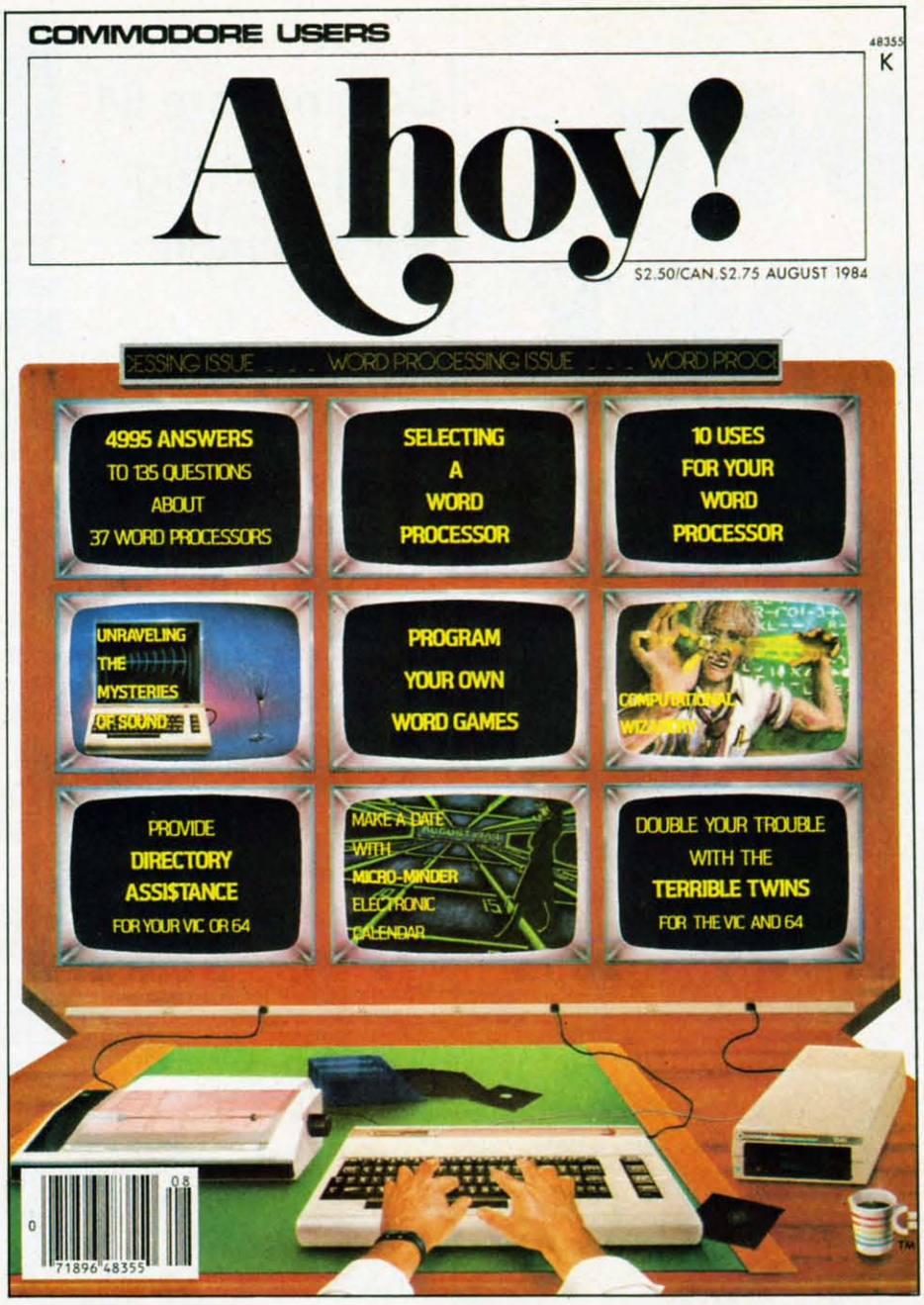
Ducks are worth 25 points each, and the targets are worth 50 points each.

There are eight target rounds, after which the game becomes a flurry of ducks moving faster and faster until the game ends.

If you like shooting for a high score, my best is 6300. □

SEE PROGRAM LISTING ON PAGE 105





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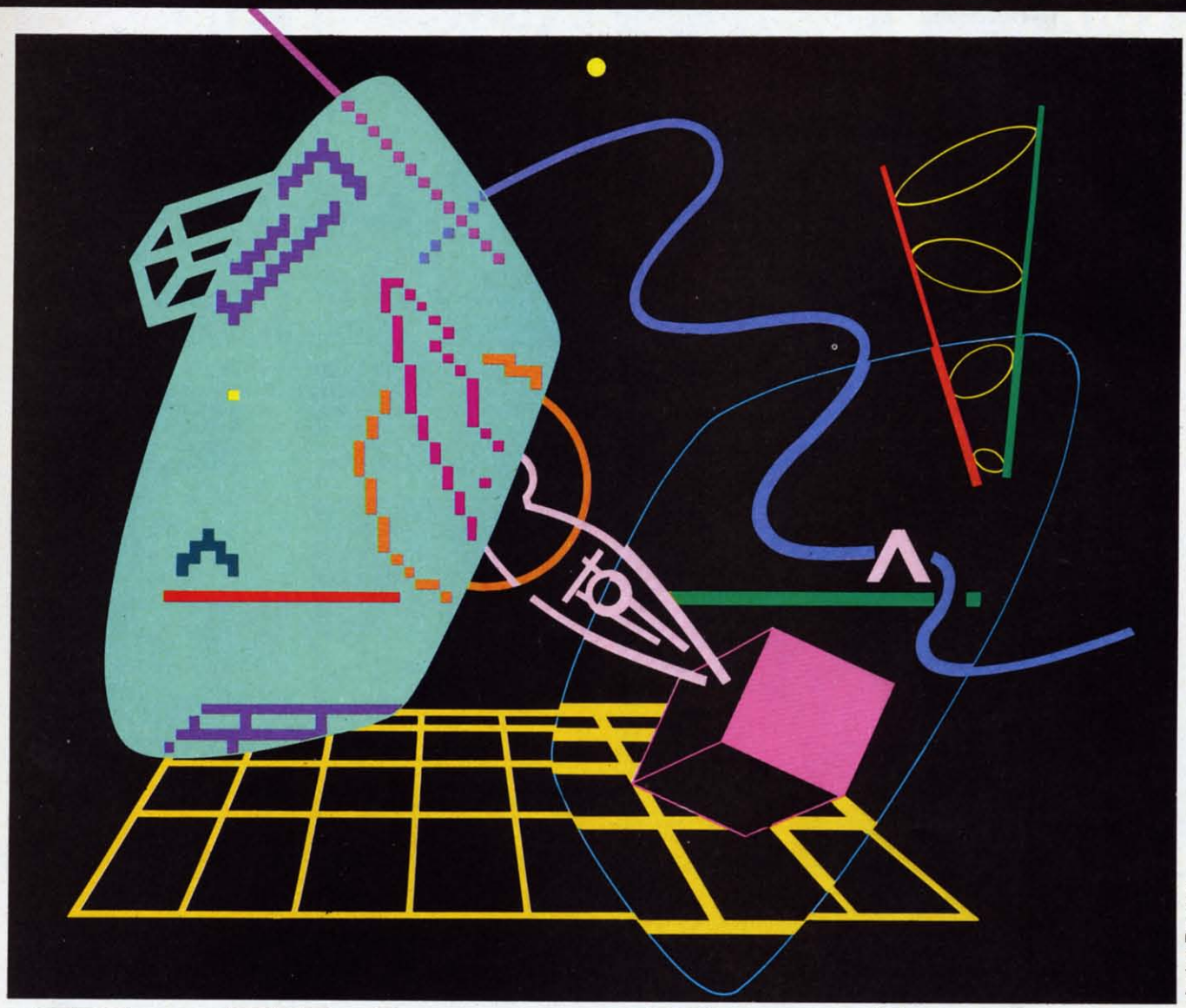

Javier Romero

The Ultimate Resolution

Exploring Bit Map Graphics on the Commodore 64

By Dale Rupert

Exploring any new feature of the Commodore 64 is always an adventure. Originally I had planned to deal with the random number generator this month. There are several interesting computer simulations involving random numbers. The Buffon Needle problem and the "infinite number of monkeys at the keyboard" problem can both be simulated by using the RND function in BASIC. Before developing those problems, I wanted to do some elementary investigations into the random number generator itself. That's where this diversion into bit map graphics began.

It is well known from the advertisements that the Commodore 64 has a graphics resolution of 320 dots (horizontal) by 200 dots (vertical). What isn't obvious from the ads is that accessing those 64,000 dots is much easier said than done. All I wanted to do was choose a random value for X from 1 to 320 and a random value for Y from 1 to 200 and then plot each X-Y pair. Truly ran-

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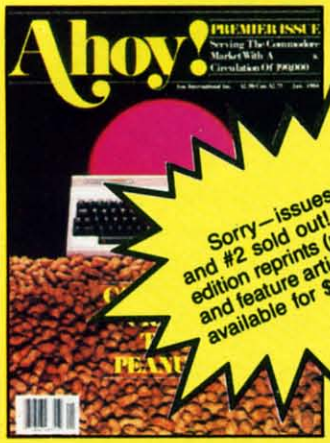

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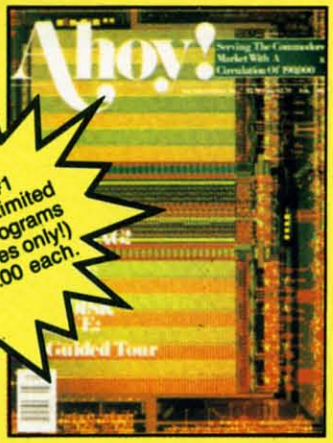

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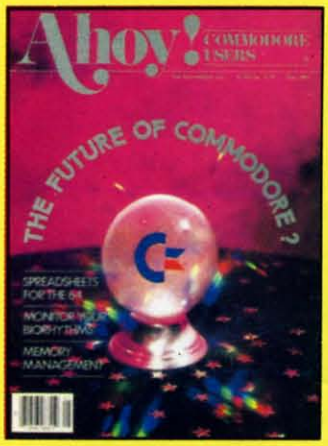

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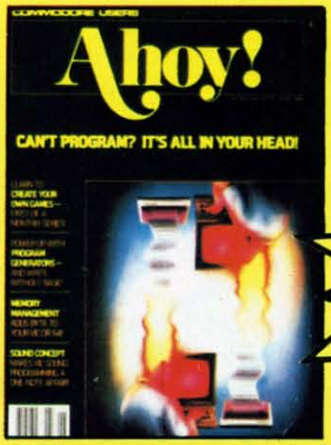

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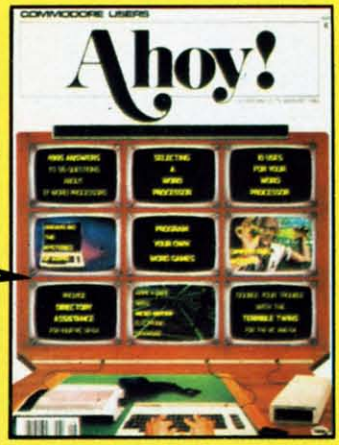

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dom numbers should produce a truly random looking pattern of dots on the screen.

Those of you who use one of the enhanced versions of BASIC are undoubtedly able to type PLOT (X,Y), or something similar, and thereby put a dot on the screen effortlessly. This article is for those of you who do not use a fancy BASIC. Or those of you who enjoy a complicated puzzle and want to find out more about the amazing silicon brains we are using.

This month we will investigate the Standard High-Resolution Bit Map Mode of displaying graphics on the Commodore 64. We will see that BASIC is barely able to operate in this mode. BASIC is very slow and cumbersome at manipulating 64,000 dots in most applications. For that reason, next month we will create some assembly language routines to help speed things up. First let's review some of the basic screen concepts we've previously discussed.

PRELIMINARIES

In the normal character mode of operation, there are twenty-five rows of characters with forty characters in each row. That gives a total of one thousand individual characters (25 times 40) which may be displayed at one time. There are 256 different characters to choose from for each of those 1000 locations. Furthermore, each and every character may be any one of sixteen colors.

The Video Matrix is the technical name for the one thousand consecutive bytes of memory whose contents are normally displayed on the screen. The Video Matrix begins at memory address 1024 and goes to address 2023 when we turn on the computer. Those addresses may be changed by programming, but we will assume that they have not been.

Each byte of the Video Matrix contains an eight-bit value ranging from 0 to 255. In normal character mode, the VIC-II Video Interface Chip translates each byte into a pattern of pixels (picture elements) which appear on the screen in some recognizable form. Appendix E in the *C-64 User's Guide* and Appendix B in the *Programmer's Reference Guide (PRG)* show 128 of the 256 possible forms. The other 128 characters are reverse images of those shown. There are indeed two sets of 256 characters each, but only one of those sets may be selected at a time. In fact it is possible to create still other sets of characters to replace these, but that is a topic for another article.

If we put the value 20 into address 1024 (POKE 1024,20), the result is a letter "T" in the upper left corner of the screen. As we have discussed before, it may not be visible until we put a contrasting color value into the corresponding color memory location (POKE 55296,1). The VIC-II uses the 20 as an index into the Character Base. The Character Base provides a 64 bit dot pattern which represents the character "T". The normal Character Base originates in ROM.

Each character consists of a box which is eight screen dots wide by eight scan lines high. Within that box of 64 dots or pixels, some of the dots are one color and the rest are another color. The dots that contrast with the background color are arranged in the shape of a "T".

To get an idea of the size of the pixels we are dealing with, put character 102 onto the screen (POKE 1024,102 : POKE 55296,1). You might be able to count the individual pixels, depending upon your monitor and your eyes. Each small square in the pattern contains four pixels. Keep in mind that those 64 pixels are generated as a result of the one-byte quantity stored in location 1024.

In graphics bit map mode, the VIC-II treats each one-byte value in locations 1024 through 2023 quite differently. Instead of representing predefined character symbols, each one-byte value is interpreted as two four-bit color codes. In the bit map memory, the "0" bits will be displayed as one color and the "1" bits will be shown as the other color. But just a moment. What is this bit map memory?

THE BIT MAP

We have already calculated that a 320 by 200 resolution display needs 64,000 bits or 8000 bytes of storage. The C-64 hardware is arranged so that the 8000 byte bit map memory may begin at either location 0 or location 8192. Since BASIC and the operating system are very dependent on the page zero memory, we wouldn't get very far by POKEing random data there. Consequently we must use the 8000 bytes beginning at address 8192 for our bit map memory.

Having defined a suitable block of memory, we can create an image on the screen by turning some of the 64,000 bits on and turning others off. The first eight bytes of this memory contain 64 bits which correspond to the small, character-sized region in the upper left hand corner of the screen. The bits that are 1's will be displayed as one color, and those that are 0's will be displayed as another color. The actual colors depend upon the value stored in location 1024. The next block of 64 pixels will also be displayed in two colors. Those colors are determined by the value stored in location 1025. And so forth.

There is a very definite similarity between the character mode and the bit map graphics mode. Each mode has a data memory and a separate color memory. For character mode, data memory consists of 1000 bytes beginning at location 1024. Its color memory consists of 1000 nybbles beginning at location 55296. Each of the 1000 characters may have any one of sixteen colors. For bit map mode, data memory consists of 8000 bytes beginning at location 8192. The corresponding color memory begins at location 1024. Each of the 1000 bytes starting at 1024 contain two color nybbles. Each block of eight bytes in data memory can be displayed in any two of sixteen possible colors. As we discuss the details, the confusion should subside.

THE DETAILS

Pick two colors, any two colors, as long as they are from the group of sixteen listed in Appendix G of the

User's Manual or Appendix D of the *PRG.* A number 20 in location 1024 while in bit map mode is interpreted as the colors white and purple. The easiest way to see this is to convert it to hexadecimal. In hexadecimal, 20 becomes $14 where the "$" signifies that this is a hexadecimal value.

The "4" is in the units place, and "4" corresponds to purple. The "1" representing white is in the 16's place. The decimal value of $14 is 1*16 + 4 or 20. That is how the value 20 in location 1024 represents the colors white and purple.

If you want the 64 pixels in the upper left corner of the screen to be light blue or yellow, you must poke 231 into address 1024. Light blue has a value of 14, and yellow has a value of 7 (14*6 + 7 = 231). The color value in the most significant nybble is treated as the foreground color, and the other is the background color. Poking 126 into 1024 would reverse the colors since 7*16 + 14 = 126.

A simple example should clarify the situation. Assume we are working in bit map mode, and location 1024 contains the value 20 (white/purple). Put values 255,0,255, 0,255,0,255,0 into the first eight locations starting at address 8192. Remember that these eight bytes represent the pixel pattern displayed in the upper left corner of the screen. That eight by eight square will look like this:

```
11111111
00000000
11111111
00000000
11111111
00000000
11111111
00000000
```

The number 255 contains all 1's, and of course 0 is stored as all 0's. The computer does not display 1's and 0's on the screen. Instead all the 1's are displayed as white pixels, and all the 0's are shown as purple pixels. Consequently there will be a white and purple striped square in the upper left corner of the screen.

If we replace the 255 in location 8192 with 254, the pixel in the upper right corner of the box above will change from white to purple. If we put the value 1 into memory location 8199, the lower right corner of the box will change from purple to white. If we change the value in location 1024 from 20 to 231, the box will change from white and purple stripes to light blue and yellow stripes as we calculated earlier.

It should now be clearer as to where the term "bit map graphics" originates. The value of each bit corresponds to a pixel on the screen. The screen image is essentially a map of the bits in memory.

The details of the organization of the 8000 byte bit map memory are shown on page 125 of the *PRG.* Unfortunately the calculations needed to determine the specific byte and bit to turn on any given pixel on the screen are somewhat involved.

Using the terminology in the *PRG,* the formulas for locating the pixel at location X,Y are as follows:

BYTE = BASE + 320*ROW + 8*CHAR + LINE
BIT = 7 − (X AND Y)

where

BASE = 8192 (the starting address of the bit map)
ROW = INT(Y/8)
CHAR = INT(X/8)
LINE = (Y AND 7)

The calculated BIT is set to 1 or reset to 0 in address BYTE in order to select the foreground color or the background color for the pixel at screen location X,Y. X ranges from 0 to 319 and Y ranges from 0 to 199 with the origin 0,0 in the upper left corner of the screen.

Unfortunately these formulas represent a fair amount of work for BASIC to locate just one pixel. You enter the bit map mode in BASIC only if you have plenty of time. Let's look at the details of initiating bit map mode and working in it.

USING THE BIT MAP

The steps required for using bit map mode are as follows:

1. Set the bit map starting address to 8192.
2. Enter bit map mode.
3. Clear the bit map memory.
4. Put desired color(s) into the color memory.
5. Set (or reset) desired bits in bit map memory.

The sequence for these steps depends upon the application. The program on page 88 shows how these steps are implemented.

We will use the "set bit" and "reset bit" functions which we have discussed in previous columns. They are defined in lines 10 and 20. Line 420 shows how these functions are used. The argument of the function must be a number from 0 to 7 corresponding to the chosen bit. The memory location must be stored in the variable named MM. The statement POKE MM, FNSB(5) will set bit 5 of address MM to 1. If BIT has a value of 3 and MM equals 9000, then POKE MM,FNRB(BIT) will reset bit 3 of location 9000 to 0.

To place the bit map memory at address 8192, we must set bit 3 of VIC-II register 24. ("Set" will mean to give a value of one and "reset" will mean to give a value of zero in the following discussion.) The VIC-II registers begin at location 53248. Register 24 is at address 53248 + 24. The variable VV in line 30 stores the starting address of the VIC-II registers. Line 40 sets bit 3 of register 24 and defines the starting location of bit map memory.

To enter bit map mode, line 50 sets bit 5 of VIC-II register 17. If you stop the program at this point, you see a jumble of dots, especially if the screen had characters on it before you typed RUN. The eight by eight demarcations should be visible as the colors vary from box to box. The colors are determined by the characters which were on the screen when you ran this program. The dots within the boxes show the data that happened

to be in memory beginning at location 8192 when you ran the program.

Lines 70 and 80 POKE 0 into the 8000 bit map locations. This seems to take forever. (A good place for a machine language routine!) The whole screen will now display the background color(s).

Line 90 sets the foreground color C1 to white (1) and the background color C0 to black (0). Not very imaginative, but feel free to pick your own colors. The 1000 bytes of color memory are filled with this one color combination in line 100. Remember, you may put various color combinations anywhere within the color memory.

The main program in lines 200 through 220 performs the operation described at the start of this article. Random values for X and Y are chosen, and the corresponding X-Y pixel is turned on (set to the foreground color). The main program calls the subroutine at lines 400 through 430, which performs the calculations for an X-Y pair and lights the proper pixel. Notice that some of the formulas mentioned earlier have been combined into one formula in line 410 to help speed things up.

A pause in line 250 allows you to see the screen for a while after the one thousandth random pixel has been lit. Lines 310 and 330 return things to normal character mode. All the characters which were on the screen are now P's. Do you know why? Look at line 100 for a clue. List the program to see that everything is in fact normal.

Here are a few tips before you take off on your own to work with this graphics mode. Remember that RUN-STOP/RESTORE will return the screen to normal mode. I found it useful to memorize the line number 300. If I stopped the program before it finished, I would blindly type GOTO300 which allowed the program to return the screen to normal. That way my screen colors weren't reset as they would be with RUN-STOP/RESTORE.

It is very frustrating to sit and wait for 8000 bytes of memory to be cleared every time the program is run. You might put in a statement to bypass lines 70 and 80 after memory has been cleared once. You will end up with multiple images on the screen but that may not be objectionable for debugging.

Put your own statements between lines 100 and 300. Just define values for X and Y then GOSUB 400. This program does not check the validity of any parameters, so be careful with your values of X and Y, or add checking routines (and slow the program down even more).

Horizontal and vertical lines are easily generated. A sequence such as this creates a small rectangle:

```
200 FOR X=100 TO 130
210 Y=20 : GOSUB 400
220 Y=40 : GOSUB 400
230 NEXT X
240 FOR Y=20 TO 40
250 X=100 : GOSUB 400
260 X=130 : GOSUB 400
270 NEXT Y
```

These instructions from the *PRG* draw a sine wave:

```
200 FOR X=0 TO 319 STEP 0.5
210 Y=INT(90 + 80*SIN(X/10))
220 GOSUB 400
230 NEXT X
```

There is a warning on page 127 of the *PRG* that BASIC variables can overlay the high resolution screen. It is clear from the memory map on page 320 of the *PRG* that our bit map memory (8192 to 16191) is in the midst of the BASIC program space. BASIC closes in on this bit map memory from both directions. This is all right if the two regions don't reach the bit map memory. If your program is so large that an overlap occurs, you will have to move the bottom of BASIC memory up above address 16191. The TXTTAB pointer at locations 43 and 44 determines the lowest address used by your BASIC program. Change this if your programs conflict with bit map memory.

It's obvious after running the program on page 88 that the random number generator doesn't generate patternless random numbers. We'll go further with random numbers another time. Next month we'll replace some of these sluggish BASIC statements with high-speed assembly routines. In the meantime, what will you do with those 64,000 pixels now that you have control of them? ☐

SEE PROGRAM LISTING ON PAGE 88

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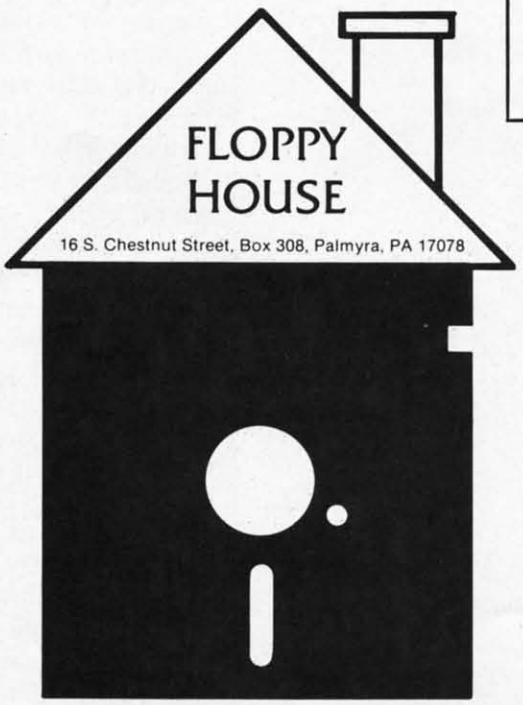

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BOOK REVIEW

MAPPING THE COMMODORE 64 by Sheldon Leemon (COMPUTE! Publications, Inc., 1984; $14.95). 268 pages, 65536 memory locations, softbound.

Mention memory map to a veteran peruser of computer journals and you will conjure up a vision of a nearly endless column of numbers, flanked by cryptic labels to the left and equally cryptic descriptive messages to the right. While this sort of information is eminently useful to those familiar with the innermost secrets of their computer, it provides the average user with very little that's definitive.

Mapping The Commodore 64 is a memory map with a difference. The list of numbers (in hexadecimal and decimal) is still there along with the cryptic labels and associated comments. However, comparing this book to a memory map is akin to comparing a detailed travel guide to a simple road map. Each significant address or group of addresses is annotated in considerable—yet concise—detail. These are not just one or two sentence descriptions. The shortest explanations run several paragraphs. The longest are actually comprehensive tutorials on the specific features on the Commodore 64.

For example, the memory locations devoted to the VIC chip comprise a surprisingly thorough description of the graphics capabilities of the Commodore 64. This book by my side proved a valuable aid in preparing the graphics articles for the October and November issues of *Ahoy!* Actually, the entire C-64 4K I/O block (53248-57343; $D000-$DFFF) spans nearly 100 pages.

"And not only that...but someday your name will be mud in the computer industry!"

The layout follows the memory arrangement of the C-64. Thus chapter 1 is entitled "Page 0" in reference to the machine language notation for the first 256 bytes (0-255) of available memory. This has nothing to do with the page numbering of the book. As a result, the book lacks a definitive topical organization other than that which may be associated with a specific memory block. Beginners should take warning. Some idea of what you are looking for is needed to comfortably find your way around this format. Detailed explanations of specific locations are often associated with other addresses which may be further on in the text.

Specific areas of emphasis are the first kilobyte of RAM (used by BASIC and the operating system) and the ROMs themselves. Most of the addresses in the first group include useful hints and tips on the effect of modifying the contents of the particular location. The second group is broken down into the specific operating system routines. Brief descriptions are provided on just what each routine does.

Sprinkled throughout are program examples in both BASIC and ML which are used to illustrate the various points. These range from brief one or two line affairs to full blown utilities. For example, the Vector to Keyboard Table Setup Routine, addresses 655-656 ($28F-$290), includes a C-64 version of a keypress routine which generates an entire BASIC keyword from a single SHIFTed or COMMODOREd keystroke.

The index was a bit unusual. Rather than the customary page numbers, each item was referenced to its actual memory address. On occasion this proved to be a minor boon, particularly when all that was needed was the actual address associated with the item in question. Most of the time, this arrangement was less than optimum as the relationship between page numbers and address was not immediately obvious (let's see now, 56576 should be around page 203 or thereabouts...). The most serious flaw in this system was trying to find my way around the I/O block, which in the C-64 is multilayered. Tracking down the description of the character generator ROM took a little doing.

The appendix section was surprisingly brief, consisting only of a program typing guide and a list of the Commodore ASCII, screen, color and key codes. You definitely get a lot of meat in this volume.

Mapping the Commodore 64 is a must-have for anyone serious about using the 64 for anything other than running canned software. For beginners, appreciation will increase directly with their computational sophistication. Advanced users will find many surprises within its covers. All users will find it a valuable aid in working with their machine. □ ***—Morton Kevelson***

MAPPING 4.4

A Function Plotter for the C-64

This program will provide assistance in solving numerous problems in physics, mathematics, and other fields where it is necessary to see the behavior of a mathematical function. It will plot a function, in high resolution, into a given range on a small screen (which is large enough for most applications). It is practically error-proof and easy to use, employing the same principles as bit map graphics, but over a screen of only 9600 pixels (120 * 80). The user can specify the portion of the function he wants depicted, and change the function.

For programmers, the listing on page 109 is easy to understand. It is composed almost entirely of subroutines, and contains many REM's throughout.

HOW TO USE THE PROGRAM

On the bottom of the screen, the names of all the keys that can be used are displayed. Their functions are as follows:

f1: Graph Cleaner. Clears the small screen, but not the equation. You can ask for another range without respecifying the function.

f3: Range Changer. When you press this key, the program will request the minimum value (XO) and the maximum value (XM) on the X-Axis into which you want to plot the function. It will then request the minimum and maximum values on the Y-Axis (YO, YM). It will then ask for the number of pixels you want to use in making the graphic. The plotting will follow this last input.

f5: Function Changer. Changes the function in the program. It is located on line 55 of the program. After this operation the values of all the variables vanish, due to the fact that the program is ENDed and then RUN again.

f7: Compare with Memory. This key, when pressed once, shows the graphic on the screen together with the one in memory, in order to allow you to compare them. When you press the key again, it returns the screen to its original condition.

f2: Store M+. When this key is pressed, any graphic on the screen is copied into memory over any graphic residing there.

f4: Recall. Calls the graphic in memory back, and puts it on the screen over any graphic that is there.

f6: Clear Memory. □

SEE PROGRAM LISTING ON PAGE 109

By J.M. Marcano

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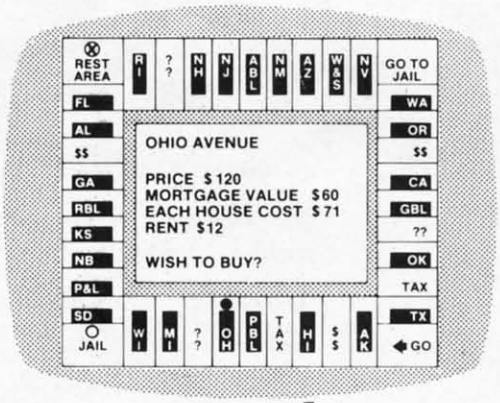

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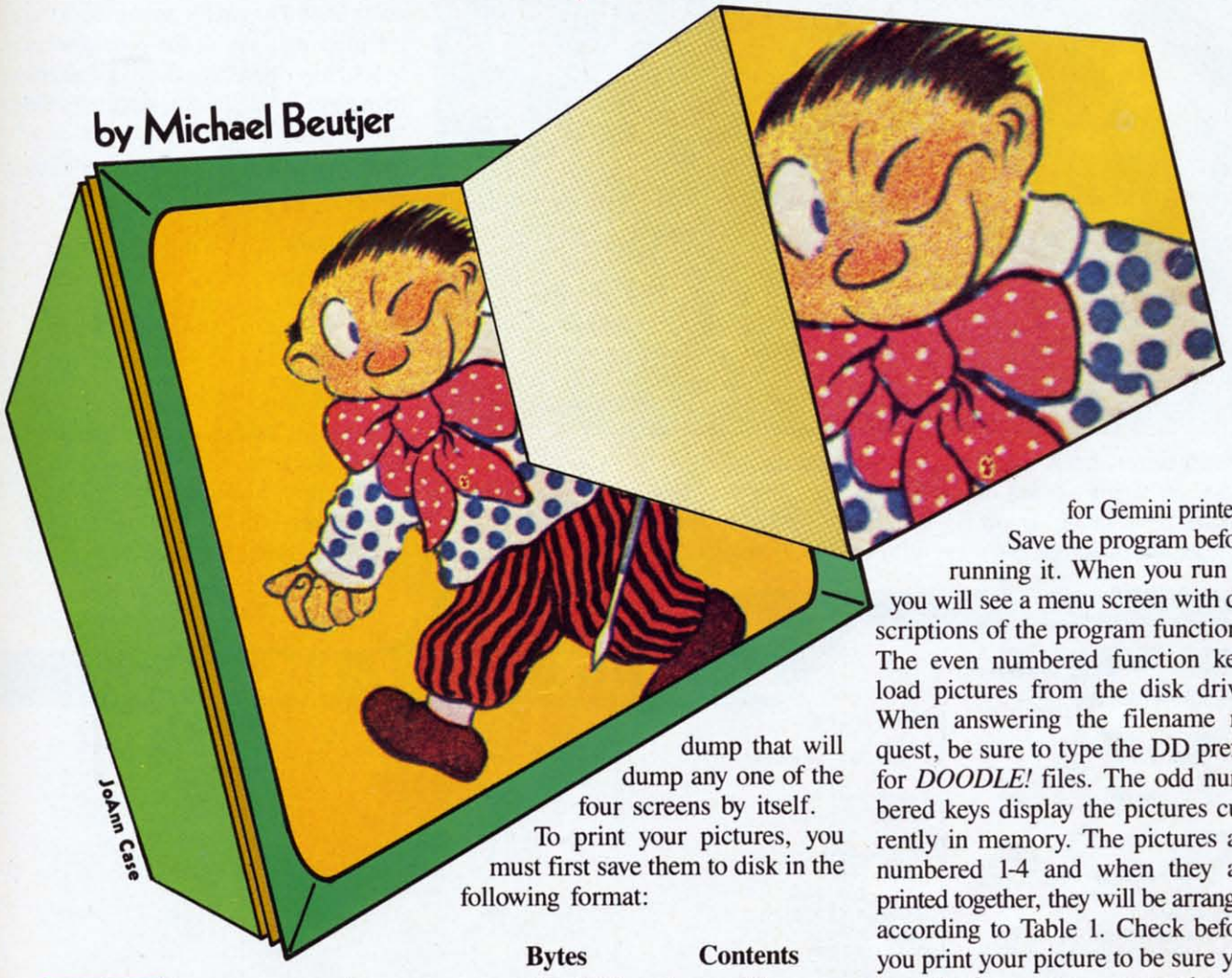
QUAD-PRINT

A Screen-Dump Utility for the C-64

by Michael Beutjer



Almost everyone loves to doodle, and your 64 is a great place to do it! Whether you use a light pen, joystick, trackball, or write special programs to make your high resolution screens, the 320 x 200 sketch pad in your Commodore 64 is just plain fun. Sometimes, though, that doesn't seem to be enough. So why not 640 by 400?

That's exactly what you'll get with *Quad-Print,* a printer utility that dumps four hi-res screens together to form one big picture. Versions are provided to work with the Commodore 1526, Epson, or Gemini printers. With a little work, you can probably use any printer. Included within the 1526 version is a single screen dump that will dump any one of the four screens by itself.

To print your pictures, you must first save them to disk in the following format:

Bytes	Contents
0 - 1023	Screen Memory
1024 - 9023	Hi-res Bit map

This is compatible with disk files created with *DOODLE!* from City Software, so you can use those pictures directly. Note that the color memory section is used only for displaying the pictures, not in the printout. Making edges match is a little tricky at first, but with a little practice it becomes much easier.

The 1526 version begins on page 95, and the Epson/Gemini version on page 97. If you type in the Epson/Gemini version, only the set of control code lines (1140 - 1190) corresponding to your printer should be typed. The number in line 565 must also be changed from 61145 to 61166 for Gemini printers.

Save the program before running it. When you run it, you will see a menu screen with descriptions of the program functions. The even numbered function keys load pictures from the disk drive. When answering the filename request, be sure to type the DD prefix for *DOODLE!* files. The odd numbered keys display the pictures currently in memory. The pictures are numbered 1-4 and when they are printed together, they will be arranged according to Table 1. Check before you print your picture to be sure you have the four screens arranged properly. If you need to swap pictures from one place to another, use the @ key from the main menu and enter the numbers of the screens you want to swap. Notice that your picture names are printed at the top of the menu screen to help you keep track of them.

Other program functions are positive or negative dump (English pound sign or left arrow key, respectively), and quick view screens (asterisk) which display the pictures in "slide show" fashion. To use the quick view feature, press the asterisk key from the main menu. Screen 1 will be displayed, and you may cycle through the screens by pressing the odd numbered function keys. To return to the

TABLE 1

Picture No.	Address	Position
1	$4000	Top Left
2	$6000	Top Right
3	$8000	Bottom Left
4	$A000	Bottom Right

TABLE 2

ML Routine	Epson/Gemini Address	1526 Address
Move Picture	49490	49430
Display on/off	49188	49188
Dump positive	49209	49209
Dump negative	49205	49205
Load picture	49454	49374

Note that all "POKE" values are the same for either version.

main menu, press the space bar. To use the single screen dump for the 1526, press the up arrow key and indicate which screen (1-4) you wish to dump.

Let's look at the Epson/Gemini version to see how it works. (The 1526 version works in generally the same way and the SYS addresses for it are in Table 2.) There are four machine language subroutines that the BASIC program uses to handle the jobs of loading, moving, and printing your pictures. The move routine starts at 49490, and it moves both the bit map and the color information block anywhere in the computer's memory. To use it, we must pass the "from" and "to" addresses to the routine. POKE the desired addresses as follows:

POKE	Value
49152	Bit Map : From
49153	Bit Map : To
49154	Color Info : From
49155	Color Info : To

We need only POKE the high byte of these addresses—the low byte must always be zero. The routine moves the two areas independently; it is up to us to keep track of where we have put them. We may use any of the

QUAD-PRINT SOURCE CODE LISTINGS

1526 VERSION

Main Routine

```
;
;  Quad-Print
;   (C) 1984
;
; by M. Beutjer
;
; This program
; dumps 4 hi-res
; screens side by
; side to produce
; one 640 x 400
; printout on
; a 1526 printer.
;
;
        *=$C000
;
; DATA AREA
;
ORIG    .BYTE   0
DEST    .BYTE   0
CORIG   .BYTE   0
CDEST   .BYTE   0
LENGTH  .BYTE   0
NAME    *=*+16
PBLOCK  .BYTE   0,0,
        0,0,0,0,0,0
ROWCNT  .BYTE   0
COLCNT  .BYTE   0
FCSAVE  .BYTE   0
FBSAVE  .BYTE   0
REVRSE  .BYTE   0
TEMP    .BYTE   0
FLAG    .BYTE   0
;
; LABEL DEFINITIONS
;
SCREEN=$2000
SCRN1=$4000
SCRN2=$6000
SCRN3=$8000
SCRN4=$A000
CODES=$C1D0
POINTR=$FB
;
; KERNAL LABELS
;
CHKOUT=$FFC9
CHROUT=$FFD2
CLOSE=$FFC3
CLRCHN=$FFCC
OPEN=$FFC0
SETLFS=$FFBA
SETNAM=$FFBD
LOAD=$FFD5
CLALL=$FFE7
STOP=$FFE1
UNLSN=$FFAE
;
;   PROGRAM AREA
;
; TURN HIRES SCREEN
;    ON OR OFF
DISPL   LDA     $D011
        EOR     #$20
        STA     $D011
        LDA     $D018
        EOR     #$08
        STA     $D018
        RTS
;
;       DUMP ROUTINE
;
; NEGATIVE ENTRY
REV     LDA     #255
        BNE     STORE
;
;   NORMAL ENTRY
NOREVS  LDA     #0
STORE   STA     REVRSE
        JSR     COPEN
;   POINT TO
;   SCREEN 1 & 2
        LDA     #<SCRN1
        STA     POINTR
        LDA     #>SCRN1
        STA     POINTR+1
        LDA     #<SCRN2
        STA     FBSAVE
        LDA     #>SCRN2
        STA     FCSAVE
;   25 ROWS PER SCREEN
;   PRINT 2 SCREENS
        LDA     #25
        STA     ROWCNT
        JSR     ROW
; POINT TO
; SCREEN 3 & 4
        LDA     #<SCRN3
        STA     POINTR
        LDA     #>SCRN3
        STA     POINTR+1
        LDA     #<SCRN4
        STA     FBSAVE
        LDA     #>SCRN4
        STA     FCSAVE
; PRINT 2 MORE!
        LDA     #25
        STA     ROWCNT
        JSR     ROW
QUIT    JSR     CFIN
        RTS
;
; DO 25 ROWS
; OF 80 COLUMNS
;
; SEND GRAPHICS
ROW     JSR     CLFD
; SEND 40 COLUMNS
        JSR     DOCOL
; SAVE POINTER
        LDA     $FB
        PHA
        LDA     $FC
        PHA
; POINT TO
; SECOND SCREEN
        LDA     FBSAVE
        STA     $FB
        LDA     FCSAVE
        STA     $FC
; SEND 40 MORE
; COLUMNS
        JSR     DOCOL
; RESTORE SCREEN
; POINTERS
        LDA     $FB
        STA     FBSAVE
        LDA     $FC
        STA     FCSAVE
        PLA
        STA     $FC
        PLA
        STA     $FB
; CHECK STOP KEY
        JSR     STOP
        BNE     NOQUIT
        PLA
        PLA
        JMP     QUIT
; NEXT ROW
NOQUIT  DEC     ROWCNT
        BNE     ROW
        RTS
;
;   PRINT 40 COLUMNS
;
DOCOL   LDA     #40
        STA     COLCNT
COLUMN  LDY     #0
ROTATE  LDX     #0
; TURN OFF BASIC ROM
        SEI
        LDA     #46
        STA     1
        LDA     (POINTR),Y
        STA     TEMP
; TURN ON BASIC ROM
        LDA     #47
        STA     1
        CLI
; SHIFT BITS INTO
```

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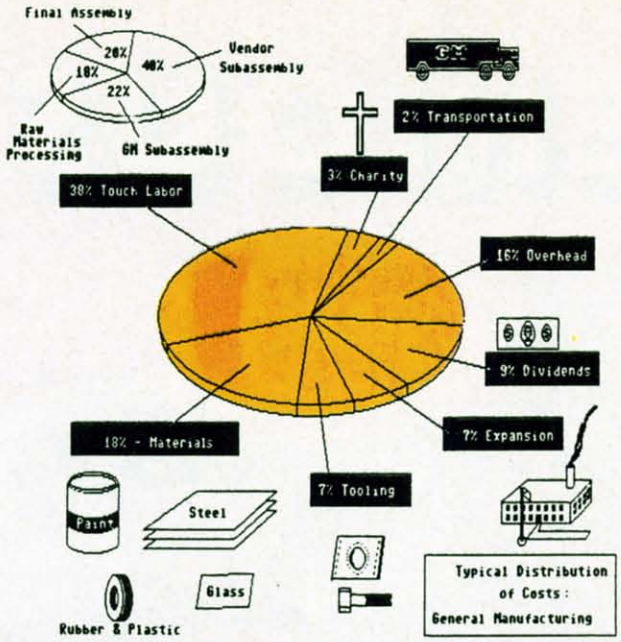

Quad-Print dump on a Gemini 10X printer.

C-64's RAM including "under" the kernal or BASIC, but to avoid conflicts the BASIC program doesn't store screen maps between $0000 and $1C00 or $C000 to $CFFF.

The display on/off routine toggles hi-res display on or off. The picture's bit map must already be at 8192 ($2000), and the screen memory section must be at 1024 ($0400). The BASIC program uses the move routine to copy the desired picture into position, and the second to turn it on for viewing. When you are finished viewing it, calling the second routine again will turn it off.

The load routine is done from machine language so that the address header of the disk file may be ignored easily. The routine loads the bit map file in the display area so that there are no conflicts with already loaded pictures. It is then moved to the desired location. Before using this routine, the filename must be POKEd into the filename area at 49157, and the filename length must be POKEd into 49156.

The print routine has two entry points: 49209 and 49205 for normal and negative printouts respectively. Table 1 gives the start address of the bit maps which are printed. Printer

```
; PRINT AREA
DOTS    ASL   TEMP
        ROL   PBLOCK,X
        INX
        CPX   #8
        BNE   DOTS
        INY
        CPY   #8
        BNE   ROTATE
        CLC
; BUMP BIT MAP POINTER
        LDA   POINTR
        ADC   #8
        STA   POINTR
        LDA   POINTR+1
        ADC   #0
        STA   POINTR+1
        LDX   #0
; SEND TO 1526
PRINT   JSR   CSEND
        DEC   COLCNT
        BNE   COLUMN
        RTS
;
;  LOAD A DOODLE FILE
;     AND MOVE IT.
;
; OPEN 1,8,0
SCRNLD  LDA   #1
        LDX   #8
        LDY   #0
        JSR   SETLFS
        LDA   LENGTH
        LDX   #<NAME
        LDY   #>NAME
        JSR   SETNAM
        LDA   #0
        TAX
; LOAD DOODLE AT 1C00
        LDY   #$1C
        JSR   LOAD
        LDA   #1
        JSR   CLOSE
        JSR   CLRCHN
        RTS
;
; MOVE A DOODLE FILE
; FROM HI=ORIG LO=00
; TO: HI=DEST LO=00
;
        LDY   #0
        STY   $FB
        LDX   DEST
        STX   $FC
        STY   $FD
        LDX   ORIG
        STX   $FE
        STX   TEMP
M1      INC   TEMP
        INY
        CPY   #$20
        BNE   M1
        LDY   #0
MOVE    SEI
        LDA   #46
        STA   1
        LDA   ($FD),Y
        STA   ($FB),Y
        LDA   #47
        STA   1
        CLI
        INY
        BNE   MOVE
        INC   $FC
        INC   $FE
        LDA   $FE
        CMP   TEMP
        BNE   MOVE
        LDA   CDEST
        STA   $FC
        LDA   CORIG
        STA   $FE
        LDX   #4
        SEI
        LDA   #40
        STA   1
CMOVE   LDA   ($FD),Y
        STA   ($FB),Y
        INY
        BNE   CMOVE
        INC   $FC
        INC   $FE
        DEX
        BNE   CMOVE
        LDA   #47
        STA   1
        CLI
        RTS
CRSR    .BYTE  0
        .LIB   QUICKQ1526
        .LIB   SING1526
        .END
```

Fast Dump Routine

```
;
; Fast 1526 graphic
; dump routine
; for Quad Print
;
; OPEN4,4,255 (DATA)
COPEN   LDA   #4
        TAX
        LDY   #255
        JSR   SETLFS
        LDA   #0
        JSR   SETNAM
        JSR   OPEN
        BCS   CO1
; OPEN6,4,6(SPACING)
        LDA   #6
        TAY
        LDX   #4
        JSR   SETLFS
        LDA   #0
        JSR   SETNAM
        JSR   OPEN
        BCS   CO1
; OPEN 5,4,5
; (PROGRAM CHAR.)
        LDA   #5
        TAY
        LDX   #4
        JSR   SETLFS
        LDA   #0
        JSR   SETNAM
        JSR   OPEN
        BCS   CO1
        JSR   SETSPC
        CLC
CO1     RTS
; SET SPACING TO"21"
SETSPC  LDX   #6
        JSR   CHKOUT
        LDA   #21
        JSR   CHROUT
        LDA   #13
        JSR   CHROUT
        JSR   UNLSN
        JSR   CLRCHN
.; SEND A LINEFEED
CLFD    LDX   #4
        JSR   CHKOUT
        LDA   #13
        JSR   CHROUT
        JSR   UNLSN
        JSR   CLRCHN
        LDA   #0
        STA   CRSR
        RTS
; THIS ROUTINE
; PERFORMS
; THE SEND FUNCTION.
; BEFORE THE NEW
; CHAR IS PROGRAMMED
; IT IS CHECKED
; AGAINST THE
; OLD CHARACTER TO
; AVOID UNNECESSARY
; CARRIAGE RETURNS.
CSEND   JSR   CHECK
; SEND OLD CHAR.
        BEQ   CSN1
        LDX   #4
        JSR   CHKOUT
        LDA   #141
        JSR   CHROUT
        JSR   UNLSN
        JSR   CLRCHN
        LDX   #5
        JSR   CHKOUT
        LDX   #0
SEN1    LDA   PBLOCK,X
        EOR   REVRSE
        JSR   CHROUT
        INX
        CPX   #8
        BNE   SEN1
        JSR   UNLSN
BIAS    LDX   #4
        JSR   CHKOUT
        LDX   CRSR
BI1     BEQ   BI2
        LDA   #32
        JSR   CHROUT
        DEX
        JMP   BI1
```

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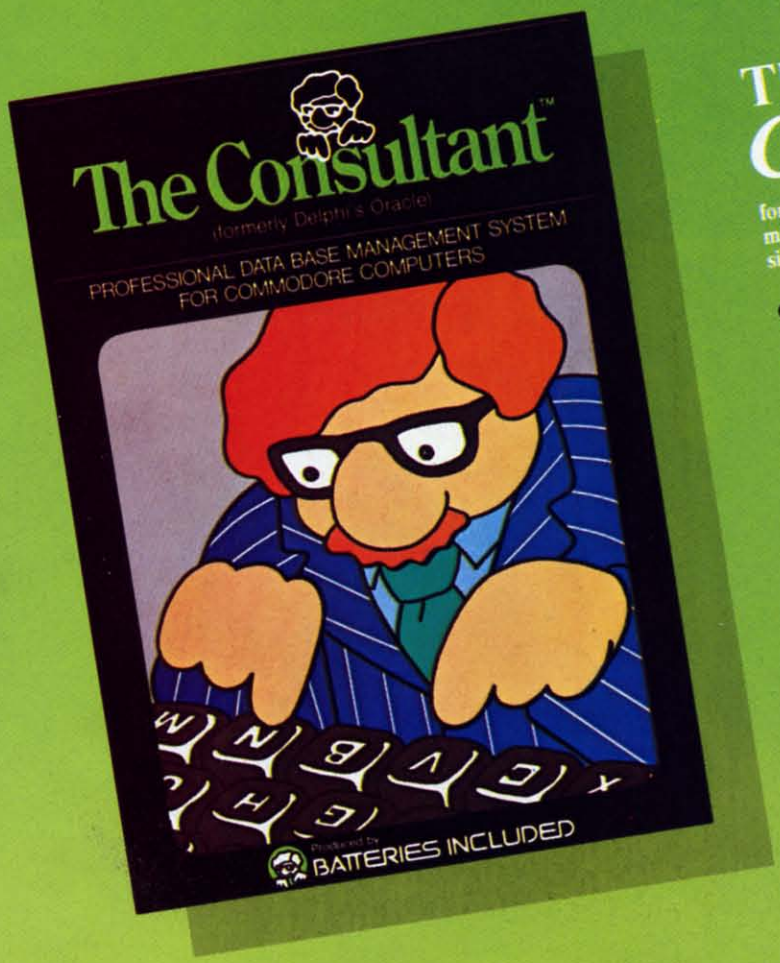

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ALBERT

Single screen dump on a Commodore 1526 printer.

setup information for the Epson/Gemini version is contained in the modules at the end of the DATA statements. The first byte of each command contains the number of bytes in the command string followed by the actual string. The line spacing command area begins at 49600 ($C1C0); the line graphics setup command begins at 49608 ($C1C8). If you have a printer other than Epson or Gemini, you will need to change these values to those recognized by your printer. This will not guarantee that the routine will work, because there are differences in the way printers translate graphics codes into print patterns. The Epson and Gemini patterns print bit 7 at the top and bit 0 at the bottom of each column of eight dots of graphics byte. If your printer is different, you may need to do another translation of the printer codes before you print them; however you will have to use the source code (reproduced on these pages) and an assembler to do this.

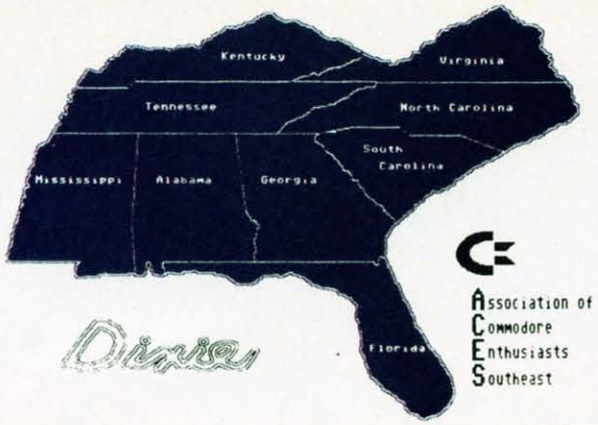
```
BI2     INC   CRSR
        LDA   #254
        JSR   CHROUT
        JSR   UNLSN
        JSR   CLRCHN
        JSR   PBLSV
        RTS
; DONE. CLOSE CHANS.
CFIN    JSR   CLFD
        LDX   #6
        JSR   CHKOUT
        LDA   #24
        JSR   CHROUT
        LDA   #13
        JSR   CHROUT
        JSR   UNLSN
        JSR   CLRCHN
        JSR   CLALL
        RTS
; SEND SAME CHAR AGAIN
CSN1    LDX   #4
        JSR   CHKOUT
        LDA   #254
        JSR   CHROUT
        JSR   UNLSN
        JSR   CLRCHN
        INC   CRSR
        RTS
CHECK   LDX   #0
CHK1    LDA   PBLOCK,X
        CMP   PBSAVE,X
        BNE   CKOUT
        INX
        CPX   #8
        BNE   CHK1
CKOUT   RTS
PBLSV   LDX   #0
PBL1    LDA   PBLOCK,X
        STA   PBSAVE,X
        INX
        CPX   #8
        BNE   PBL1
        RTS
PBSAVE  .BYTE 0
        .END
```

Single Screen Dump

```
 ;This routine sends
 ;a single 1526 pic.
REV1    LDA   #255
        BNE   STORE1
NOREV1  LDA   #0
STORE1  STA   REVRSE
        JSR   COPEN
        LDA   #0
        STA   POINTR
        LDA   ORIG
        STA   POINTR+1
        LDA   #25
        STA   ROWCNT
ROW1    JSR   CLFD
        JSR   DOCOL
        JSR   STOP
        BNE   NOQ1
        JMP   DONE
NOQ1    DEC   ROWCNT
        BNE   ROW1
DONE    JSR   CFIN
        RTS
        .END
```

EPSON/GEMINI VERSION

```
;
;  Quad-Print
;    (C) 1984
; by M. Beutjer
;
; This program dumps
; 4 hi-res screens
; side by side to
; produce one
; 640 x 400 printout.
;
;
        *=$C000
;
; DATA AREA
;
ORIG    .BYTE  0
DEST    .BYTE  0
CORIG   .BYTE  0
CDEST   .BYTE  0
LENGTH  .BYTE  0
NAME    *=*+16
PRNTLN  .BYTE  0,0,0,
               0,0,0,0,0
ROWCNT  .BYTE  0
COLCNT  .BYTE  0
FCSAVE  .BYTE  0
FBSAVE  .BYTE  0
REVRSE  .BYTE  0
TEMP    .BYTE  0
FLAG    .BYTE  0
;
; LABEL DEFINITIONS
;
SCREEN=$2000
SCRN1=$4000
SCRN2=$6000
SCRN3=$8000
SCRN4=$A000
CODES=$C1D0
POINTR=$FB
;
; KERNAL LABELS
;
CHKOUT=$FFC9
CHROUT=$FFD2
CLOSE=$FFC3
CLRCHN=$FFCC
OPEN=$FFC0
SETLFS=$FFBA
SETNAM=$FFBD
LOAD=$FFD5
CLALL=$FFE7
STOP=$FFE1
;
;  PROGRAM AREA
;
;
; TURN HIRES SCREEN
; ON OR OFF
DISPL   LDA   $D011
        EOR   #$20
        STA   $D011
        LDA   $D018
        EOR   #$08
        STA   $D018
        RTS
;
;       DUMP ROUTINE
;
;
; NEGATIVE ENTRY
REV     LDA   #255
        BNE   STORE
; NORMAL ENTRY
NOREVS  LDA   #0
STORE   STA   REVRSE
; OPEN 4,4,0
        LDA   #4
        LDX   #4
        LDY   #0
        JSR   SETLFS
        LDA   #0
        JSR   SETNAM
        JSR   OPEN
; DIRECT OUTPUT
; TO DEVICE 4
        LDX   #4
        JSR   CHKOUT
; POINT TO SCREEN 1
; AND 2
        LDA   #<SCRN1
        STA   POINTR
        LDA   #>SCRN1
        STA   POINTR+1
        LDA   #<SCRN2
        STA   FBSAVE
        LDA   #>SCRN2
        STA   FCSAVE
; SET PRINTER LINE
; SPACING
        LDX   #<SPCMLN
        JSR   PNTCMD
        JSR   CHROUT
; 25 ROWS PER SCREEN
        LDA   #25
        STA   ROWCNT
; PRINT 2 SCREENS!
        JSR   ROW
; POINT TO SCREEN 3
; AND 4
        LDA   #<SCRN3
        STA   POINTR
        LDA   #>SCRN3
        STA   POINTR+1
        LDA   #<SCRN4
        STA   FBSAVE
        LDA   #>SCRN4
        STA   FCSAVE
        LDA   #25
        STA   ROWCNT
; PRINT 2 MORE!
        JSR   ROW
; SEND PRINTER
; RESET CODE
QUIT    LDA   #27
        JSR   CHROUT
        LDA   #64
        JSR   CHROUT
        LDA   #4
; CLOSE CHANNEL
        JSR   CLOSE
```



Quad-Print dump on a Commodore 1526 printer.

You should also keep in mind the fact that the interface you use (for your Epson or Gemini printer) will affect the graphics operation. These programs assume that your printer does no translation of the data that is sent by the computer (transparent), and that the printer will do a linefeed automatically whenever it receives a carriage return.

For those of you using the 1526 version, I'm sure you will notice that your printer seems to do a lot of moving back and forth to print the pictures. Unfortunately, this seems to be unavoidable due to the way Commodore has set up the graphics for this printer. According to the manual, you may print one graphics character per line. The only way to print more than one graphics character per line is to send the printer a CHR$(141), or $8D hex, which is a "line reset" command. This command causes a carriage return without a linefeed, and that is why you see all the shaking. I don't think it will cause any problems, as I have dumped numerous pictures on mine. If there is a better way to do this, I haven't seen it. (But I would like to!)

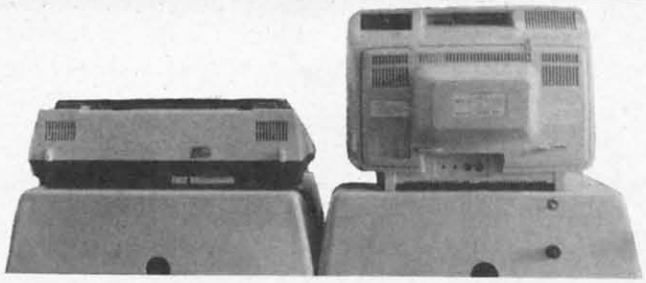
Although hi-res screen design programs for the 64 are presently limited to one screen for the "sketch pad," this utility will allow you to do a lot of designs with your computer and printer that are not yet possible any other way. Good luck and happy doodling! □

SEE PROGRAM LISTINGS ON PAGE 95

```
        JSR   CLRCHN
        RTS
;
; DO 25 ROWS
; OF 80 COLUMNS
;
; SEND GRAPHICS
; SETUP COMMAND
ROW     LDX   #<LNCMLN
        JSR   PNTCMD
; SEND 40 COLUMNS
        JSR   DOCOL
; SAVE POINTER
        LDA   $FB
        PHA
        LDA   $FC
        PHA
; POINT TO
; SECOND SCREEN
        LDA   FBSAVE
        STA   $FB
        LDA   FCSAVE
        STA   $FC
; SEND 40 MORE COLS.
        JSR   DOCOL
; RESTORE SCREEN
; POINTERS
        LDA   $FB
        STA   FBSAVE
        LDA   $FC
        STA   FCSAVE
        PLA
        STA   $FC
        PLA
        STA   $FB
; CARRIAGE RETURN
        LDA   #13
        JSR   CHROUT
; CHECK STOP KEY
        JSR   STOP
        BNE   NOQUIT
        PLA
        PLA
        JMP   QUIT
; NEXT ROW
NOQUIT  DEC   ROWCNT
        BNE   ROW
        RTS
;
;  PRINT 40 COLUMNS
;
DOCOL   LDA   #40
        STA   COLCNT
COLUMN  LDY   #0
ROTATE  LDX   #0
; TURN OFF BASIC ROM
        SEI
        LDA   #46
        STA   1
        LDA   (POINTR),Y
        STA   TEMP
; TURN ON BASIC ROM
        LDA   #47
        STA   1
        CLI
; SHIFT BITS
; INTO PRINT AREA
DOTS    ASL   TEMP
        ROL   PRNTLN,X
        INX
        CPX   #8
        BNE   DOTS
        INY
        CPY   #8
        BNE   ROTATE
; BUMP BIT MAP
; POINTER
        CLC
        LDA   POINTR
        ADC   #8
        STA   POINTR
        LDA   POINTR+1
        ADC   #0
        STA   POINTR+1
        LDX   #0
; SEND GRAPHICS
; TO PRINTER
PRINT   LDA   PRNTLN,X
        EOR   REVRSE
        JSR   CHROUT
        INX
        CPX   #8
        BNE   PRINT
        DEC   COLCNT
        BNE   COLUMN
        RTS
;
;  LOAD A DOODLE
;  FILE AND MOVE IT.
;
; OPEN 1,8,0
SCRNLD  LDA   #1
        LDX   #8
        LDY   #0
        JSR   SETLFS
; LOAD DOODLE
; AT 1C00
        LDA   LENGTH
        LDX   #<NAME
        LDY   #>NAME
        JSR   SETNAM
        LDA   #0
        TAX
        LDY   #$1C
        JSR   LOAD
        LDA   #1
        JSR   CLOSE
        JSR   CLRCHN
        RTS
;
;  MOVE A DOODLE
;  FILE FROM
;  HI=ORIG LO=00
;  TO: HI=DEST LO=00
;
        LDY   #0
        STY   $FB
        LDX   DEST
        STX   $FC
        STY   $FD
        LDX   ORIG
        STX   $FE
        STX   TEMP
M1      INC   TEMP
        INY
        CPY   #$20
        BNE   M1
        LDY   #0
MOVE    SEI
        LDA   #46
        STA   1
        LDA   ($FD),Y
        STA   ($FB),Y
        LDA   #47
        STA   1
        CLI
        INY
        BNE   MOVE
        INC   $FC
        INC   $FE
        LDA   $FE
        CMP   TEMP
        BNE   MOVE
        LDA   CDEST
        STA   $FC
        LDA   CORIG
        STA   $FE
        LDX   #4
        SEI
        LDA   #40
        STA   1
CMOVE   LDA   ($FD),Y
        STA   ($FB),Y
        INY
        BNE   CMOVE
        INC   $FC
        INC   $FE
        DEX
        BNE   CMOVE
        LDA   #47
        STA   1
        CLI
        RTS
PNTCMD  STX   PNTOUT+2
        STX   CMPARE+1
        LDY   #0
        LDX   #0
PNTOUT  INX
        LDA   LNCMLN,X
        JSR   CHROUT
        TXA
CMPARE  CMP   LNCMLN,Y
        BMI   PNTOUT
        RTS
;
;    EPSON PRINTER
;    CONTROL CODES
;
; LNCMLN IS
; LINE COMMAND LENGTH
; (NO. OF BYTES)
LNCMLN .BYTE  5
;
; LINDAT IS
; PRINTER SETUP
; COMMAND:
; ESC,*,6,128,2
LINDAT .BYTE
        27,42,6,128,2
;
        *=LNCMLN+10
; SPCMLN IS
; LENGTH OF
; LINE SPACING
; COMMAND
SPCMLN .BYTE  3
;
; SPCDAT IS
; PRINTER SPACING
; COMMAND: ESC,A,8
SPCDAT .BYTE  27,65,8
        .END
```

INNOVATIVE ORGANIZERS, INC.

For Commodore 64™ & VIC-20™



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Plus Shipping

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Reader Service No. 276

Speedy

For the Unexpanded VIC 20

By Kevin Dewey

In this game you are Speedy, the fastest being in the universe—not an amazing accomplishment, seeing that no one else can move. Your goal is to collect all your smiley-faced green friends for a party you're throwing, while avoiding your frowning purple enemies, who are no fun at all, and in fact tend to make you explode upon contact with them. Yes, they are party poopers.

You get seven little Speedy clones to do this, and you gain another for every screen of friends you successfully clear. Speedy clones move very fast, and in all directions, so good reflexes and hand-eye coordination come in handy, but it's wise to also incorporate a bit of strategy into your gameplay. For instance, try to find the easiest ways to get a friend out from a group of enemies before plunging into the group. This, as well as other ways of using brain power instead of relying solely on a fast hand, will affect the outcome of the game for the better.

SCORING

The game is scored as follows. Every friend you pick up is worth seven points. Every *bonus token* is worth the number of the screen you are on, multiplied by the number of friends you have picked up thus far on that screen. For this reason, it is best to pick up a lot of your friends on a screen, and then pick up the bonus object when there are, say, one or two friends left, to maximize your score. The bonus objects are easy to spot, because they look unlike anything else.

At the end of the game, 50 bonus points are awarded for each screen you have successfully passed during the course of the game.

SKILL LEVELS

There are 15 skill levels, 1 being the easiest and 15 being the hardest. The main difference between the skill levels is in the amount of enemies. On screens like 15 there will be a great deal more purple faces than on the easier screens, but this can be looked at two ways. While it is harder to clear a screen of goodies when there are a lot of enemies around, the higher the skill level, the more the bonus token is worth, and the more points are possible. To get really high scores, you must learn to play well on the harder screens.

I hope you enjoy playing *Speedy*! □

SEE PROGRAM LISTING ON PAGE 108

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Our price $279.00

Panasonic KXP 1090 ..... $199.00

(does not have near-letter quality)

SG 10, NLQ Dot Matrix from Star ..... Call

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1702	Call

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*** See Page 13**

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(Examples)

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	LIST	SALE
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Reader Service No. 241

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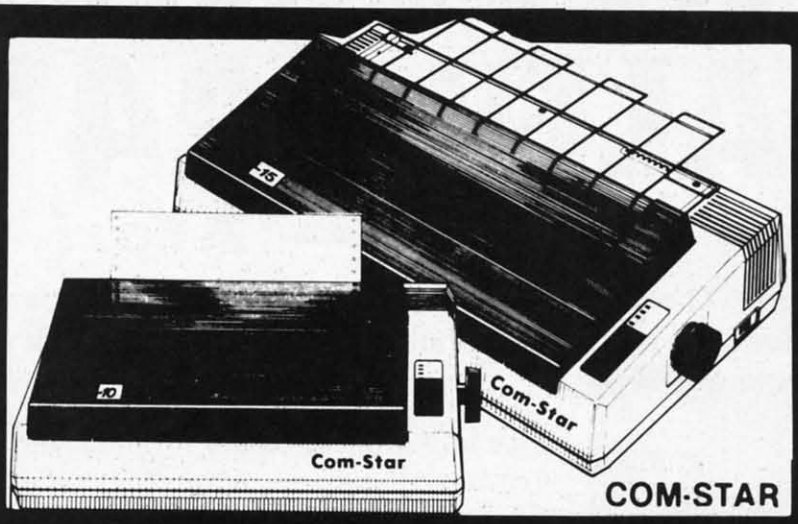

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Olympia

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Reader Service No. 242

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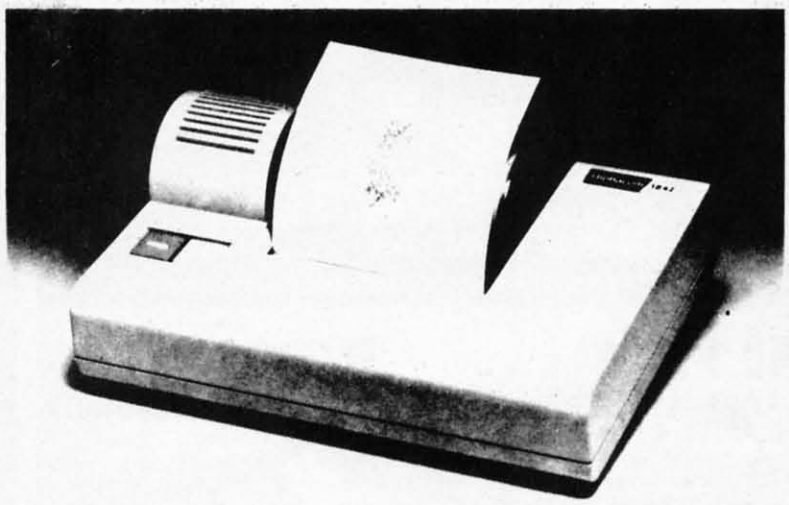

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Print out listings with full computer character sets (interface required, see below). Print in upper and lower case. Comes with a roll of paper and all power adapters needed. Perfect for a spare printer or program lister. List $99.00. **Sale $24.95.**

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3105 25 Meter Rolls Black (1 per pkg.)	$12.95	**$3.95**
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40 Column Sale $9.95. **80 Column Sale $14.95.**

3102 Intelligent Atari Interface — Allows you to hook the 40 or 80 column printer to the Atari computer, do program listings, allows software screen dumps, etc. Includes Atari graphics and reverse characters. (Specify 40 or 80 Column) List $59.95.
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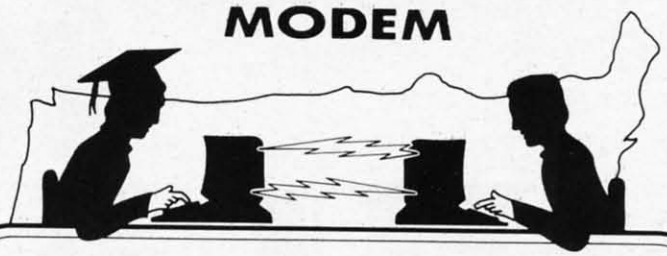

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Reader Service No. 244

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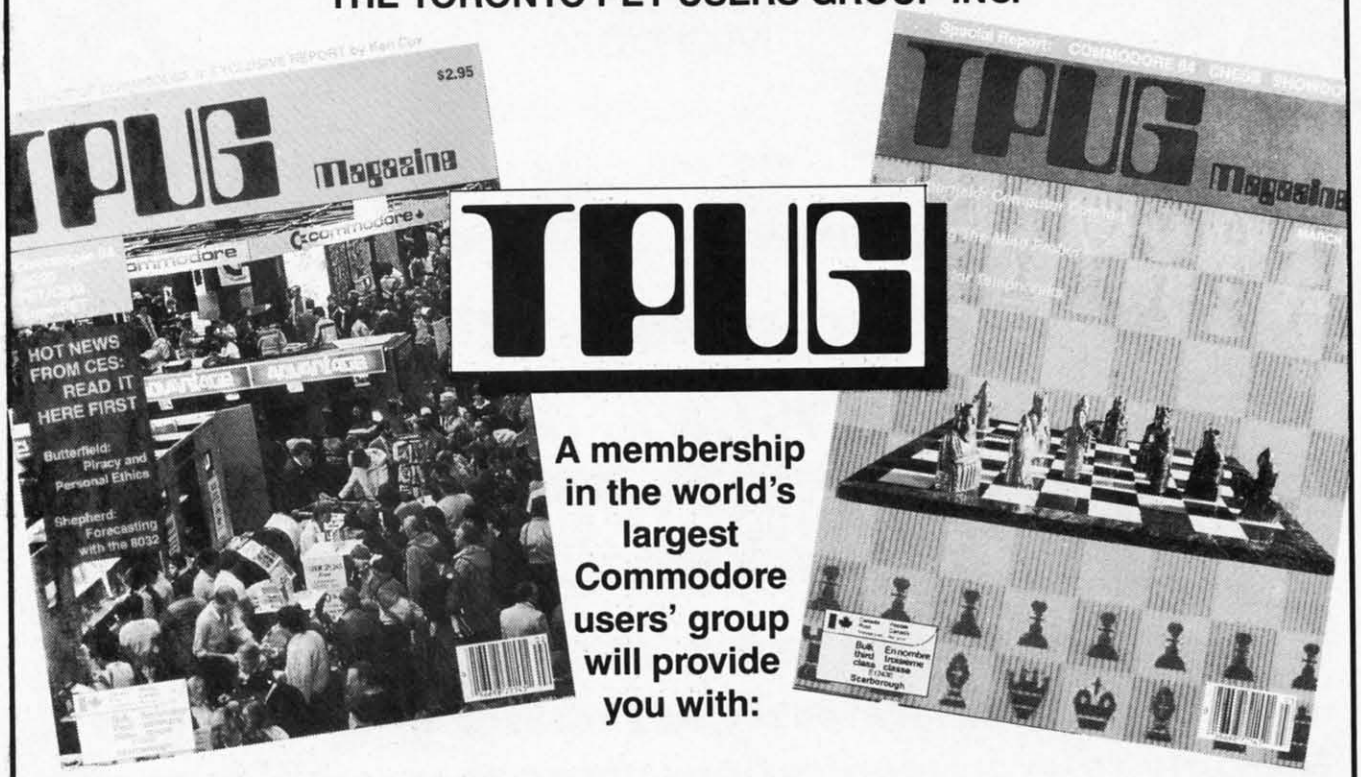

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Reader Service No. 298

REVIEWS

JUKI 6300

Juki Office Machine Corporation
$995

There is basically one word to describe the Juki 6300: professional. It has every feature that a daisy wheel printer should, and they all work flawlessly.

The 6300 prints at speeds up to 40 characters per second bidirectionally. It will vary the pitch from 10 to 12 to 15 characters per inch, or proportionally space text. Daisy wheels are readily available, for it uses the standard Diablo format. I found the print quality to be excellent. All characters were fully formed, and the alignment was perfect.

Printing effects are numerous. The 6300 will boldface, underscore, shadow print, subscript, and superscript. One unique feature is called high quality mode. Normally, the printer advances the ribbon a fraction of a space between characters. In high quality mode, the increment is one full space for each character printed. In addition to proportionally spacing text, the printer will auto-justify—add 1/120" spaces to the proportionally spaced text until the margins are reached.

Physically, the Juki 6300 is large. Measuring 22.4 x 15.8 x 4.7" and weighing almost 31 pounds, this printer is going to need some elbow room. The carriage is wide enough to accommodate paper up to 16" in width, making it ideal for most business forms. The paper feed is by friction only. A tractor would be useful, but I did not note any substantial paper slippage.

The 215-page manual includes virtually everything you need to know about the printer, unless, that is, you are a Commodore user. Operating instructions are provided for virtually all popular computers but Commodore's. Hopefully, this omission will be corrected soon.

As stated earlier, this is a professional printer, and it has a professional price: $995. While this is inexpensive for a printer of its type (intended for small office use), it's a little steep for the average user. I would not recommend purchasing a 6300 to print an occasional letter, but if your interest is serious word processing or small business use, then it is an excellent choice.

Juki Office Machine Corporation, 299 Market Street, Saddle Brook, NJ 07662 (phone: 201-368-3666).

—David Barron

The Juki 6300 daisy wheel printer offers auto-justification, numerous printing effects, and 40 cps speed. READER SERVICE NO. 238

***21st-century sequel to* Blue Max.**
READER SERVICE NO. 239

BLUE MAX 2001

Synapse Software
Commodore 64
Disk; $29.95

Bob Polin's *Blue Max* parlayed its brand of scrolling action combat into a slew of awards last year. Now the same author leaps from biplanes to futuristic hovercraft in this exciting sequel.

Blue Max 2001 puts the computerist into the flight suit of Max Chatsworth IX, a remote descendant of the heroic aviator of *Blue Max* fame. The implacable FURXX Empire has extended its tentacles to Earthbase Gamma IV. The game scenario begins just after the FURXX have conquered the planet and drained the lifeforce of the survivors to lengthen the lifespans of imperial bigwigs.

If the FURXX aren't stopped, their attack will spread to other colonies and eventually engulf Earth itself. The player must use the joystick to guide a single hovercraft in a desperate attack against the alien invaders.

The flying ship is equipped with two super weapons capable of breaching the FURXX defense system. The gravonic penetrator, fired by pressing the action button while pointing the stick in the desired cardinal direction, can strafe ground installations or knock aircraft out of the sky. The hovercraft also carries 40 gravonic annihilator bombs which it can drop on buildings, bridges, and vehicles.

Two special targets merit the highest priority. The diamond-shaped Shield Enhancer increases the hovercraft's defensive capabilities. The Terrain Sequencer, a disk with a rotating core, allows the lone attacker to advance to the next alien hoverfield.

Once the hovercraft takes off from its field, the gamer pushes the stick up and to the left to start the terrain scrolling diagonally down the screen. The scrolling can be stopped by moving the stick down and to the right.

Slik Load

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Slik Load is a Kartridge for the C-64.
Slik Load is the most reliable, effective and thought out Kartridge of it's kind.
The options include:

- **5 times faster load**
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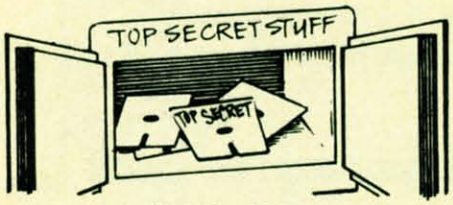
- **Old and un-new Will restore a basic program**
- **Status key will give you information on device number, bytes free and status of the drive.**
- **Silk Load is also fully compatible with the 1541 Super Rom**



$19.95

DMS-Errors 20, 21, 22, 23, 27 & 29 Format Single Tracks Read Disk Errors
½ Track Reader-read and select ½ track
½ Track Formatter-Format a disk with ½ tracks. This is where the next protection schemes are coming from.
Drive Mon-Disk Drive assembler/disassembler. For your 1541.
The Doc-Disk Doctor that reads code under errors.
Sync Maker-Place a sync mark on **any** track out to 41. Also used for protection.
Sync Reader-Check for Sync bits on **any** track out to 41.
Change Drive No.-Changes drive number (7-30).
Disk Logger-Finds starting track sector; start and end addresses.
Disk Match-Compare any two diskettes. Byte for byte.
New Wedge-Easier to use DOS wedge.
ID Check-Check ID's on **any** track.
Unscratch-Restore a scratched file.
View-BAM-Visual display of the free and used sectors on a diskette.
Read/Write Test-1541 performance test.
Repair a Track-Repair a track with checksum errors. Reads code under errors and restores track.
Fast Format-Format a disk in just 10 seconds (with verify!).

This is the only utility of its kind. It even has a 3 min. copy on it.

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1-Auto Dial will automatically dial a set of numbers you choose.
2-Review Numbers will review numbers that were answered by a computer.
3-Save Numbers will save numbers where a computer answered.
4-Hardcopy of Numbers will print out list of numbers where a computer answered.
5-LOAD Numbers will load in numbers to continue where it left off.
6-Continue will pick up dialing where it was interrupted.

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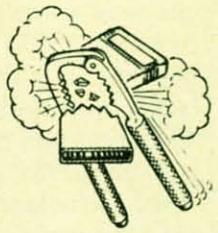

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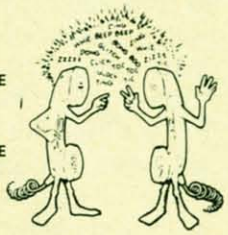
6-SCRATCH MESSAGE	13-SCRATCH DOWNLOAD FILE
7-CYCLE MESSAGES	14-ADD TO OTHER SYSTEMS
	15-CREATE OTHER SYSTEMS



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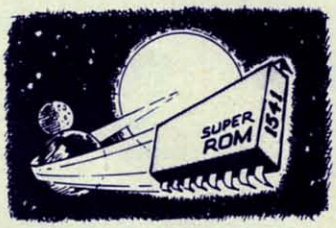
Reader Service No. 273

D-Compiler $59.95

The first D-Compiler to give you back your source code *after* your program has been compiled with **Blitz.*

*Blitz is a trademark of Skyles Electric Works

1541 Super ROM $39.95



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You no longer need to be an EGGHEAD to read Machine Language.

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- Load wedge
- Works with more drive
- Takes up no memory
- Reset switch included

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This Disk has over 100 routines, some of them are routines for protection, smooth scrooling, modem routines, and sound and color routines. They can easily be incorporated into all of your programs. It is also fully documented.

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The publisher cannot assume responsibility for errors in the above listing.

REVIEWS

Rebels have established secret strongholds on the surface of Gamma IV. When the ship lands at a field, it can take on fuel, resupply its bombs racks, and repair damage caused by alien aircraft and flak guns.

The joystick steers the ship in any desired direction and changes altitude. Though the hovercraft can drop bombs from any height, it must get fairly close to the ground before its gravonic penetrator can wreak havoc.

The control panel located directly below the main display monitors the hovercraft status. This includes altitude, fuel supply, accumulated damage to specific ship systems, number of bombs remaining, and current score. Changes in the color of the playfield border provide an additional visual indicator of the current altitude range. For example, a gray border informs the pilot that the hovercraft is at the proper height to strafe the ground.

Better documentation would have improved this otherwise excellent program. In particular, labeled illustrations of each of the major play-features would have greatly speeded up the learning process.

Blue Max 2001 doesn't introduce any startling design concepts, but it fulfills the essential requirements of a good sequel. It extends and refines the elements which made the original game popular, while it introduces enough new challenges to generate fresh excitement.

Synapse Software, 5221 Central Avenue, Richmond, CA 94804 (phone: 415-527-7751). ***—Arnie Katz***

PLUSWRITER PRINTER

Alphacom, Inc.
$399.00

Priced at $399, the Alphacom Pluswriter is yet another addition to the vast array of low-cost letter quality printers available today.

Housed in a sleek black and grey plastic case, the Pluswriter interfaces easily to the Commodore. Alphacom uses an interesting method of interfacing: an intelligent interface cartridge plugs into a slot on the back of the printer. The cartridge is different for every computer, and provides the hardware/software link to make it function properly for your situation. I experienced no problems listing programs or using word processors. In fact, the Pluswriter emulates the Diablo 630 printer, which makes it compatible with just about everything.

When printing, the Pluswriter cruises at a moderate 18cps bidirectionally; painful for printing out your science fiction trilogy, but for most applications well within reason. The print quality is good, except for those occasions when characters will move slightly up, down, left, or right, and appear a bit disoriented. I didn't like the Courier 10 printwheel included with the printer so I purchased a more attractive daisy wheel. I was pleased to learn that either Qume or Diablo daisy wheels will work, and can be found most anywhere (I found mine at a local stationery store for $7.50). Ribbons are also easy to find, for the Pluswriter uses Diablo Hy-Type II. I also found these locally for $4.95.

Since the Alphacom emulates the Diablo 630 many special effects are possible including boldface, shadow printing, subscripts, and superscripts. These all work well and are all easily accessible.

The only major problem I had with the Pluswriter was the tendency of continuous tractor paper to move across the platen. This required constant realignment and was very annoying. With single sheets I had no difficulties.

The Alphacom Pluswriter is a competitive addition to the low priced daisy wheel printer market that should satisfy the needs of most home computer users.

Alphacom, Inc., 2323 South Bascom Avenue, Campbell, CA 95008 (phone: 408-559-8000).

—David Barron

CALC NOW!

Cardco, Inc.
Commodore 64
Disk; $39.95

Computer industry pundits like to attribute the very existence of the personal computer to a spreadsheet pro-

An open letter to the readers of Ahoy Magazine Vincent Kurek President: The Ennon Corporation

My purpose in writing is to ask you to join me in shaping the future of the new and most unusual field in computer technology today: Artificial Intelligence.

This incredible power and spectacular creative potential are available to you, for your computer right now. However, there is an alarming possibility that such amazing technology which you have every right to, may not be available to you other that through this offer.

This is unfortunate but somewhat understandable due to the way technology is created. You see, only the business oriented corporation can finance research. It therefore is in a position to dictate immediate research goals. These goals are increasing profits through more efficient production. While valid, they are merely creative and do absolutely nothing to foster exploration in new applications. The result: technology is never used to its fullest potential. But what's worst of all is that these competitve corporations have absolutely no desire to share technology with each other, let alone with you. So, they don't. As a result, the infinitesimal amount of technology that finally trickles down to you is:

A. So expensive you are prohibited from procurring it
B. Shamefully inferior to the real thing

remember...you can buy high-tech consumer goods, but never the technology that creates it.

This same situation confronts you in the new Artificial Intelligence field, but with a difference: There is no true Artificial Intelligence for the home computer user! The few programs claiming to be Artificial Intelligence are really simulators. They are not the real thing. Possessing a mere token of the power and versatility, simulators are clearly not worth their expensive price.

I have tried repeatedly to convince my colleagues that it is in their best interest to release genuine Artificial Intelligence to the general public. The refinement, modification and adaptation as individuals create new applications would improve Artificial Intelligence tremendously. This would benefit everyone in the long run.

I have met with little success. Apparently, it seems that immediate corporate profit is more important than sharing technology with the public. Therefore, the Ennon Corporation stands alone in offering superior Artificial Intelligence programming directly to the home computer enthusiast.

Announcing AN-83: The "Thinking" Program

Believe me when I say AN-83 is the real thing. It is a true "thinking" program that receives an initial "knowledge base" from a data file read when AN-83 is started. Using inductive and deductive logical analysis, this amazing program deduces everything from that data and adds it to its memory. Conversing with you, AN-83 adds and combines with facts already known. It generates new conclusions not explicitly contained in its original knowledge base—just like your own thinking process! The result: it knows considerably more than the specific facts given to it.

AN-83 can also think about anything. It is virtually unlimited in its application. Think of your possibilities. The potential is limitless. In the right hands, AN-83 would revolutionize the adventure, strategy and other smart game-playing programs to say nothing of classic arcade games. On the other hand, AN-83 could be one of the most powerful business analysts available to the home computer.

FREE SOFTWARE

In addition, you will be receiving free, Eliza—the most amazing conversational A.I. program to date. Run this for your friends and jaws will drop with amazement. Eliza's responses are so human, it's uncanny. An entertaining program, Eliza will answer once and for all the question: What can your computer do?

How to Learn Artificial Intelligence

You can be creative. Experiment and modify to fit your personal use because AN-83 and Eliza both possess source code in basic, the most popular easy to use language for the micro. Their extensive, easy to understand commands walk you through the source code step by step. It's surprisingly simple. Even the beginner can understand the "How and Why of A.I."

A Fantastic Savings

The real profit to Ennon Corporation will be your participation in the future of Artificial Intelligence. Therefore, I am pleased to say nobody will miss this chance because they could not afford it. AN-83 is priced to cover just a fraction of its research and developmental costs.

The "Thinking" Program AN-83 is just $21.57. What's more, the astounding Eliza is yours absolutely free.

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Vincent Kurek

.....

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Reader Service No. 279

The Alphacom Pluswriter (see review on page 66) cruises at a moderate 18cps. The printer emulates the Diablo 630, so many special effects are possible.
READER SERVICE NO. 265

gram. That first spreadsheet program was *Visicalc,* which through its symbiotic relationship with the Apple introduced thousands of burned-out *Pong* players to the really useful aspects of computing.

Today, more spreadsheet programs exist than you can shake a ledger at. Regardless, the market is always on the lookout for a better, cheaper program. Depending on your exact needs, *Calc Now!* from Cardco may be exactly that.

Cardco began its product line with hardware add-ons like its numeric keypad. More recently, it has expanded into software with programs like *Write Now!,* a wordprocessor with a mail merge feature, and *Graph Now.* Cardco's latest release, *Calc Now!*, is compatible with all three. For the $39.95 price, you get most of the features of spreadsheet programs costing much more.

Calc Now! is a single load program—no disk-swapping needed. Once it's loaded, *Calc Now!* runs much like other spreadsheets. For details on the basic operations of spreadsheet programs, pull out your May 1984 issue of *Ahoy!* and reread Terry Silveria's comprehensive review and evaluations of ten competing products. To compare *Calc Now!* to those programs, here's the information for Terry's chart of spreadsheet features:

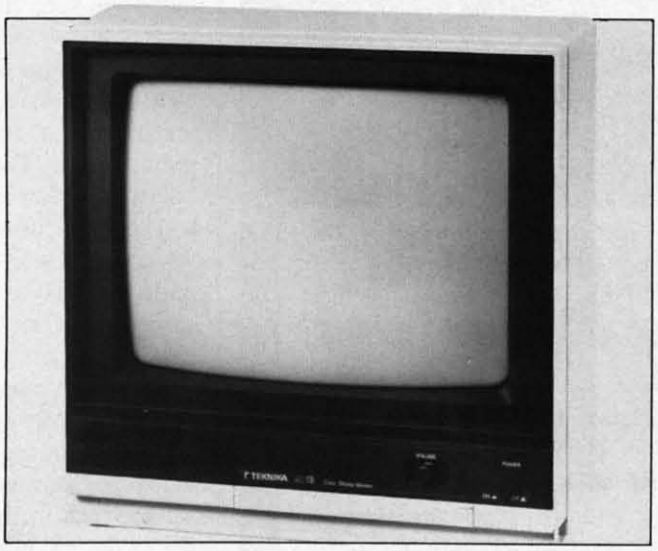
Relative Copy	Yes
If Then Command	Yes
Row/Column Insert	Yes (and row/column delete)
Rejustify Cell Contents	Yes (either left or right)
Split Screen	Yes (either vertical or horizontal, synchronized or unsynchronized
Adjustable Column Width	Yes (from 3 to 36)
Logic Operators	Yes (And, Or, Not)
Fix Titles	Yes (lock the top row(s) or the left column(s) or both in place)
Graph	Yes (print rows of asterisks to represent values)
Sort	Yes (alphabetical or numerical on any column)
Search	No
Link	No
Maximum Column Width	36
Maximum # Columns	64
Maximum # Cells	1600 (with an 8-digit number in each
Maximum # Rows	254
Price	$39.95

Calc Now! uses the top (status) lines of the screen to show you the cell number, type, justification, contents, and format. Available formats are dollar, floating point, integer, graph (*), logical (true/false), and set number of decimal places. The status lines also tell you whether recalculation will occur automatically or must be triggered and how much memory is left for your data. After the program is loaded, 39K is available. If you build spreadsheets that are larger than this, you may need to consider one of the other programs that can link spreadsheets by allowing you to reference one spreadsheet in another.

Several functions are available in *Calc Now!* that work on ranges of cells. SUM will total the contents of a range of cells; AVERAGE will average them; MIN will find the smallest; MAX the largest; and COUNT will return the number of non-blank cells. Two other powerful and more unusual functions also work on ranges. GET will evaluate a formula, count down that number of cells, and return the value in the cell it finds. FIND will evaluate an expression, search through a range of cells until it finds a value which is lower, and return the value in the next cell. Linked with the sort feature, FIND gives you a very sophisticated spreadsheet tool.

Here are some one-liners on features I especially like. Sorting rows based on the contents of any column (or part of a column) is fast; only a couple of seconds even for a big spreadsheet. Existing cell formulas can be edited—you don't have to retype a long formula which has an error near the end. Whenever you need to reference another cell in a formula, you can, after pressing the British pound sign key, point (with the cursor) to the cell you want and automatically enter its number, a necessary feature for multiscreen spreadsheets. You can command *Calc Now!* to move the cursor up, down, left, or right when you hit return—handy when you change from entering columns of numbers to entering rows.

More? Okay. Instead of printing all or part of your spreadsheet, you can choose to print all of its formulas for



The Teknika MJ-10 color monitor, like the 1702, accepts separate luminance and chrominance inputs. Its chief weakness: an undersized speaker that does not reproduce sound very well.
READER SERVICE NO. 266

verification. (If you've ever made a mistake with pencil and paper, wait until you see what havoc you can create with a spreadsheet.) Individual cells can be protected, a handy feature for spreadsheets used infrequently or by someone else. Without exiting from *Calc Now!* you can initialize a disk, get a directory, delete or rename files, and specify disk and printer device numbers.

That's a lot of features, but is *Calc Now!* hard to use? No, if you're at all familiar with spreadsheets, it's a snap. Even if you're not, keyboard templates describe the uses of function and other command keys. Forgetful? Hit the help key followed by any command key you are unsure of. In an onscreen window, a description of that key's function will appear. The program I reviewed had only an 11-page temporary manual, so I cannot say what the documentation will look like. But Cardco does provide technical support by phone.

My favorite, and final, help feature is something we all demand of ourselves in programs we write, but which is not available from spreadsheet programs. A non-printing comment or documentation can follow the contents of any cell; just start it with a semicolon. If you have ever tried to decipher one of your old spreadsheets, much less someone else's, you'll know how valuable this can be.

Cardco, Inc., 300 S. Topeka, Wichita, KS 67202 (phone: 316-267-6525). ***—Richard Herring***

MJ-10 MONITOR

Teknika Electronics Corporation
$279.95

When the carton containing the Teknika MJ-10 appeared on my desk one morning for review, I thought I would be taking a look at just another monitor. I was wrong. The MJ-10 produces a surprisingly good picture, easily the equal of the Commodore 1702's. This is partially due to the fact that the MJ-10, like the 1702, accepts separate luminance and chrominance inputs. This helps achieve a level of clarity and color rendition not possible with monitors boasting only composite video inputs.

On the front of the monitor are an exposed power switch, power light, and volume control. Hidden behind a flip-out panel are controls for horizontal position, vertical position, contrast, brightness, color, and tint. Other controls—vertical linearity, vertical size, horizontal hold, and input level—are on the back.

My only complaint with the MJ-10 has nothing to do with the video, but rather the audio. Its speaker is undersized and does not reproduce sound very well. Additionally, a larger amplifier and an earphone jack would have been useful.

All in all, the MJ-10 is an excellent choice in a monitor if the highest possible picture quality is a must.

Teknika Electronics Corporation, 353 Route 46 West, Fairfield, NJ 07006 (phone: 201-575-0380).

—David Barron

MUSICWARE
SONG BUILDER
SONG EDITOR
SONG PRINTER
SOUND MAKER

Sequential Circuits
Commodore 64
Disk; $39.95 each

I was immediately impressed with the *MusicMate* keyboard from Sequential Circuits. Its 32 keys have nice action, and the lightweight and sturdy construction make it ideal for creating music on the C-64. I was less than overwhelmed, though, by the supplied driver software, the *#970 MusicMate Musicware.* It's your basic meat-and-potatoes program, devoid of any gravy. While it does what it was designed to do—demonstrate the capabilities of the keyboard by allowing you to try several different sounds, store your creations in RAM, and play them back—no provisions are included for saving your songs to disk, recording individual voices, creating new sounds, editing, or printing out your compositions. Clearly, the MusicMate keyboard would be much more valuable to computer musicians if it had software that was commensurate with its own capabilities.

To fill this need, Sequential has released the *MusicWare* line. They've taken the modular approach, whereby dedicated software modules have specific functions, and you only buy the particular utilities you need when you need them.

The *MusicWare* line consists of four additions to the software that comes with the keyboard: *#971 Song Builder, #972 Song Editor, #973 Song Printer, and #974 Sound Maker.* The module names provide you with a good description of the functions. Let's take a look at each individually, as well as interactively.

#971 SONG BUILDER

Song Builder is the music composition module. It allows you to enter your melodies, one voice at a time, and record them on disk. You're given a selection of stock sounds that simulate a wide variety of musical instruments. A metronome feature

helps you keep time while recording your tracks.

The program is menu-driven, and only eight keys on the C-64 are used for selection or advancing through the menu items. The MusicMate keyboard is used exclusively for note entry. The documentation booklet is written in a well-illustrated, easy to understand style. Additionally, help screens concisely explain how to access the program's functions.

One of the most impressive aspects of *Song Builder* is its sequencing capability, allowing you to create individual sections, or sequences, of music and treat them as individual entities. After recording your sequences, you can link them in any desired order, or even change the key and tempo of different sequences. This lets you create whole songs of any length quickly by treating individual song sections as sequences. Let's say that your song contains these components: verse 1, verse 2, chorus, verse 3, chorus, chorus. To create a complete song, you need only record one verse and one chorus, then assemble them in the right order, since the music for the verses and choruses is the same each time they recur. What would Beethoven have thought of such a work saver? He would have loved it, I'm sure!

#972 SONG EDITOR

The *Song Editor* module provides you with the editing capability to do minor touchups on your songs or major rewrites on given measures. The documentation explains how to access its many features, and the program contains multiple help screens. As with the other *MusicWare* modules, *Song Editor* is entirely menu driven and very easy to use, requiring only eight of the C-64's keys for implementing functions. All note entry is handled through the MusicMate keyboard.

Possibly the most outstanding feature of *Song Editor* is that it automatically calculates the effects of your editing changes and compensates for them. If you alter the pitch or duration value of any note in the composition, *Song Editor* automatically

takes care of the rests! To change any note on the display, strike the correct note on the MusicMate keyboard and it will appear instantly on the staff. You can even change the time signatures or transpose the key with this program.

Another big plus is the ability to step through your music one note at a time, or view your score one measure at a time. The video display is in traditional grand-staff format, with signatures, notes, and rests looking exactly as they should.

Song Editor is a tremendously powerful music editing program that picks up where *Builder* leaves off and carries you further down the musical path.

#973 SONG PRINTER

If you have need of printed musical scores in standard notation, *Song Printer* will allow you to print out sheet music of your songs, and even give you the options of which voices to print. Consistent with the other products in the *MusicWare* line, it is menu-driven and easy to use. The program is accompanied by excellent documentation, and help screens are included.

Song Printer will work with the Commodore 1525, 801, or other compatible dot matrix printers suitably interfaced. Because the music symbols and graphics must be created, letter-quality or daisy wheel printers won't work.

In addition to printing out excellent quality music scores, *Song Printer* allows you to choose the melody line(s) to be printed. This is particularly useful for learning harmony parts in vocal arrangements, whereby the soprano, alto, and tenor may each have a score with their particular parts on it. The piano accompanist, however, may utilize a score showing all three parts. This is a great print option to have, and *Song Printer* is, to my knowledge, the only music printing program that allows this sort of flexibility.

#974 SOUND MAKER

Your C-64's SID chip is capable of creating some awesome sounds, and the *Sound Maker* module makes such sonic tailoring easy. The program disk contains twenty musical instrument sounds and sound effects which you may alter to your heart's content. Included are several help screens that explain the functions of the control settings; additionally, the documentation expands on this information.

Sound Maker also provides you with a novel video display while creating sounds. Unlike music synthesis programs which rely on bar or numeric setting displays, you get a simulated analog control display that depicts knobs for adjusting sound qualities. This feature really imparts the feel of a traditional electronic music synthesizer to the program. Another nice wrinkle is the ability to select different octaves for the sound, in addition to "tweaking" the bass, treble, or a combination of the two.

You can try out your sounds as you create them by using the MusicMate keyboard with the program. And when you've created one you particularly like, you can store it on diskette for use with other programs in the *MusicWare* line.

SUMMARY

All the *MusicWare* modules reflect a lot of thought on the part of their designers. They're very easy to use; even for the computer music novice, they perform flawlessly, and they are all interactively compatible. The modular software approach allows you to purchase specific-capability features as your needs dictate, and combining these *MusicWare* modules produces a full-featured music package that's hard to beat.

Sequential Circuits, Inc., 3051 North First Street, San Jose, CA 95134 (phone: 408-946-5240).

—Tom Benford

PROMAL

Systems Management Associates
Commodore 64
Disk; $49.95

BASIC, stand aside. A new generation of computer languages has arrived and is taking over. And, of the structured languages, PROMAL is one of the very best.

PROMAL makes a compromise between the loose syntax of BASIC and the intense structure of LISP-type languages. PROMAL is procedure-oriented, which means that programs are written in little modules, each of which performs a specific task. All of the small units of code are then called by a main procedure (program), in a structure which resembles BASIC "GOSUB-RETURN"-called subroutines.

There are two types of modules in PROMAL: procedures and functions. When called, functions return a value (data or a Boolean). Procedures are series of program commands, which return no value. Within a module, local variables may be defined. In fact, modules may even be defined recursively with up to 256 levels of nesting. All modules may be sent arguments (data) on which to perform operations. The data structures in PROMAL are similar to those in BASIC, with the exception of Boolean data.

Boolean data are the values TRUE and FALSE which may be assigned to a variable or be returned as the result of the evaluation of an expression. One example of an expression which returns a Boolean when evaluated is the CMPSTR function. CMPSTR compares two strings in relationship to an operator (<,<=,<>,=,>=,>). If the relationship is true (e.g. A<B), the CMPSTR returns TRUE, else FALSE.

PROMAL also has a very different way of treating command words. All programs, including the main program and all modules, are given names and told what arguments are needed for proper operation when initially defined. To execute a program, only the use of the name and inclusion of argument values are necessary. In a way, definition of a module is the same as creating a new command. It is even possible to create a whole range of sound and color commands, avoiding the annoyance of POKEing all those values into memory.

However, in terms of syntax of individual statements, PROMAL and BASIC vary by very little. The basic assignment primative is the = operator (a primitive is an element of a computer language which is originally written in machine language, as opposed to modules—written in PROMAL). The conditional constructs are IF-ELSE, IF-THEN, and CHOOSE. The looping constructs are WHILE, REPEAT-UNTIL, and FOR.

The most interesting and useful new primative is the ESCAPE-REFUGE construct. When an error occurs in a module called by another module, it is often desirable to return to the original module and restore all variables to their original state. Using REFUGE, it is possible to define three places and states to which the program may return and "recover" from a disaster. Each REFUGE is given a number from one to three. When an ESCAPE command is executed, the refuge number is specified and all state variables are restored at the location corresponding to the appropriate refuge.

PROMAL statements, unlike those in BASIC, have no line numbers, may only occupy one line, and must have spaces between keywords and variables. However, these small inconveniences are more than compensated for by the fact that PROMAL is a compiled language. There are two fundamental types of languages, interpreted and compiled. BASIC is interpreted. Interpreted languages are evaluated sequentially, as individual lines are executed. This is understandably slow. Compiled languages are evaluated into machine language in one large translation effort and stored in machine language form in an object file, on disk. Then, when the object file is executed, it is as if the program was originally written in machine language. However, the usual problem which arises with compiled languages is that the original program must be written into a document file, through a separate word processing program. PROMAL fully supports creation of document source files by supplying a built-in editor. An EXECUTIVE (operating system) is also included, completing the PROMAL environment.

As an introduction to structured programming languages and as an alternative to BASIC, PROMAL is well worth the time needed to learn it and the $49.95 to purchase it. Systems Management Associates deserves a round of applause for greatly extending the computing powers of the Commodore 64.

Systems Management Associates, 3700 Computer Drive, P.O. Box 20025, Raleigh, NC 27619 (phone: 919-787-7703). ***—Rachel Schleimer***

ERRATUM

On page 107 of our April '85 issue, we listed incorrect last byte information for the *BASIC Trace* program. The correct last byte is C1FA. To enter it, load your version of *Trace* (,8,1), then load and run *Flankspeed*. Enter first and (correct) last byte, hit f5, and continue from address C1F8. After typing in the last line, save the program.

CALLING ALL STARVING COMPUTER ARTISTS...

If you're in need of a square meal, we can't help you. But if it's publicity you're starved for, we've got just the ticket. In future issues, *Ahoy!* will feature a gallery of the finest computer graphics our readers can generate.

We invite you to send your best work on disk, accompanied by a stamped and self-addressed mailer, to Morton Kevelson, P.O. Box 260, Homecrest Station, Brooklyn, NY 11229. Indicate the drawing package that was used to create the image. If you employed a bit map of your own design, indicate the appropriate file parameters, i.e., hi-res or multicolor, location of bit map, screen and color data.

Send along your latest masterpiece today. Who *knows* who might be reading?

SCREEN DUMPING ON THE COMMODORE 64

GETTING SCREEN BIT GRAPHICS TO YOUR PRINTER WITH HELP FROM MACHINE LANGUAGE

BY ROGER S. MACOMBER
PROFESSOR OF CHEMISTRY
UNIVERSITY OF CINCINNATI

Sooner or later every programmer with an interest in computer graphics will tap the versatility of bit mapped graphics. The program described here will serve not only as a primer on the creation of screen bit graphics, but will also allow reproduction of the screen image on your printer. In addition, if you study the program (see page 107) carefully you will learn something about memory management on the Commodore 64, as well as experiencing the dramatic effect of machine language on the speed of execution of the program.

The program requires an 8-pin dot matrix printer with bit graphics capability. It was written for use on either a Gemini 10 or 10X, using a standard Centronics serial to parallel interface; use with other 8-bit graphics printers will require some modification.

SCREEN BIT GRAPHICS

First, let's examine how bit graphics are generated on the monitor screen. Each standard screen character comprises an 8 dot by 8 dot (64 pixel) array. If we multiply this by 40 characters per row and 25 rows, we note there are 64,000 total pixels (320 across by 200 down), each of which can be separately activated to form the screen image. Because each pixel is turned on or off by a 1 or 0 (a single bit) in the appropriate character memory location, the most direct approach is to manipulate 8 pixels at a time as one byte of memory.

The basic idea behind creation of a screen image is depicted in Figure 1 (see page 74). By examining the "zeroth" byte of character memory (hereafter referred to as the bit map), we see that pixel number 1 is controlled by bit 7, pixel 2 by bit 6, etc. Thus, for any of the possible numbers from 0 to 255 which may be stored in a byte, we generate a different pattern of activated pixels. The entire screen will require 8000 bytes, arranged as shown in Figure 2 (see page 74).

Let's examine version I of the program through line 180. In order to allow for later expansion of the BASIC program without overwriting screen memory, you should carry out the POKEs described in line 1. This moves the beginning of the BASIC program to memory location 16384 ($4000). Next (line 20) we select an 8K block of memory beginning at location 8192 ($2000) for the bit map. The POKE tells the VIC-II chip where to find the bit map and screen memory. Line 25 activates the screen bit mode. Line 30 clears the 8000 bytes of the bit map, a process that takes over a minute in BASIC. As we will see later, it is nearly instantaneous in assembly language. Line 40

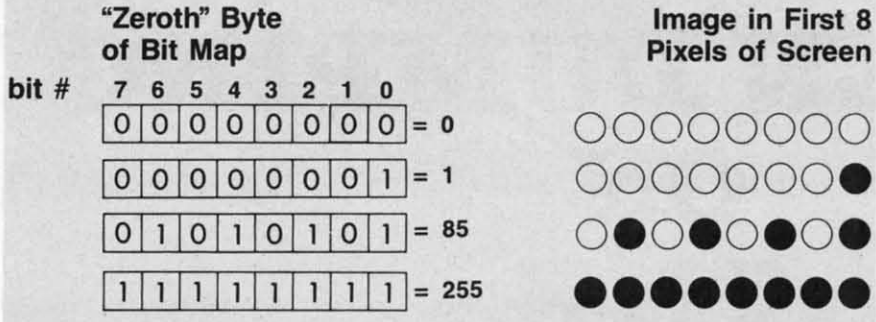


Figure 1

The correspondence between the bit map and its screen image. ○ and ● represent deactivated and activated pixels, respectively. The bit image to the right results from the four different values stored in the corresponding single byte on the left.

stores in screen memory what colors will be used for activated and deactivated pixels. The upper 4 bits of each byte control the color of activated pixels in the corresponding character, the lower 4 bits control the color of the deactivated pixel (0 = black, 1 = white, 2 = red, etc.). Thus, a 1 (00000001) results in a white background and black dots. Changing the 1 to 16 (00010000) produces the reverse. Lines 100-180 actually create the screen bit map. As an example I have chosen an exponentially damped cosine wave. Recalling that our screen image is 320 pixels wide and 200 pixels high, we generate a set of X, Y points which describe the function in lines 100 and 105. (Y = 0, X = 0 corresponds to the upper-left-most pixel.) Lines 150 through 165 determine which byte of the bit map (Figure 2) will contain the data for each point, while line 170 determines which bit of the byte should be activated. For example, consider the point X = 6, Y = 8 (shaded pixel in Figure 2). This corresponds to LINE 0 of CHARAC-

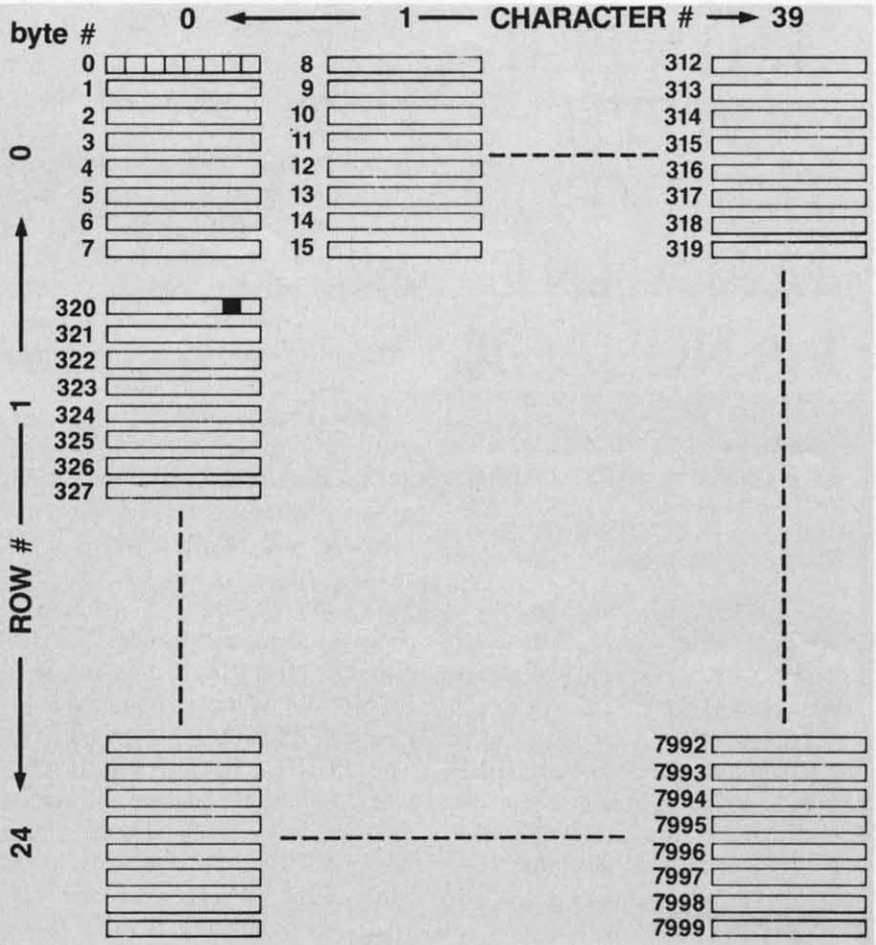


Figure 2

The arrangement of bit map memory.

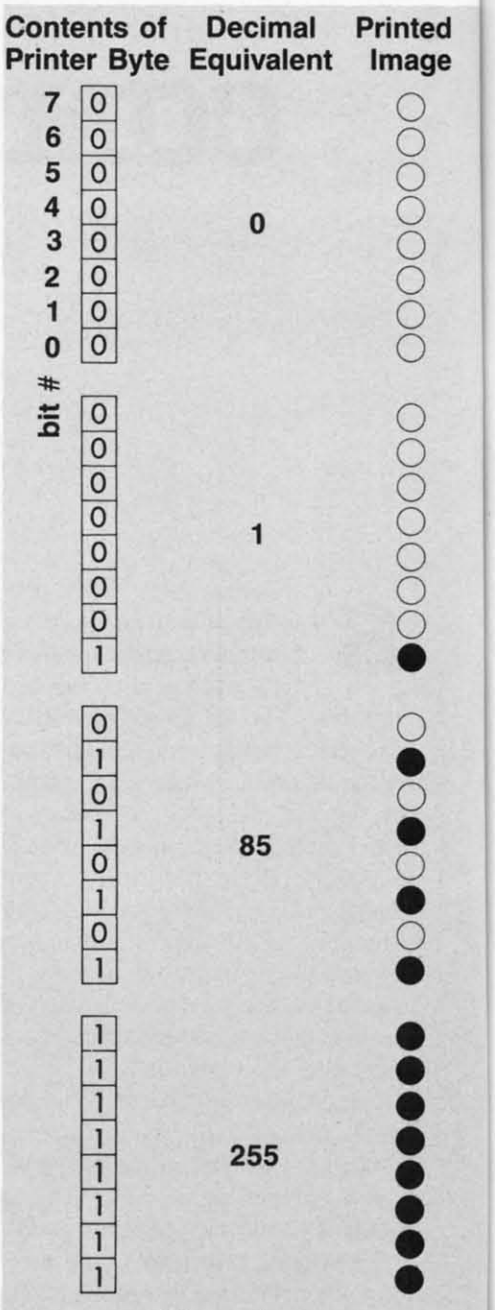


Figure 3

The correspondence of printer bit map to printed image. ○ and ● represent blanks and printed dots, respectively. (This is the order for the Gemini and Epson series of printers; the C-Itoh printers reverse the bit order.)

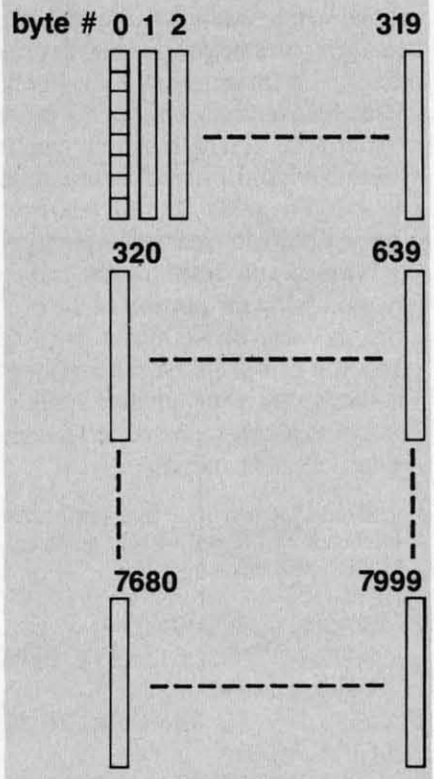


Figure 4
The arrangement of bit map memory for the printer.

TER 0 in ROW 1. Since there are 320 bytes per row (see Figure 2), and 8 bytes per character, the location of the appropriate byte is 8192 + 1*320 + 0*8 + 0 = 8512. Line 170 determines that bit 1 (seven over from the left; see Figure 1) will receive the "1". Line 175 makes the appropriate POKE, and the point appears on the screen. Line 180 sends us back to calculate the next point, and this continues until the X domain has been exhausted.

BIT GRAPHICS ON YOUR PRINTER

Your Gemini 10X (with interface in transparent mode) can be used to create printed pictures in a manner quite analogous to screen bit graphics. The main difference is in the way the bit map is accessed by the printer. The printer prints one row at a time with the height of each row determined by the number of pins in the print head. An 8-pin print head can print any combination of zero to 8 dots (vertically aligned), as shown in Figure 3. Comparison of this with Figure 1 shows that the bit map for a printer must be arranged differently (Figure 4) than the screen bit map (Figure 2). If you are doing printed bit graphics directly, you can plan your memory setup to correspond to Figure 4. The problem we have, however, is to take a screen image stored as in Figure 2, and make it accessible, bit by bit, as shown in Figure 4. Thus, to create the "zeroth" printer byte, we need the 7th *bit* of each of the first 8 *bytes* of the screen bit map, each multiplied by the appropriate power of 2. Printer byte 1 comes from the 6th *bit* of each of the first 8 *bytes* of the bit map, and so on.

Now let's look at the rest of version 1. Line 190 starts the printing sequence when you depress the f1 key on the Commodore keyboard. Lines 205 and 210 activate the printer and set the linefeed length to 16/144".

Lines 215 and 220 draw a horizontal border, indented one inch. The actual printing takes place in a loop of instructions 225-270. For each printed row (8 dots high) the high resolution bit mode is activated (225), then a one inch margin is created, marked with a " I " [CHR$(245) in 230]. Next, in a series of nested loops (lines 235-265), an entire row is assembled and printed byte by byte from the screen bit map. To discover how this section works, I recommend setting up a sample "character" (8 horizontally stacked bytes of the screen bit map) and carry through the process by hand to create the corresponding 8 sequential vertical bytes of the printer bit map. Note also that each byte is printed twice (line 255) to improve clarity. At the end of the row another " I " is printed (line 265) and we return to assemble the next row. After the 25th row (L = 24) we draw another indented horizontal line (line 275, 280), and finally close up shop.

Now that you understand how it works, save it and run it. Don't forget the preliminary POKEs! Right before your eyes you will see the bit map zeroed (about 70 seconds), the field turned white (all pixels are deactivated, remember?), and black dots describing the function beginning to appear. After the screen has filled (about 2 minutes), press f1. Now the wait begins, because each printed line requires over 2 minutes to be assembled, making the entire plot an hour-long process! The final printed result is shown in Figure 5.

A LITTLE HELP FROM ASSEMBLY LANGUAGE

It would certain be preferable to have the image printed in a matter of seconds rather than hours. Fortunately, this can be readily accomplished using machine language for the time-consuming loops (lines 230 through 265) as well as the task of clearing the bit map (line 30) and setting colors (line 40). Using the technique of appending machine code at the end of our BASIC program, we now generate version II of the program as follows:

1) delete lines 20-40, and 225-265 from version I

2) add lines 5, 30, 195, 200, 225, 230 and 265 of version II

3) by PEEKing in 45 (40) and 46 (67), we note the location of the end of the BASIC program is at 17192. Now, POKE 45, 250 to extend the memory allocation by 210 bytes, more than enough to accommodate the machine code.

4) add the following instruction:

```
10 FORI=0 TO 206:INPUTB%:P
OKES1+I,B%:NEXT:STOP
```

5) run the program, and enter the 207 bytes of machine code, one by one, as listed at the end of version II. Do it slowly and carefully!*

6) delete line 10

Now save version II, and run it. Notice anything different? First, the bit map is cleared and the screen turns white instantly. But the big change comes when you hit f1 to print the screen image. Now each line is assembled almost as fast as the printer can print it. The entire bit map is assembled and printed in one minute (see Figure 5)! So, you now have the capability to create whatever type of bit map you desire on the screen by modifying the portion of the program between lines 100 and 150. And then you can print the screen image as hard copy. (For another application of this program, see the follow-up article next month.)

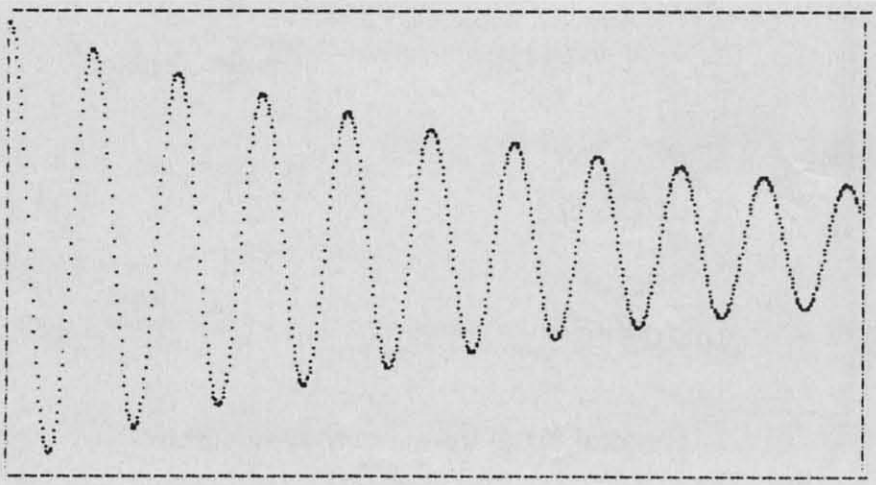


Figure 5
The final printed output from both versions of the program.

***Should you ever want to print the machine code at the end of your program, use the following sequence:**

```
7 OPEN4,4,2:CMD4:J=0
9 FORI=0 TO 206:PRINT PEEK
(S1+I);:J=J+1
11 IF J > 15 THEN PRINT CH
R$(10);:J=0
13 NEXT:PRINT#4,:CLOSE4:ST
OP
```

A WORD ABOUT THE MACHINE CODE

If you're interested in how the machine code does its job, disassembling the program and studying the assembly language is recommended. The first 31 lines accomplish the clearing of the bit map and setting screen color. Note that locations 251 ($FB) and 252 ($FC) are used as zero page indirect addresses to the bit map.

The assembling of lines for the printer is more complicated, and begins in line 32. Again locations 251 and 252 are used as indirect pointers for the section of memory being assembled (see line 195 in version II). Also, a table of powers of 2 is stored in 2048-2055 ($0800-$0807); see line 200 of version II. A step-by-step analysis of this program, though beyond the scope of this paper, would show that it accomplishes all the same things as lines 230-265 in the original version, but the machine code executes over 100 times faster! For those starting their foray into machine language programming, I recommend this as an instructive example. □

SEE PROGRAM LISTING ON PAGE 107

UNDER THE HOOD

An Inside Look At Your Commodore's Microprocessor

By Mark Andrews

Every computer can be divided into three main parts: a memory (often subdivided into RAM and ROM), input and output devices (such as keyboards, video monitors, cassette recorders, and disk drives), and a *central processing unit,* or CPU.

In a microcomputer such as the Commodore 64, all the functions of a CPU are contained in a microprocessor unit (sometimes abbreviated MPU). And your Commodore's MPU is a very large scale integrated circuit (VLSI) called the 6510. In this column, we're going to peek inside the 6510 chip and see what makes it go.

The 6510 microprocessor, an improved version of the 6502 chip used in Apple and Atari computers, contains seven main parts: an arithmetic-logical unit (ALU) and six addressable registers.

The ALU is one of the most important components of the 6510 chip. Every time the 6510 performs a calculation or a logical operation, the ALU is where all the work is done.

The ALU can actually perform only two kinds of calculations: addition and subtraction. Division and multiplication problems can also be solved by the ALU, but only in sequences of addition and subtraction operations.

The ALU can compare values, too—but only by subtracting one value from the other. By performing a subtraction operation, the ALU can determine whether one number is larger than the other, or the two numbers are the same.

When two numbers are to be added, subtracted, or compared, both are fed into the ALU, along with a simple three-letter instruction called a mnemonic. When the requested calculation has been performed, its result is left in a special 6510 register called an *accumulator.* Once a value is stored in the 6510's accumulator, it can be moved into any other 6510 register, or any register in your Commodore's memory.

Now we'll look at how the ALU and the accumulator in the 6510 chip work together. Suppose you wanted your computer to add 2 and 2, then place the result into a certain memory register. You could use an assembly language routine like this:

```
LDA #02
ADC #02
STA $FB
```

The first instruction in this routine, "LDA", means "load the accumulator" (with the value that follows). In this case, that value is 2. The "#" sign that is in front of the 2 means that the 2 is to be interpreted as a literal number, rather than as the address of a memory location in your computer.

The second instruction in the routine, "ADC", means "add with carry." In this addition problem, there is no number to be carried, so the "carry" part of the instruction has no effect here, and all the ADC instruction does is add 2 and 2.

The third and last instruction in our routine, "STA", means "store the contents of the accumulator" (in the memory address that follows).

As you can see, the memory address that follows the instruction "STA" is $FB—the hexadecimal equivalent of the decimal number 251.

Since there is no "#" sign in front of the hex number $FB, your assembler will not interpret $FB as a literal number. Instead, $FB will be interpreted as a memory address—and your Commodore will store the sum of 2 and 2 in Memory Register $FB.

(Incidentally, if you did want your assembler to interpret $FB as a literal number, you would have to write it "#$FB." When both a "#" symbol and a dollar sign appear before a number, it is interpreted as a literal hexadecimal number.)

If the third line of our routine read "STA #$FB", however, that would be a syntax error—because "STA" (store the contents of the accumulator in...) is an instruction that must be followed by a value that can be interpreted as a memory address, not by a literal number.

Besides the accumulator, the 6510 processor has five other registers: the X Register, the Y Register, the Program Counter, the Stack Pointer, and the Processor Status Register. Here is a brief summation of the functions of each:

- The *X Register* (abbreviated "X") is an 8-bit register often used for temporary storage of data during a pro-

gram. But it has a special feature: it can be incremented and decremented with a pair of one-byte assembly language instructions (INX and DEX). It is therefore often used as an index register, or counter, during loops and read/data-type instructions in programs.

• The *Y Register* (abbreviated "Y") is also an 8-bit register, and can also be incremented and decremented with a pair of one-byte instructions (INY and DEY). So, like the X Register, it is used both for data storage and as a counter.

• The *Program Counter* (abbreviated "PC") is a pair of 8-bit registers used together as one 16-bit register. The two 8-bit registers are sometimes referred to as "Program Counter-Low (PCL)" and "Program Counter-High (PCH)."

The program counter always contains the 16-bit memory address of the next instruction to be executed by the 6510 processor. When that instruction has been carried out, the address of the next instruction is loaded into the program counter.

• The *Stack Pointer* (abbreviated "S" or "SP") is an 8-bit register that always contains the address of the top element in a block of RAM, called the hardware stack (usually called simply "the stack"). This is a segment of memory in which data is often stored temporarily during the execution of a program. We'll go into more detail about how the stack works later on.

• The *Processor Status Register* (usually called just the "status register," but abbreviated "P") is an 8-bit register that keeps track of the results of operations performed by the 6510 processor.

THE PROCESSOR STATUS REGISTER

The processor status register is different from the other registers in the 6510 microprocessor. It isn't used for storing ordinary 8-bit numbers, as the others are. Instead, it uses its bits as flags to keep track of several kinds of important information.

Four of the status register's bits are called status flags: the carry flag (C), the overflow flag (V), the negative flag (N), and the zero flag (Z). These are used to keep track of the results of operations being carried out by the other registers inside the 6510 processor.

Three of the P register's other bits, called condition flags, are used to determine whether certain conditions exist in a program. These three bits are the interrupt disable flag (I), the break flag (B), and the decimal mode flag (D).

An eighth bit in the status register is not used.

THE PROCESSOR STATUS FLAG

The processor status register can be visualized as a rectangular box containing six square compartments. Each "compartment" in the box is actually a bit, and each bit is used as a flag.

If a given bit is a "1" instead of a "0," it is said to be a flag that is set.

If a given bit is a "0" instead of a "1," it is said to be a flag that is cleared.

The bits in the 6510 status register—like the bits in all 8-bit registers—are customarily numbered from 0 to 7. The rightmost bit is Bit 0, the leftmost is Bit 7.

THE PROCESSOR STATUS REGISTER

BITS	7	6	5	4	3	2	1	0
FLAGS	N	V	–	B	D	I	Z	C

Following is a complete list of the flags in the 6510's processor status register, and an explanation of each.

Bit 0—The Carry Flag (C): As you'll recall from last month, it isn't easy to do 16-bit arithmetic with an 8-bit chip like the 6510. When the 6510 chip is required to perform an addition operation on a number greater than 255—or if the result of a calculation might be greater than 255—a program has to be written that will break each number down into 8-bit segments for processing, and will then patch all of the numbers back together.

This kind of mathematical cutting and pasting involves a lot of carrying (during addition) and borrowing (during subtraction). And the carry flag of the 6510 P register is the flag that keeps up with all of this carrying and borrowing. If an addition operation results in a carry, the carry flag is automatically set; if a subtraction operation requires a borrow, the carry flag notes that, too.

Since the carry flag is almost constantly being set and cleared as a result of carries and borrows in addition and subtraction, it's a good idea to clear it before an addition operation is to be carried out—and to *set* it before a *subtraction* operation takes place. Otherwise, your calculations may be messed up by the leftover results of previous operations.

The assembly language instruction that clears the P register's carry bit is CLC, which stands for "clear carry." The instruction that sets the carry bit is SEC, which stands for "set carry."

Bit 1—The Zero Flag (Z): When the result of an arithmetical or logical operation is zero, the status register's zero flag is automatically set. Addition, subtraction, and logical operations can all result in changes in the status of the zero flag. If a memory location or an index register is decremented to zero, that will also result in a set zero flag.

An ironic 6510 convention is that when the result of an operation is zero, the zero flag is *set* to 1, and when the result of an operation is not zero, the zero flag is *cleared* to 0. It's important to understand this concept, since it would be easy to assume that the zero flag operates in the opposite manner.

There are no assembly language instructions to clear or set the zero flag. It's strictly a "read" bit, so instructions to write to it are not provided.

Bit 2—The Interrupt Disable Flag (I): Some Commodore programs contain interrupts—instructions that halt operations temporarily so that other operations can take place. Some of these are called maskable interrupts because you can prevent them from taking place by in-

cluding "masking" instructions in a program. Others are called nonmaskable because you can't stop them from taking place, no matter what you do.

You can disable a maskable interrupt with the P register's interrupt disable flag. When it is set, maskable interrupts are not permitted; when it is clear, they are.

The assembly language instruction to clear the interrupt flag is CLI. The instruction to set the interrupt flag is SEI.

Bit 3—The Decimal Mode Flag (D): The 6510 processor normally operates in binary mode, using standard binary numbers of the type discussed last month. But the 6510 can also operate in what is known as a binary-coded decimal (or BCD) mode. To put the 6510 into BCD mode, you have to set the decimal flag of the 6510 status register.

BCD arithmetic is slower than plain binary arithmetic, and it consumes more memory. But its results, unlike those of plain binary arithmetic, are always 100% accurate. So it is often used in programs in which accuracy is more important than speed or memory efficiency.

The assembly language instruction that clears the decimal flag is CLD. The instruction that sets the flag is SED.

Bit 4—The Break Flag (B): The break flag is set by a special assembly language instruction, BRK. Programmers often use the break instruction while debugging. When the instruction is used and the break flag is set, certain error-flagging operations take place and control of the computer returns to the programmer.

Bit 5—Unused: For some reason, the microprogrammers who designed the 6510 status register left one bit unused. This is the one.

Bit 6—The Overflow Flag (V): The overflow flag is used to detect an overflow from Bit 6 (the next-to-leftmost bit) in a binary number. If you don't know what that means yet, don't be concerned. The overflow flag is used primarily in advanced 6510 arithmetic—specifically, to keep track of changes in the plus and minus signs of signed numbers when signed binary arithmetic is being performed. As a beginning- or intermediate-level Commodore assembly language programmer, you'll rarely—if ever—have occasion to use the overflow flag. Nevertheless, we'll discuss it at length in a later column.

The assembly language instruction that clears the overflow flag is CLV. There is no instruction to set the flag, since it's read-only.

Bit 7—The Negative Flag (N): The negative flag is set when the result of an operation is negative, and cleared when the result is zero. It is often used in operations involving signed numbers, and has other uses that will be discussed in later columns. There are no instructions to set or clear the negative flag; there is no need for any, since the flag is used for test purposes only.

PROGRAM: THE 6510 SIMULATOR

To give you a closeup look at what happens inside your computer when it runs an assembly language program, I've created a BASIC program called the *6510 Simulator* (see page 98). It is not a machine language assembler, but it works much like one. When you load it and run it, it will present you with a screen display that will show you exactly what happens inside your 6510 chip's X, Y, and P registers when your computer is running an assembly language program.

To use the *6510 Simulator*, all you have to do is type in legal statements written in assembly language. You can use it with any of the instructions mentioned in this column, and with all other instructions that are legal in 6502/6510 assembly language. The simulator will not accept labels or indirect addressing modes (two more topics that will be discussed in later columns). It will also reject statements that contain incorrect spacing, syntax errors, illegal address modes, and unacceptably long numbers. And, although it can read memory locations, it can't write to them. So it can't freeze up your computer while you're testing out a program.

The *6510 Simulator* is a rather long and complex program, but well worth the time it will take to type it. If an assembly language routine won't work correctly, the *6510 Simulator* will often show you exactly what's going wrong. So please type it and save it (or purchase this month's *Ahoy!* disk or cassette). By the time we get to later columns in this series, you'll be glad you did. □

SEE PROGRAM LISTING ON PAGE 98

COMMODARES

PROGRAMMING CHALLENGES

By Dale Rupert

Each month, we'll present several challenges designed to stimulate your synapses and toggle the bits in your cerebral random access memory. We invite you to send your solutions to:

Commodares c/o *Ahoy!*
P.O. Box 723
Bethel, CT 06801

We will print the most interesting and/or unusual solutions. Be sure to identify the *name* and *number* of the problems you are solving. Also show sample runs if possible, where appropriate. Programs on diskettes are welcome, but they must be accompanied by listings. Also tell what makes your solutions unique or interesting, if they are. You must enclose a stamped, self-addressed envelope if you want any of your materials returned.

Your original programming problems, suggestions, and ideas are equally welcome! The best ones will become *Commodares.*

Problem #18-1: Cycling Function

Jim Speers (Niles, MI) suggested this problem. Complete the function definition in line 10 so that the output in line 30 will cycle from 0 to 100 and back again in steps of 5. Perhaps a little head scratching is in order.

```
10 DEF FNC(D)=...
20 D=5 : X=0
30 PRINT X : X=X+D : D=FNC(D) : GOTO 30
```

Jim sent some general purpose cycling functions which we will reveal next month.

Problem #18-2: Billiard Balls

Wallace Leeker (Lemay, MO) has sent his solution to the classic billiard ball problem. A warning before you start on this one: it's addictive and time consuming. Here it is:

You have twelve billiard balls, all identical in appearance. One has an internal flaw, making it either heavier or lighter than the other eleven. The computer has a simple balance scale and is allowed only three weighings in order to determine which is the flawed ball.

The user will decide which of the balls, numbered 1 through 12, is the culprit. The computer will select a combination of balls to put onto the balance (some on the left side and some on the right). The user will then tell the computer whether the scale is a) heavy on the left, b) balanced, or c) heavy on the right. The computer will repeat this sequence two more times. After the user's third response, the computer will tell which ball is different and whether it is heavy or light.

If some of you end up dreaming about billiard balls, don't say we didn't warn you.

Problem #18-3: Scroll Ski

Use the Commodore's screen scrolling to create a downhill skiing game. One simple catch: your program must be only one or two lines long. As easy as that!

Problem #18-4: Letter Math

Here's one of millions of similar problems. Perhaps you've solved them with paper and pencil before. This time you can be lazy and let the computer do all the work. Write a program to let the computer find values of X, Y, and Z to make this sum correct. Except for FOR and NEXT statements, use only one statement per program line. By the way, Z must not be 0.

```
 XYZ
  ZY
   X
 ---
 YXX
```

This month we will look at reader's solutions to February's *Commodares* as well as a few odds and ends. First I want to reiterate the time schedule for this column. This June issue is being written in mid-February. All letters received by the middle of the magazine cover month will be given prime consideration for publication. Responses to February *Commodares* received after the middle of February will still be read, but they have less probability of being mentioned since they are too late to be discussed this month. Don't let that discourage you from sending your solutions any time. The most unusual ones will be included in this column. If you sent a valid solution to some of the *Commodares* but your name didn't appear in genuine print, it is probably because your solution didn't reach us before mid-month.

In response to *Commodare #10-1: Numeric Palindrome* from last October, James Killman (Memphis, TN) mentioned that he ran his program for 28 days, 12 hours, 28 minutes, and 46 seconds before he got fed up and

quit—without a solution! His program cycled through 12,954 passes and reached a number 5,366 digits long. The problem was to take a number (196), reverse it, add the two together, see if the sum is a palindrome, and if not repeat the process using the sum instead of the original number. The palindrome for 196 has supposedly not been determined even on large computers. Mr. Killman's routine POKEs each digit into a reserved section of memory, reversing the direction each time. It POKEs, compares, reverses the digits, and then adds them. The numbers can be as large as the amount of memory allows. If you would like to see a listing of Mr. Killman's twenty line BASIC program, send a stamped, self-addressed envelope to *Commodares* with your request.

Rick Nash (Millersburg, OH) sent the following assembly language implementation of *Commodare #13-3: Micro Calc.* As we mentioned last month, the solution to this problem doesn't really do anything that isn't already available in BASIC. The user can easily type in a string of numbers and mathematical operators in command mode and let the computer print the results. Writing a program to let the user type the numbers and operators gives some insight into the problems of parsing and of how a compiler might be created. Rick's solution shows some useful procedures for accessing various BASIC utility routines from assembly language. The assembly language listing and a BASIC program to run it are listed below:

```
1 REM ASSEMBLY LANGUAGE USR ROUTINE
2 REM SOLUTION TO PROBLEM #13-3
3 REM                MICRO CALC
4 REM BY RICK NASH
5 REM
90 :*=$02A7      ;PROGRAM ORIGIN
100 :TXTPTR=$7A
110 :INDEX =$22
120 :FRESPC=$35
130 :VARPTR=$64
140 :BUFFER=$0200
150 :CHRGET=$0073
160 :MOVSTR=$B68C  (VIC=$D68C)
170 :CRUNCH=$A57C  (VIC=$C57C)
180 :FRMEVL=$AD9E  (VIC=$CD9E)
190 REM SAVE TEXT POINTER ON STACK
200 :LDA TXTPTR
210 :PHA
220 :LDA TXTPTR+1
230 :PHA
240 REM (64) PTS. TO STRING DESCRIPTOR
250 :LDY #0
260 :LDA (VARPTR),Y     ;STRING LENGTH
270 :PHA                ;ON STACK
280 :INY
290 :LDA (VARPTR),Y     ;ADDRESS LOW
300 :STA INDEX
310 :INY
320 :LDA (VARPTR),Y     ;ADDRESS HIGH
330 :STA INDEX+1
340 :PLA                ;STRING LENGTH
350 :TAY                ;TO Y
360 :LDA #0
370 :STA BUFFER,Y       ;SET END
380 :LDA #<BUFFER
390 :LDX #>BUFFER
400 :STA FRESPC         ;SET PTRS FOR
410 :STX FRESPC+1       ;VARIABLE MOVE
420 :STA TXTPTR         ;SET PTRS FOR
430 :STX TXTPTR+1       ;CRUNCH ROUTINE
440 :TYA                ;.A=VAR LENGTH
450 REM MOVE VARIABLE TO INPUT BUFFER
460 :JSR MOVSTR
470 REM TOKENIZE STRING
480 :JSR CRUNCH
490 REM BUMP TEXT POINTER
500 :JSR CHRGET
510 REM EVALUATE EXPRESSION
520 :JSR FRMEVL
530 REM RESTORE TEXT POINTER
540 :PLA
550 :STA TXTPTR+1
560 :PLA
570 :STA TXTPTR
580 REM RETURN TO USR ROUTINE & ASSIGN
590 REM VALUE IN FAC1 TO FLOATING
600 REM POINT VARIABLE
610 :RTS
```

```
1 REM BASIC SOLUTION TO PROBLEM #13-3
2 REM MICRO CALC
3 REM BY RICK NASH
4 REM
40 FORA=679 TO 738:READ D:POKE A,D:NEXT
50 POKE 785,167:POKE 786,2
60 INPUT"PROBLEM ";A$:IF A$="END" THEN E
ND
70 PRINT"THE ANSWER IS: ";USR(A$):PRINT:
GOTO 60
80 DATA 165,122,72,165,123
90 DATA 72,160,0,177,100
100 DATA 72,200,177,100,133
110 DATA 34,200,177,100,133
120 DATA 35,104,168,169,0
130 DATA 153,0,2,169,0
140 DATA 162,2,133,53,134
150 DATA 54,133,122,134,123
160 DATA 152,32,140,182,32
170 DATA 124,165,32,115,0
180 DATA 32,158,173,104,133
190 DATA 123,104,133,122,96
```

The BASIC program installs the machine language routine, then asks the user to enter a numeric problem such as 2-3*SQR(18), which is stored as a string. You may use any BASIC functions, previously defined floating point or integer variables, or mathematical or Boolean

operators in the numeric problem. In the machine language program, the sequence is as follows: 1) the string (A$) is copied into the input buffer ($0200), 2) the string is scanned and tokenized, 3) the formula is evaluated using BASIC's evaluator routine with the result left in the floating point accumulator, and 4) the USR routine returns the value from the floating point accumulator (FAC1).

Below is the solution from R.W. Kober (Buffalo, TX) to his *Commodare #17-2: Printer Sentinel* from last month:

```
1 REM  R.W. KOBER
2 REM  PROBLEM #17-2 : PRINTER SENTINEL
5 GOTO 100
10 OPEN 4,4
20 PRINT#4:IF ST AND 128 THEN 40
30 CLOSE 4:RETURN
40 PRINT TAB(248)"THE PRINTER IS NOT ON!
"CHR$(19):GOTO 20
99 REM ---MAIN PROGRAM---
100 PRINT CHR$(147)
110 GOSUB 10 :REM <<< CHECK ON PRINTER
120 OPEN 4,4:PRINT#4,"PRINTER IS ON"
130 CLOSE 4
```

Before printing, the program calls this subroutine. If the printer is not on, the message is printed, and the subroutine loops until the printer is turned on. If the printer is on, control is returned immediately to the calling program. Notice the use of the ST (STATUS) function. Also notice that the space between the ST and the AND is necessary. Can you figure out why? Omit the space and see what happens.

John Twardowski (Albany, NY) sent solutions *Commodares #14-1: Maximus Input* and *#14-2: Singles Only* combined into one program.

```
1 REM JOHN TWARDOWSKI
2 REM PROBLEMS 14-1 AND 14-2
3 REM MAXIMUS INPUT AND SINGLES ONLY
4 REM
10 PRINT CHR$(147) : LF$=CHR$(157)
20 PRINT CHR$(164);
30 GET A$:IF A$="" THEN 30
40 IF A$=CHR$(13) THEN PRINT LF$" " : GO
TO 70
50 IF A$=CHR$(20) THEN PRINT LF$" "LF$LF
$;:B$=LEFT$(B$,LEN(B$)-1):GOTO 20
60 B$=B$+A$:PRINT LF$A$;:GOTO 20
70 DIM A(90):FOR K=1 TO LEN(B$):B=ASC(MI
D$(B$,K,1)):A(B)=A(B)+1:NEXT
80 PRINT:PRINT"MISSING":FOR K=65 TO 90:I
F A(K)=0 THEN PRINT CHR$(K)" ";
90 NEXT:PRINT:PRINT"DUPLICATES":FOR K=65
 TO 90:IF A(K)>1 THEN PRINT CHR$(K)" ";
100 NEXT
```

Several other readers took a similar approach to creating a cursor in *Problem #14-1.* There was no requirement that the cursor must blink. The majority of the solutions to *Problem #14-2* were much like John's approach.

Paul Sisul (St. Louis, MO) sent the following solution to *Problem #14-2: Singles Only* which doesn't use any IF statements. Instead he uses logical expressions. Furthermore, his solution contains no arrays or subscripted variables.

```
1 REM PAUL SISUL
2 REM PROBLEM #14-2 : SINGLES ONLY
3 REM
20 INPUT S$:FOR J=65 TO 90:C=0:FOR K=1 T
O LEN(S$):C=C-(MID$(S$,K,1)=CHR$(J))
30 NEXT K:PRINT CHR$(48*(1+(C=1))+C);" "
;CHR$(J*-(C<>1)),:NEXT J
```

To understand Paul's solution, recall that a logical expression has a value of 0 if it is false and −1 if it is true. Consequently the function CHR$(J * −(C< >1)) represents CHR$(0) for any letter whose count is equal to one If the current letter's count does not equal one, the expression (C< >1) is true and has the value −1. Therefore −(C< >1) equals 1, and CHR$(J * −(C< >1)) equals CHR$(J). The other CHR$ function in line 30 converts the count C into its ASCII value which is also printed. Some tricky but interesting programming!

Several readers sent panagrams from various sources in response to *Problem #14-2: Singles Only.* Mike Skloff (New York, NY) included his favorite typing test, "Pack my box with five dozen liquor jugs" as well as an even shorter "Waltz, nymph, for quick jigs vex Bud." Neither of these are perfect pangrams since they contain duplicate letters. Some of the perfect ones he sent include:

Cwm, fjord-bank glyphs vext quiz.
Zing! Vext cwm fly jabs Kurd qoph.
Milk-vat fez bugs qoph-crwd jynx.

These are from Dmitri A. Borgmann's book *Language on Vacation* (Scribner's, 1965). Mr. Skloff leaves the translations of these sentences up to you. Dig out the unabridged dictionary for these!

Jim Root (Whitmore Lake, MI) sent this sentence containing all the letters: "Wafting zephyrs quickly vexed Jumbo." I think he's talking about a flying elephant. Clifford Dedmore Jr. (North Bend, OR) sent "Cwm kvutza qoph jynx fled brigs" from the *Guinness Book of World Records,* which was supposedly found with the use of three computers. Again, the translation is up to you.

There were many good solutions to *Problem #14-3: Digital Deduction.* Most readers knew that by using binary search techniques the computer can deduce the user's number (between 1 and 1000) in ten or fewer guesses. In fact, since 1024 is two raised to the tenth power, the range of numbers could be 1 to 1024 and still guarantee that not more than ten guesses are needed.

David Alan Wright (New Britain, CT) sent the following solution which requires only (are you ready for this?) nine, yes, nine guesses by the computer! Now before you start throwing the books on mathematical theory at me,

a word of explanation. As David points out, "The maximum number of guesses is nine. After each guess, the possibilities are halved. On the ninth guess, only one possible number is left, and the program *tells* you the answer rather than asks, so a tenth guess is unnecessary." Voilà! His solution is listed below.

```
1 REM COMMODARE #14-3:DIGITAL DEDUCTION
2 REM SOLUTION BY DAVID ALAN WRIGHT
3 REM
10 PRINT" CHOOSE A NUMBER FROM 1 TO 1000
 AND HIT RETURN":INPUT A$:H=1000
20 A$="X":IF(L+H)/2<>L+1THEN N=INT((L+H)
/2):PRINT"IS"N"H, L OR EQUAL";:INPUT A$
30 IF LEFT$(A$,1)="H" THEN H=N:G=G+1:GOT
O 20
40 IF LEFT$(A$,1)="L" THEN L=N:G=G+1:GOT
O 20
50 PRINT"AFTER"G"GUESSES YOUR NUMBER IS
";:IF (L+H)/2=L+1 THEN PRINT L+1:END
60 PRINT N
```

Chuck McGaffin (Ballston Lake, NY) sent an equation for calculating the maximum number of guesses (N) required to find a single item from a group of M items:

```
N = INT(LOG(M)/LOG(2) +1)
```

Wallace Leeker (Lemay, MO) simplified the mathematics of this problem by making his first guess 512. From then on, he merely divided the guess by two and either added or subtracted the result to obtain the next guess. That way he eliminated all the INT and rounding statements that other readers used.

John Deering (Tustin, CA) and Chuck McGaffin both sent separate programs which simulated the entire game. Both programs tabulated the numbers of computer guesses required for each chosen number from 1 to 1000. For example if the user thought of the number 500, the computer would guess it on the first try. If the target number was 250, the computer could guess it on the second try, and so forth. Mr. Dearing's program calculated the maximum and the average number of guesses required for all selected numbers. Mr. McGaffin's program below keeps track of the total of one-guess numbers, two-guess numbers, etc. Perhaps you could expand this concept to find the "safest" targets, i.e., the numbers that require the most computer guesses to deduce.

```
1 REM CHUCK MCGAFFIN
2 REM PROBLEM #14-3 : DIGITAL DEDUCTION
3 REM COMPUTER SIMULATION TO VERIFY THAT
 EVERY NUMBER IS GUESSED IN < 10 TRIES
4 REM
10 FOR N=1 TO 1000:NG=1
20 LL=1:UL=1000:I=500:GOTO 40
30 I=INT((LL+UL)*.5):NG=NG+1
40 IF N<I THEN UL=I-1:GOTO 30
50 IF N>I THEN LL=I+1:GOTO 30
60 IF NG>10 THEN PRINT N
70 G(NG)=G(NG)+1
80 NEXT
90 FOR J=1 TO 10:PRINT G(J);:NEXT
```

The final solutions this month are for *Problem #14-4: Roman Translation*. The user types a Roman numeral and the computer gives the Arabic equivalent. These programs from Clifford Dedmore Jr. (North Bend, OR) and John Immarino (Hackensack, NJ) were chosen from several submitted because of their brevity and because they use such greatly differing approaches to the solution.

```
1 REM CLIFFORD DEDMORE JR.
2 REM PROBLEM #14-4 : ROMAN TRANSLATION
3 REM
10 DIM T(20):INPUT"ENTER ROMAN NUMERAL";
A$
20 FOR K=1 TO LEN(A$):B$=MID$(A$,K,1)
30 L=-(B$="I")-5*(B$="V")-10*(B$="X")-50
*(B$="L")-100*(B$="C")-500*(B$="D")
35 L=L-1000*(B$="M")
40 T(K)=L:NEXT
50 FOR K=1 TO LEN(A$):IF T(K)>=T(K+1) TH
EN TT=TT+T(K):GOTO 70
60 TT=TT+T(K+1)-T(K):K=K+1
70 NEXT:PRINT TT
```

```
1 REM JOHN IMMARINO
2 REM PROBLEM #14-4 : ROMAN TRANSLATION
3 REM
10 V$="MDCLXVI"
20 INPUT"ROMAN NUMERAL";R$:L=7
30 FOR A=LEN(R$) TO 1 STEP -1
40 :X=2:F=5000
50 ::FOR B=1 TO 7
60 :::IF MID$(R$,A,1)=MID$(V$,B,1) THEN
C=B:B=7
70 :::X=ABS(X-7):F=F/X
80 ::NEXT B
90 :T=T+F*((C>L)-(C<=L)):L=C
100 NEXT A
110 PRINT"ARABIC";T:PRINT:T=0:GOTO 20
```

Notice Clifford's use of the "conditional LET" statement in line 102. This technique is based upon the concepts of logical expressions which we discussed above. John also employs a logical expression in line 180 to determine the correct result when a smaller value occurs before a larger value and must be subtracted from it. A good exercise would be to "play computer" and figure out how both of these programs work. Jim Speers (Niles, MI) pointed out that these programs work only if the user types in Roman numerals in the proper format. An input such as "CIVX," for example, will be evaluated, but it

Continued on page 114

PROGRAM LISTINGS

Attention new *Ahoy!* readers! You must read the following information very carefully prior to typing in programs listed in *Ahoy!* Certain Commodore characters, commands, and strings of characters and commands will appear in a special format. Follow the instructions and listing guide on this page.

On the following pages you'll find several programs that you can enter on your Commodore computer. But before doing so, read this entire page carefully.

To insure clear reproductions, *Ahoy!*'s program listings are generated on a daisy wheel printer, incapable of printing the commands and graphic characters used in Commodore programs. These are therefore represented by various codes enclosed in brackets [ ]. For example: the SHIFT CLR/HOME command is represented onscreen by a heart ♥. The code we use in our listings is [CLEAR]. The chart below lists all such codes which you'll encounter in our listings, except for one other special case.

The other special case is the COMMODORE and SHIFT characters. On the front of most keys are two symbols. The symbol on the left is obtained by pressing that key while holding down the COMMODORE key; the symbol on the right, by pressing that key while holding down the SHIFT key. COMMODORE and SHIFT characters are represented in our listings by a lower-case "s" or "c" followed by the symbol of the key you must hit. COMMODORE J, for example, is represented by [c J], and SHIFT J by [s J].

Additionally, any character that occurs more than two times in a row will be displayed by a coded listing. For example, [3 "[LEFT]"] would be 3 CuRSoR left commands in a row, [5 "[s EP]"] would be 5 SHIFTed English Pounds, and so on. Multiple blank spaces will be noted in similar fashion: 22 spaces, for example, as [22 " "].

Sometimes you'll find a program line that's too long for the computer to accept (C-64 lines are a maximum of 80 characters, or 2 screen lines, long; VIC 20 lines, a maximum of 88 characters, or 4 screen lines). To enter these lines, refer to the *BASIC Command Abbreviations Appendix* in your User Manual.

On the next page you'll find our *Bug Repellent* programs for the VIC 20 and C-64. The version appropriate for your machine will help you proofread our programs after you type them. (Please note: the *Bug Repellent* line codes that follow each program line, in the whited-out area, should *not* be typed in. See the instructions preceding each program.) □

When You See	It Means	You Type		You Will See
[CLEAR]	Screen Clear	SHIFT	CLR/HOME	♥
[HOME]	Home		CLR/HOME	▯
[UP]	Cursor Up	SHIFT	↑ CRSR ↑	▯
[DOWN]	Cursor Down		↑ CRSR ↑	▯
[LEFT]	Cursor Left	SHIFT	←CRSR→	▯
[RIGHT]	Cursor Right		←CRSR→	▯
[SS]	Shifted Space	SHIFT	Space	▯
[INSERT]	Insert	SHIFT	INST/DEL	▯
[DEL]	Delete		INST/DEL	▯
[RVSON]	Reverse On	CNTRL	9	▯
[RVSOFF]	Reverse Off	CNTRL	0	▯
[UPARROW]	Up Arrow		↑	▯
[BACKARROW]	Back Arrow		←	▯
[PI]	PI		π	▯
[EP]	English Pound		£	▯

When You See	It Means	You Type		You Will See
[BLACK]	Black	CNTRL	1	▯
[WHITE]	White	CNTRL	2	▯
[RED]	Red	CNTRL	3	▯
[CYAN]	Cyan	CNTRL	4	▯
[PURPLE]	Purple	CNTRL	5	▯
[GREEN]	Green	CNTRL	6	▯
[BLUE]	Blue	CNTRL	7	▯
[YELLOW]	Yellow	CNTRL	8	▯
[F1]	Function 1		F1	▯
[F2]	Function 2	SHIFT	F1	▯
[F3]	Function 3		F3	▯
[F4]	Function 4	SHIFT	F3	▯
[F5]	Function 5		F5	▯
[F6]	Function 6	SHIFT	F5	▯
[F7]	Function 7		F7	▯
[F8]	Function 8	SHIFT	F7	▯

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** This and the preceding page explain these codes and provide other essential information on entering **Ahoy!** programs. Read these pages **before** entering programs.

BUG REPELLENT

This program will let you debug any *Ahoy!* program. Follow instructions for VIC 20 (cassette or disk) or C-64.

VIC 20 VERSION

By Michael Kleinert and David Barron

For cassette: type in and save the *Bug Repellent* program, then type RUN 63000[RETURN]SYS 828[RETURN]. If you typed the program properly, it will generate a set of two-letter line codes that will match those listed to the right of the respective program lines.

Once you've got a working *Bug Repellent*, type in the program you wish to check. Save it and type the RUN and SYS commands listed above once again, then compare the line codes generated to those listed in the magazine. If you spot a discrepancy, a typing error exists in that line. Important: you must use exactly the same spacing as the program in the magazine. Due to memory limitations on the VIC, the VIC *Bug Repellent* will register an error if your spacing varies from what's printed.

You may type SYS 828 as many times as you wish, but if you use the cassette for anything, type RUN 63000 to restore the *Repellent*.

When your program has been disinfected you may delete all lines from 63000 on. (Be sure the program you type doesn't include lines above 63000!)

For disk: enter *Bug Repellent*, save it, and type RUN:NEW [RETURN]. Type in the program you wish to check, then SYS 828.

To pause the line codes listing, press SHIFT.

To send the list to the printer type OPEN 4,4:CMD 4:SYS 828[RETURN]. When the cursor comes back, type PRINT#4:CLOSE 4[RETURN].

```
·63000 FORX=828TO1023:READY:POKEX,Y:NEXT:END   AC
·63001 DATA169,0,133,63,133,64,165,43,133,251  JL
·63002 DATA165,44,133,252,160,0,132,254,32,228 DF
·63003 DATA3,234,177,251,208,3,76,208,3,230     OE
·63004 DATA251,208,2,230,252,169,244,160,3,32   OH
·63005 DATA30,203,160,0,177,251,170,230,251,20
 8                                              KO
·63006 DATA2,230,252,177,251,32,205,221,169,58  JJ
·63007 DATA32,210,255,169,0,133,253,230,254,32  OK
·63008 DATA228,3,234,165,253,160,0,170,177,251  LG
·63009 DATA201,32,240,6,138,113,251,69,254,170  BP
·63010 DATA138,133,253,177,251,208,226,165,253
 ,41                                            DD
·63011 DATA240,74,74,74,74,24,105,65,32,210     EK
·63012 DATA255,165,253,41,15,24,105,65,32,210   FO
·63013 DATA255,169,13,32,210,255,173,141,2,41   PK
·63014 DATA1,208,249,230,63,208,2,230,64,230    CB
·63015 DATA251,208,2,230,252,76,74,3,169,236    KH
·63016 DATA160,3,32,30,203,166,63,165,64,32     DP
·63017 DATA205,221,169,13,32,210,255,96,230,25
 1                                              EL
·63018 DATA208,2,230,252,96,0,76,73,78,69       OI
·63019 DATA83,58,32,0,76,73,78,69,32,35         FG
·63020 DATA32,0,0,0,0,0                         LE
```

C-64 VERSION

By Michael Kleinert and David Barron

Type in, SAVE, and RUN the *Bug Repellent*. Type NEW, then type in or LOAD the *Ahoy!* program you wish to check. When that's done, SAVE your program (don't RUN it!) and type SYS 49152 [RETURN].

To pause the listing depress and hold the SHIFT key.

Compare the codes your machine generates to the codes listed to the right of the respective program lines. If you spot a difference, an error exists in that line. Jot down the number of lines where contradictions occur. LIST each line, spot the errors, and correct them.

```
·5000 FORX=49152TO49488:READY:POKEX,Y:NEXT:END GJ
·5001 DATA32,161,192,165,43,133,251,165,44,133 DL
·5002 DATA252,160,0,132,254,32,37,193,234,177  DE
·5003 DATA251,208,3,76,138,192,230,251,208,2    OF
·5004 DATA230,252,76,43,192,76,73,78,69,32      KN
·5005 DATA35,32,0,169,35,160,192,32,30,171      CA
·5006 DATA160,0,177,251,170,230,251,208,2,230   CE
·5007 DATA252,177,251,32,205,189,169,58,32,210  JE
·5008 DATA255,169,0,133,253,230,254,32,37,193   CL
·5009 DATA234,165,253,160,0,76,13,193,133,253   NE
·5010 DATA177,251,208,237,165,253,41,240,74,74  ME
·5011 DATA74,74,24,105,65,32,210,255,165,253    EP
·5012 DATA41,15,24,105,65,32,210,255,169,13     GH
·5013 DATA32,220,192,230,63,208,2,230,64,230    AN
·5014 DATA251,208,2,230,252,76,11,192,169,153   NG
·5015 DATA160,192,32,30,171,166,63,165,64,76    BF
·5016 DATA231,192,96,76,73,78,69,83,58,32       EP
·5017 DATA0,169,247,160,192,32,30,171,169,3     PJ
·5018 DATA133,254,32,228,255,201,83,240,6,201   FK
·5019 DATA80,208,245,230,254,32,210,255,169,4   FL
·5020 DATA166,254,160,255,32,186,255,169,0,133  CL
·5021 DATA63,133,64,133,2,32,189,255,32,192     GC
·5022 DATA255,166,254,32,201,255,76,73,193,96   NN
·5023 DATA32,210,255,173,141,2,41,1,208,249     NH
·5024 DATA96,32,205,189,169,13,32,210,255,32    IM
·5025 DATA204,255,169,4,76,195,255,147,83,67    KC
·5026 DATA82,69,69,78,32,79,82,32,80,82         DC
·5027 DATA73,78,84,69,82,32,63,32,0,76          ML
·5028 DATA44,193,234,177,251,201,32,240,6,138   GN
·5029 DATA113,251,69,254,170,138,76,88,192,0    JK
·5030 DATA0,0,0,230,251,208,2,230,252,96        NA
·5031 DATA170,177,251,201,34,208,6,165,2,73     DM
·5032 DATA255,133,2,165,2,208,218,177,251,201   JA
·5033 DATA32,208,212,198,254,76,29,193,0,169    FM
·5034 DATA13,76,210,255,0,0,0                   PA
```

FLANKSPEED FOR THE C-64

By Gordon F. Wheat

Flankspeed will allow you to enter machine language *Ahoy!* programs without any mistakes. Once you have typed the program in, save it for future use. While entering an ML program with *Flankspeed* there is no need to enter spaces or hit the carriage return. This is all done automatically. If you make an error in a line a bell will ring and you will be asked to enter it again. To LOAD in a program Saved with *Flankspeed* use LOAD "name",1,1 for tape, or LOAD "name",8,1 for disk. The function keys may be used after the starting and ending addresses have been entered.

f1 – SAVEs what you have entered so far.

f3 – LOADs in a program worked on previously.

f5 – To continue on a line you stopped on after LOADing in the previously saved work.

f7 – Scans through the program to locate a particular line, or to find out where you stopped the last time you entered the program. f7 temporarily freezes the output as well.

```
·5 POKE53280,12:POKE53281,11·                   LL
·6 PRINT"[CLEAR][c 8][RVSON][15" "]FLANKSPEED[
 15" "]";                                       ED
·10 PRINT"[RVSON][5" "]MISTAKEPROOF ML ENTRY P
 ROGRAM[6" "]"                                  MC
·15 PRINT"[RVSON][9" "]CREATED BY G. F. WHEAT[
 9" "]"                                         DM
·20 PRINT"[RVSON][3" "]COPR. 1984, ION INTERNA
```

```
TIONAL INC.[3" "]"
·30 FORA=54272TO54296:POKEA,0:NEXT
·40 POKE54272,4:POKE54273,48:POKE54277,0:POKE5
 4278,249:POKE54296,15
·70 FORA=680TO699:READB:POKEA,B:NEXT
·75 DATA169,251,166,253,164,254,32,216,255,96
·76 DATA169,0,166,251,164,252,32,213,255,96
·80 B$="STARTING ADDRESS IN HEX":GOSUB2010:AD=
 B:SR=B
·85 GOSUB2520:IFB=0THEN80
·86 POKE251,T(4)+T(3)*16:POKE252,T(2)+T(1)*16
·90 B$="ENDING ADDRESS IN HEX":GOSUB2010:EN=B
·95 GOSUB2510:IFB=0THEN80
·96 POKE254,T(2)+T(1)*16:B=T(4)+1+T(3)*16
·97 IFB>255THENB=B-255:POKE254,PEEK(254)+1
·98 POKE253,B:PRINT
·100 REM  GET HEX LINE
·110 GOSUB3010:PRINT": [c P][LEFT]";:FORA=0TO8
·120 FORB=0TO1:GOTO210
·125 NEXTB
·130 A%(A)=T(1)+T(0)*16:IFAD+A-1=ENTHEN310
·135 PRINT" [c P][LEFT]";
·140 NEXTA:T=AD-(INT(AD/256)*256):PRINT" "
·150 FORA=0TO7:T=T+A%(A):IFT>255THENT=T-255
·160 NEXT
·170 IFA%(8)<>TTHENGOSUB1010:GOTO110
·180 FORA=0TO7:POKEAD+A,A%(A):NEXT:AD=AD+8:GOT
 O110
·200 REM    GET HEX INPUT
·210 GETA$:IFA$=""THEN210
·211 IFA$=CHR$(20)THEN270
·212 IFA$=CHR$(133)THEN4000
·213 IFA$=CHR$(134)THEN4100
·214 IFA$=CHR$(135)THENPRINT" ":GOTO4500
·215 IFA$=CHR$(136)THENPRINT" ":GOTO4700
·220 IFA$>"@"ANDA$<"G"THENT(B)=ASC(A$)-55:GOTO
 250
·230 IFA$>"/"ANDA$<":"THENT(B)=ASC(A$)-48:GOTO
 250
·240 GOSUB1100:GOTO210
·250 PRINTA$"[c P][LEFT]";
·260 GOTO125
·270 IFA>0THEN280
·272 A=-1:IFB=1THEN290
·274 GOTO140
·280 IFB=0THENPRINTCHR$(20);CHR$(20);:A=A-1
·285 A=A-1
·290 PRINTCHR$(20);:GOTO140
·300 REM LAST LINE
·310 PRINT" ":T=AD-(INT(AD/256)*256)
·320 FORB=0TOA-1:T=T+A%(B):IFT>255THENT=T-255
·330 NEXT
·340 IFA%(A)<>TTHENGOSUB1010:GOTO110
·350 FORB=0TOA-1:POKEAD+B,A%(B):NEXT
·360 PRINT:PRINT"YOU ARE FINISHED!":GOTO4000
·1000 REM BELL AND ERROR MESSAGES
·1010 PRINT:PRINT"LINE ENTERED INCORRECTLY":PR
 INT:GOTO1100
·1020 PRINT:PRINT"INPUT A 4 DIGIT HEX VALUE!":
 GOTO1100
·1030 PRINT:PRINT"ENDING IS LESS THAN STARTING
 !":B=0:GOTO1100
·1040 PRINT:PRINT"ADDRESS NOT WITHIN SPECIFIED
  RANGE!":B=0:GOTO1100
·1050 PRINT:PRINT"NOT ZERO PAGE OR ROM!":B=0:G
 OTO1100
·1060 PRINT"?ERROR IN SAVE":GOTO1100
·1070 PRINT"?ERROR IN LOAD":GOTO1100
·1080 PRINT:PRINT:PRINT"END OF ML AREA":PRINT
·1100 POKE54276,17:POKE54276,16:RETURN
·1200 OPEN15,8,15:INPUT#15,A,A$:CLOSE15:PRINTA
 $:RETURN
·2000 REM GET FOUR DIGIT HEX
·2010 PRINT:PRINTB$;:INPUTT$
·2020 IFLEN(T$)<>4THENGOSUB1020:GOTO2010
·2040 FORA=1TO4:A$=MID$(T$,A,1):GOSUB2060:IFT(
 A)=16THENGOSUB1020:GOTO2010
·2050 NEXT:B=(T(1)*4096)+(T(2)*256)+(T(3)*16)+
 T(4):RETURN
·2060 IFA$>"@"ANDA$<"G"THENT(A)=ASC(A$)-55:RET
 URN
·2070 IFA$>"/"ANDA$<":"THENT(A)=ASC(A$)-48:RET
 URN
·2080 T(A)=16:RETURN
·2500 REM ADRESS CHECK
·2510 IFAD>ENTHEN1030
·2515 IFB<SRORB>ENTHEN1040
·2520 IFB<256OR(B>40960ANDB<49152)ORB>53247THE
 N1050
·2530 RETURN
·3000 REM ADDRESS TO HEX
·3010 AC=AD:A=4096:GOSUB3070
·3020 A=256:GOSUB3070
·3030 A=16:GOSUB3070
·3040 A=1:GOSUB3070
·3060 RETURN
·3070 T=INT(AC/A):IFT>9THENA$=CHR$(T+55):GOTO3
 090
·3080 A$=CHR$(T+48)
·3090 PRINTA$;:AC=AC-A*T:RETURN
·4000 A$="**SAVE**":GOSUB4200
·4050 OPEN1,T,1,A$:SYS680:CLOSE1
·4060 IFST=0THENEND
·4070 GOSUB1060:IFT=8THENGOSUB1200
·4080 GOTO4000
·4100 A$="**LOAD**":GOSUB4200
·4150 OPEN1,T,0,A$:SYS690:CLOSE1
·4160 IFST=64THEN110
·4170 GOSUB1070:IFT=8THENGOSUB1200
·4180 GOTO4100
·4200 PRINT" ":PRINTTAB(14)A$
·4210 PRINT:A$="":INPUT"FILENAME";A$
·4215 IFA$=""THEN4210
·4220 PRINT:PRINT"TAPE OR DISK?":PRINT
·4230 GETB$:T=1:IFB$="D"THENT=8:A$="@0:"+A$:RE
 TURN
·4240 IFB$<>"T"THEN4230
·4250 RETURN
·4500 B$="CONTINUE FROM ADDRESS":GOSUB2010:AD=
 B
·4510 GOSUB2515:IFB=0THEN4500
·4520 PRINT:GOTO110
·4700 B$="BEGIN SCAN AT ADDRESS":GOSUB2010:AD=
 B
·4705 GOSUB2515:IFB=0THEN4700
·4706 PRINT:GOTO4740
·4710 FORB=0TO7:AC=PEEK(AD+B):GOSUB3030:IFAD+B
 =ENTHENAD=SR:GOSUB1080:GOTO110
·4715 PRINT" ";:NEXTB
·4720 PRINT:AD=AD+8
·4730 GETB$:IFB$=CHR$(136)THEN110
·4740 GOSUB3010:PRINT": ";:GOTO4710
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering ***Ahoy!*** programs. Refer to these pages **before** entering any programs!

The Ultimate Resolution

FROM PAGE 37

```
·1 REM                                          JD
·2 REM      RUPERT REPORT #18                   PA
·3 REM      LISTING                             LI
·4 REM      BIT MAP GRAPHICS                    KG
·5 REM                                          JD
·10 DEF FNSB(N)=PEEK(MM) OR 2[UPARROW]N         LG
·20 DEF FNRB(N)=PEEK(MM) AND (255-2[UPARR
 OW]N)                                          FP
·30 VV=53248 :REM VIC-II REGISTER 0             FL
·35 :REM >>> PUT BIT MAP AT 8192 <<<
     (SET BIT 3 OF VIC REGISTER 24)             JA
·40 MM=VV+24 : POKE MM,FNSB(3)                  OO
·45 :REM >>> SELECT BIT MAP MODE <<<
     (SET BIT 5 OF VIC REGISTER 17)             DH
·50 MM=VV+17 : POKE MM,FNSB(5)                  JM
·60 BASE=8192 :REM START BIT MAP MEMORY         KD
·65 :REM >>> CLEAR BIT MAP <<<                  HG
·70 FOR MM=BASE TO BASE+7999                    FN
·80 POKE MM,0 : NEXT MM                         OP
·85 :REM >>> SELECT COLORS C1 AND C0 <<<        LC
·90 C1=1 : C0=0 : CC=16*C1 + C0                 OM
·95 :REM >>FILL SCREEN MEMORY WITH COLOR        AI
·100 FOR MM=1024 TO 2023:POKE MM,CC:NEXT        OM
·194 :                                          DI
·195 ::REM:: MAIN PROGRAM ::                    AE
·196 :                                          DI
·200 FOR N=1 TO 1000                            CJ
·210 X=RND(0)*320 : Y=RND(0)*200                PO
·220 GOSUB 400 : NEXT                           NN
·250 FOR P=1 TO 3000 : NEXT                     NE
·294 :                                          DI
·296 :                                          DI
·300 :REM >>> RESET BIT MAP MODE <<<            HJ
·310 MM=VV+17 : POKE MM,FNRB(5)                 JN
·320 :REM >>> RESTORE SCREEN MEMORY BASE        GC
·330 MM=VV+24 : POKE MM,FNRB(3)                 MP
·390 END                                        IC
·395 :REM >>> TURN ON PIXEL AT (X,Y)            OB
·400 BIT=7-(X AND 7)                            PJ
·410 MM=BASE+320*INT(Y/8)+8*INT(X/8)+(Y A
 ND 7)                                          AP
·420 POKE MM,FNSB(BIT)                          MO
·430 RETURN                                     IM
```

Sing a Song of Anything

FROM PAGE 18

THREE-VOICE PLAYER

```
·1 REM "THREE VOICE PLAYER"                     MM
·2 REM PLAY 1, 2, OR 3 VOICES WITH THIS R
 OUTINE                                         OP
·3 REM ADD IT TO YOUR PROGRAMS: ADJUST TH
 E DURATIONS AT 9200-9210 AS NEEDED             MJ
·4 REM                                          JD
·5 REM PLAYS "GOD SAVE THE KING" ("MY COU
 NTRY, 'TIS OF THEE")                           CL
·6 REM                                          JD
·10 GOSUB 9000:GOTO 120                         LE
·60 FOR N=1 TO LEN(MD$(PH))                     FJ
·61 FOR VC=0 TO EV%                             GG
·62 POKE GR(VC),UG%(VC):REM NORMAL NOTES;
  DON'T POKE UG% FOR LEGATO                     AE
·63 FOR I=0 TO 1                                JB
·64 POKE FR(VC,I),PI%(ASC(MID$(ME$(PH,VC)
 ,N,1)),I)                                      BD
·65 NEXT:NEXT                                   EF
·66 FOR VC=EV% TO 0 STEP -1:POKE GR(VC),G
 %(VC):NEXT                                     MB
·67 FOR I=0 TO DU%(VAL(MID$(MD$(PH),N,1))
 ):NEXT                                         JB
·68 REM FOR VC=0 TO EV%:POKE GR(VC),UG%(V
 C):NEXT:REM STACCATO NOTES                     BO
·69 NEXT:PH=PH+1:IF PH>ES% THEN PH=0            IJ
·70 FOR VC=0 TO EV%:POKE GR(VC),UG%(VC):N
 EXT:RETURN                                     EP
·100 GOSUB 60                                   PC
·110 IF PEEK(653)>0 THEN END                    FF
·120 PRINT "PHRASE "PH                          FC
·190 GOTO 100                                   CF
·8997 REM                                       JD
·8998 REM SET UP SOUND SHAPE                    FD
·8999 REM                                       JD
·9000 DIM MD$(23),ME$(23,2),MV$(23,2),G%(
 2),GR(2),FR(2,1),AD(2)                         CF
·9001 DIM DU%(9),PI%(168,1),AK%(2),DY%(2)
 ,SN%(2),RE%(2),WF%(2)                          OF
·9007 REM                                       JD
·9008 REM ATTACK--VOICES 0,1,2                  KG
·9009 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=SHARPER ATTACK                              OK
·9010 AK%(0)=2:AK%(1)=2:AK%(2)=2                AN
·9015 FOR I=0 TO 2:AK%(I)=AK%(I)*16:NEXT        FF
·9017 REM                                       JD
·9018 REM DECAY--VOICES 0,1,2                   PK
·9019 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=FASTER DECLINE                              GA
·9020 DY%(0)=4:DY%(1)=6:DY%(2)=6                NC
·9027 REM                                       JD
·9028 REM SUSTAIN--VOICES 0,1,2                 FC
·9029 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=SOFTER VOLUME DURING SUSTAIN                JM
·9030 SN%(0)=12:SN%(1)=8:SN%(2)=9               FB
·9035 FOR I=0 TO 2:SN%(I)=SN%(I)*16:NEXT        BD
·9037 REM                                       JD
·9038 REM RELEASE--VOICES 0,1,2                 OK
·9039 REM NUMBER FROM 0 TO 15; LOWER NUMB
```

```
 ER=FASTER DROP TO SILENCE AT END                    PJ
•9040 RE%(0)=0:RE%(1)=3:RE%(2)=5                     BG
•9047 REM                                            JD
•9048 REM SET SOUND ADDRESSES                        JC
•9049 REM                                            JD
•9050 FR(0,0)=54272:FR(1,0)=54279:FR(2,0)
 =54286                                              PG
•9055 FOR I=0 TO 2:FR(I,1)=1+FR(I,0):GR(I
 )=FR(I,0)+4:AD(I)=GR(I)+1:NEXT                      HJ
•9057 REM                                            JD
•9058 REM POKE ADSR ENVELOPES                        JL
•9059 REM                                            JD
•9060 FOR I=0 TO 2:POKE AD(I),AT%(I) OR D
 Y%(I)                                               EN
•9065 POKE AD(I)+1,SN%(I) OR RE%(I):NEXT             DK
•9066 REM                                            JD
•9067 REM SET UP GATES                               JN
•9068 REM WAVEFORMS, VOICES 0,1,2 (ADD VA
 LUES):                                              DJ
•9069 REM TRIANGLE ON=16; SAWTOOTH ON=32;
  PULSE ON=64 (SET WIDTH!); NOISE ON=128             IL
•9070 WF%(0)=64:WF%(1)=64:WF%(2)=32                  HP
•9075 FOR I=0 TO 2:G%(I)=1 OR WF%(I):UG%(
 I)=G%(I)AND 254:NEXT                                AB
•9077 REM                                            JD
•9078 REM SET PULSE WIDTHS                           AC
•9079 REM VOICES 0,1,2; LOW BYTE, HIGH BY
 TE                                                  MG
•9080 POKE GR(0)-2,200:POKE GR(0)-1,3                JD
•9081 POKE GR(1)-2,200:POKE GR(1)-1,3                LD
•9082 POKE GR(2)-2,200:POKE GR(2)-1,3                EP
•9096 REM                                            JD
•9097 REM SET UP PITCH ARRAY                         DK
•9098 REM EACH NOTE, IN ALL ITS OCTAVES              JB
•9099 REM C                                          NE
•9100 X%=3:GOSUB 9190                                BK
•9101 DATA 12,1,24,2,48,4,97,8,195,16,135
 ,33,15,67,30,134                                    IF
•9102 REM D                                          NH
•9103 X%=4:GOSUB 9190                                PH
•9104 DATA 45,1,90,2,180,4,104,9,209,18,1
 62,37,69,75,139,150                                 PA
•9105 REM E (F-FLAT)                                 MH
•9106 X%=5:GOSUB 9190:Y%=13:GOSUB 9195               DN
•9107 DATA 81,1,163,2,71,5,143,10,31,21,6
 2,42,125,84,250,168                                 HM
•9108 REM F (E-SHARP)                                DB
•9109 X%=6:GOSUB 9190:Y%=19:GOSUB 9195               GE
•9110 DATA 102,1,204,2,152,5,48,11,96,22,
 193,44,131,89,6,179                                 IL
•9111 REM G                                          NI
•9112 X%=7:GOSUB 9190                                AO
•9113 DATA 145,1,35,3,71,6,143,12,30,25,6
 0,50,121,100,243,200                                GM
•9114 REM A                                          NC
•9115 X%=1:GOSUB 9190                                PA
•9116 DATA 195,1,134,3,12,7,24,14,49,28,9
 9,56,199,112,143,225                                PI
•9117 REM B                                          NF
•9118 X%=2:GOSUB 9190                                PF
•9119 DATA 250,1,244,3,233,7,210,15,165,3
 1,75,63,151,126,46,253                              CF
•9120 REM D-FLAT (C-SHARP)                           JL
•9121 X%=11:GOSUB 9190:Y%=17:GOSUB 9195              NN
•9122 DATA 28,1,56,2,112,4,225,8,195,17,1
 34,35,12,71,24,142                                  KJ
•9123 REM E-FLAT (D-SHARP)                           FD
•9124 X%=12:GOSUB 9190:Y%=18:GOSUB 9195              LD
•9125 DATA 62,1,125,2,251,4,247,9,239,19,
 223,39,191,79,126,159                               FB
•9126 REM G-FLAT (F-SHARP)                           HH
•9127 X%=14:GOSUB 9190:Y%=20:GOSUB 9195              HK
•9128 DATA 123,1,246,2,237,5,218,11,181,2
 3,107,47,214,94,172,189                             HG
•9129 REM A-FLAT (G-SHARP)                           HE
•9130 X%=8:GOSUB 9190:Y%=21:GOSUB 9195               GN
•9131 DATA 169,1,83,3,167,6,78,13,156,26,
 57,53,115,106,230,212                               PA
•9132 REM B-FLAT (A-SHARP)                           FP
•9133 X%=9:GOSUB 9190:Y%=15:GOSUB 9195               DD
•9134 DATA 221,1,187,3,119,7,239,14,223,2
 9,190,59,124,119,248,238                            CN
•9135 REM C-FLAT                                     CH
•9136 X%=10:GOSUB 9190                               DL
•9137 DATA 4,1,250,1,244,3,233,7,210,15,1
 65,31,75,63,151,126                                 AK
•9138 REM B-SHARP                                    IN
•9139 X%=16:GOSUB 9190                               CJ
•9140 DATA 24,2,48,4,97,8,195,16,135,33,1
 5,67,30,134,255,255                                 NM
•9185 GOTO 9200                                      FM
•9189 REM READ PITCHES                               NA
•9190 FOR I=0 TO 147 STEP 21:READ PI%(I+X
 %,0),PI%(I+X%,1):NEXT:RETURN                        FN
•9194 REM IDENTICAL PITCHES                          GA
•9195 FOR I=0 TO 147 STEP 21:PI%(I+Y%,0)=
 PI%(I+X%,0):PI%(I+Y%,1)=PI%(I+X%,1)                 LN
•9196 NEXT:RETURN                                    EJ
•9197 REM                                            JD
•9198 REM SET UP DURATIONS                           ME
•9199 REM                                            JD
•9200 FOR I=0 TO 9:READ DU%(I):NEXT                  MB
•9205 DATA 0,128,256,384,512,640,768,1024
 ,1152,1280                                          CA
•9296 REM                                            JD
•9297 REM SET FILTER AND VOLUME                      BN
•9298 REM FILTER FREQUENCY                           DE
•9299 REM LOW BYTE (0-7) X%; HIGH BYTE (0
 -255) Y%                                            PA
•9300 X%=0:Y%=100                                    GD
•9305 POKE 54293,X%:POKE 54294,Y%                    KJ
•9308 REM FILTER ON?                                 DD
•9309 REM VOICE 1 ON=1; 2 ON=2; 3 ON=4; 1
 &2 ON=3; 2&3 ON=6; ALL ON=7                         AL
•9310 X%=0                                           FM
•9318 REM FILTER RESONANCE                           CE
```

```
•9319 REM PEAK VOLUME (0=LOW, 15=HIGH)    FH
•9320 Y%=14                               JL
•9325 Y%=Y%*16:POKE 54295,X% OR Y%        MG
•9328 REM SELECT FILTER TYPE              CP
•9329 REM LOW-PASS=1;BAND-PASS=2;HIGH-PAS
 S=4;LO-BAND=3;HI-BAND=6;ALL=7            MH
•9330 X%=1                                FP
•9335 X%=X%*16                            LC
•9337 REM                                 JD
•9338 REM SELECT OVERALL VOLUME           FJ
•9339 REM 15=HIGH, 0=LOW                  PB
•9340 Y%=15                               JK
•9345 POKE 54296,X% OR Y%                 HN
•9496 REM                                 JD
•9497 REM SET MELODIES HERE               PA
•9498 REM                                 JD
•9499 REM HOW MANY VOICES? (MINUS ONE)    GN
•9500 EV%=2                               KA
•9508 REM                                 JD
•9509 REM HOW MANY PHRASES? (MINUS ONE)   MA
•9510 ES%=1                               JO
•9514 REM                                 JD
•9515 REM MELODY STRINGS                  JJ
•9516 REM                                 JD
•9517 REM EACH PHRASE HAS ONLY ONE DU%(PH
 ) STRING, NO MATTER HOW MANY VOICES      AO
•9518 REM EACH PHRASE HAS ONE ME$(PH,VC)
 & ONE MV$(PH,VC) STRING PER VOICE        IP
•9519 REM PHRASE 0                        IP
•9520 MD$(0)="[3"2"]40[4"2"]40[4"2"]8"    GK
•9521 ME$(0,0)="FFGEFGAA[c B]AGFGFEF"     JC
•9522 MV$(0,0)="5[15" "]"                 KL
•9523 ME$(0,1)="CCDCDECFGFEADAGC"         KI
•9524 MV$(0,1)="5[12" "]4 5"              PB
•9525 ME$(0,2)="FA[c B][3"C"]FD[c B]CCD[c
  B]CCA"                                  DG
•9526 MV$(0,2)="3  234  34  343 "         HP
•9529 REM PHRASE 1                        IO
•9530 MD$(1)="[3"2"]40[4"2"]4022[4"0"]402
 00228"                                   BD
•9531 ME$(1,0)="[4"C"][c B]A[4"[c B]"]AGA
 [c B]AGFA[c B]CD[c B]AGF"                JD
•9532 MV$(1,0)="6[3" "]5[14" "]6 5[3" "]" LP
•9533 ME$(1,1)="[4"A"]GF[4"G"]FEFF@F@FEFF
 GFEA"                                    IK
•9534 MV$(1,1)="43 4[3" "]3 4[3" "]3[3" "
 ]4[6" "]3"                               EO
•9535 ME$(1,2)="FAC[3"F"]CEGCBCFDC[c B]AC
 GA[c B]DCCF"                             HN
•9536 MV$(1,2)="2 32[6" "]1234 3  2  3 21
 "                                        CL
•9897 REM                                 JD
•9898 REM CONVERT STRINGS TO USABLE FORM  IG
•9899 REM                                 JD
•9900 FOR PH=0 TO ES%:FOR VC=0 TO EV%     AH
•9905 A$=ME$(PH,VC):ME$(PH,VC)=""         EC
•9910 FOR I=1 TO LEN(A$)                  OE
•9920 X%=ASC(MID$(A$,I,1))                IP
•9930 IF X%<72 THEN X%=X%-64:IF X%<0 THEN
  X%=0                                    ED
•9931 IF X%>192AND X%<200 THEN X%=X%-178  GP
•9932 IF X%=176 THEN X%=8                 IF
•9933 IF X%=191 THEN X%=9                 FN
•9934 IF X%=188 THEN X%=10                II
•9935 IF X%=172 THEN X%=11                IM
•9936 IF X%=177 THEN X%=12                LA
•9937 IF X%=187 THEN X%=13                IE
•9938 IF X%=165 THEN X%=14                HL
•9939 IF X%>21 THEN X%=0                  DL
•9950 V$=MID$(MV$(PH,VC),I,1):IF V$<>" "
 THEN Y%=21*VAL(V$)                       PG
•9960 X%=X%+Y%                            MJ
•9970 ME$(PH,VC)=ME$(PH,VC)+CHR$(X%)      OC
•9975 NEXT:NEXT:NEXT                      PI
•9980 PH=0                                HP
•9990 RETURN                              IM
```

ONE-VOICE PLAYER

```
•1 REM ONE VOICE PLAYER (FAST)            EH
•2 REM PLAYS "MEXICAN HAT DANCE"          NB
•3 REM                                    JD
•10 GOSUB 9000:GOTO 120                   LE
•60 FOR N=1 TO LEN(MD$(PH))               FJ
•61 D%=VAL(MID$(MD$(PH),N,1))             LE
•64 POKE GR,UG%:REM NORMAL NOTES; DELETE
 POKES FOR LEGATO                         IF
•65 FOR I=0 TO 1:POKE FR(I),PI%(ASC(MID$(
 ME$(PH),N,1)),I):NEXT                    JN
•66 POKE GR,G%                            NA
•67 FOR I=0 TO DU%(VAL(MID$(MD$(PH),N,1))
 ):NEXT                                   JB
•68 REM POKE GR,UG%:REM STACCATO NOTES    EE
•69 NEXT:PH=PH+1:IF PH>ES% THEN PH=0      IJ
•70 POKE GR,UG:RETURN                     NF
•100 GOSUB 60                             PC
•110 IF PEEK(653)>0 THEN END              FF
•120 PRINT "PHRASE "PH                    FC
•190 GOTO 100                             CF
•8997 REM                                 JD
•8998 REM SET UP SOUND SHAPE              FD
•8999 REM                                 JD
•9000 DIM MV$(23),MD$(23),ME$(23),FR(1)   JI
•9001 DIM DU%(9),PI%(168,1)               PB
•9007 REM                                 JD
•9008 REM ATTACK                          FE
•9009 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=SHARPER ATTACK                        OK
•9010 AK%=0                               JL
•9015 AK%=AK%*16                          DL
•9017 REM                                 JD
•9018 REM DECAY                           PJ
•9019 REM NUMBER FROM 0 TO 15; LOWER NUMB
 ER=FASTER DECLINE                        GA
•9020 DY%=5                               KF
•9027 REM                                 JD
•9028 REM SUSTAIN                         NH
```

```
ED 9029 REM NUMBER FROM 0 TO 15; LOWER NUMBER=SOFTER VOLUME DURING SUSTAIN
GP 9030 SN%=1
IF 9035 SN%=SN%*16
FN 9037 REM
II 9038 REM RELEASE
IM 9039 REM NUMBER FROM 0 TO 15; LOWER NUMBER=FASTER DROP TO SILENCE AT END
LA 9040 RE%=0
IE 9047 REM
HL 9048 REM SET SOUND ADDRESSES
DL 9049 REM
PG 9050 FR(0)=54272
MJ 9055 FR(1)=1+FR(0):GR=FR(0)+4:AD=GR+1
OC 9057 REM
PI 9058 REM POKE ADSR ENVELOPE
HP 9059 REM
IM 9060 POKE AD,AT% OR DY%
   9065 POKE AD+1,SN% OR RE%
   9066 REM
EH 9067 REM SET UP GATE
NB 9068 REM WAVEFORMS (ADD VALUES):
JD 9069 REM TRIANGLE ON=16; SAWTOOTH ON=32;
LE  PULSE ON=64 (SET WIDTH!); NOISE ON=128
FJ 9070 WF%=32
LE 9075 G%=1 OR WF%:UG%=G% AND 254
   9077 REM
IF 9078 REM SET PULSE WIDTH
   9079 REM LOW BYTE, HIGH BYTE
JN 9080 POKE GR-2,200:POKE GR-1,3
NA 9096 REM
   9097 REM SET UP PITCH ARRAY
JB 9098 REM EACH NOTE, IN ALL ITS OCTAVES
EE 9099 REM C
IJ 9100 X%=3:GOSUB 9190
NF 9101 DATA 12,1,24,2,48,4,97,8,195,16,135
PC ,33,15,67,30,134
FF 9102 REM D
FC 9103 X%=4:GOSUB 9190
CF 9104 DATA 45,1,90,2,180,4,104,9,209,18,1
JD 62,37,69,75,139,150
FD 9105 REM E (F-FLAT)
JD 9106 X%=5:GOSUB 9190:Y%=13:GOSUB 9195
JI 9107 DATA 81,1,163,2,71,5,143,10,31,21,6
PB 2,42,125,84,250,168
JD 9108 REM F (E-SHARP)
FE 9109 X%=6:GOSUB 9190:Y%=19:GOSUB 9195
   9110 DATA 102,1,204,2,152,5,48,11,96,22,
OK 193,44,131,89,6,179
JL 9111 REM G
DL 9112 X%=7:GOSUB 9190
JD 9113 DATA 145,1,35,3,71,6,143,12,30,25,6
PJ 0,50,121,100,243,200
   9114 REM A
GA 9115 X%=1:GOSUB 9190
KF 9116 DATA 195,1,134,3,12,7,24,14,49,28,9
JD 9,56,199,112,143,225
NH 9117 REM B
   9118 X%=2:GOSUB 9190
JM 9119 DATA 250,1,244,3,233,7,210,15,165,3
LL 1,75,63,151,126,46,253
HB 9120 REM D-FLAT (C-SHARP)
JD 9121 X%=11:GOSUB 9190:Y%=17:GOSUB 9195
IP 9122 DATA 28,1,56,2,112,4,225,8,195,17,1
PJ 34,35,12,71,24,142
KA 9123 REM E-FLAT (D-SHARP)
JD 9124 X%=12:GOSUB 9190:Y%=18:GOSUB 9195
JC 9125 DATA 62,1,125,2,251,4,247,9,239,19,
JD 223,39,191,79,126,159
JD 9126 REM G-FLAT (F-SHARP)
OK 9127 X%=14:GOSUB 9190:Y%=20:GOSUB 9195
CI 9128 DATA 123,1,246,2,237,5,218,11,181,2
JD 3,107,47,214,94,172,189
FE 9129 REM A-FLAT (G-SHARP)
JD 9130 X%=8:GOSUB 9190:Y%=21:GOSUB 9195
KD 9131 DATA 169,1,83,3,167,6,78,13,156,26,
GJ 57,53,115,106,230,212
JD 9132 REM B-FLAT (A-SHARP)
EN 9133 X%=9:GOSUB 9190:Y%=15:GOSUB 9195
GB 9134 DATA 221,1,187,3,119,7,239,14,223,2
   9,190,59,124,119,248,238
IL 9135 REM C-FLAT
NP 9136 X%=10:GOSUB 9190
EJ 9137 DATA 4,1,250,1,244,3,233,7,210,15,1
JD 65,31,75,63,151,126
MG 9138 REM B-SHARP
FB 9139 X%=16:GOSUB 9190
HO 9140 DATA 24,2,48,4,97,8,195,16,135,33,1
JD 5,67,30,134,255,255
DK 9150 FOR I=0 TO 147 STEP 21:PI%(I,0)=0:P
JB I%(I,1)=0:NEXT
NE 9185 GOTO 9200
BK 9189 REM READ PITCHES
   9190 FOR I=0 TO 147 STEP 21:READ PI%(I+X
IF %,0),PI%(I+X%,1):NEXT:RETURN
NH 9194 REM IDENTICAL PITCHES
PH 9195 FOR I=0 TO 147 STEP 21:PI%(I+Y%,0)=
   PI%(I+X%,0):PI%(I+Y%,1)=PI%(I+X%,1)
PA 9196 NEXT:RETURN
MH 9197 REM
DN 9198 REM SET UP DURATIONS
   9199 REM
HM 9200 FOR I=0 TO 9:READ DU%(I):NEXT
DB 9205 DATA 16,32,48,64,96,128,160,192,256
GE ,320
   9296 REM
IL 9297 REM SET FILTER AND VOLUME
NI 9298 REM FILTER FREQUENCY
AO 9299 REM LOW BYTE (0-7) X%; HIGH BYTE (0
   -255) Y%
GM 9300 X%=0:Y%=100
NC 9305 POKE 54293,X%:POKE 54294,Y%
PA 9308 REM FILTER ON?
   9309 REM VOICE 1 ON=1
PI 9310 X%=0
NF 9318 REM FILTER RESONANCE
```

```
•9319 REM PEAK VOLUME (0=LOW, 15=HIGH)    FH
•9320 Y%=14                               JL
•9325 Y%=Y%*16:POKE 54295,X% OR Y%        MG
•9328 REM SELECT FILTER TYPE              CP
•9329 REM LOW-PASS=1;BAND-PASS=2;HIGH-PAS
 S=4;LO-BAND=3;HI-BAND=6;ALL=7            MH
•9330 X%=1                                FP
•9335 X%=X%*16                            LC
•9337 REM                                 JD
•9338 REM SELECT OVERALL VOLUME           FJ
•9339 REM 15=HIGH, 0=LOW                  PB
•9340 Y%=15                               JK
•9345 POKE 54296,X% OR Y%                 HN
•9496 REM                                 JD
•9497 REM SET MELODY                      EJ
•9498 REM                                 JD
•9509 REM HOW MANY PHRASES? (MINUS ONE)   MA
•9510 ES%=5                               KC
•9514 REM                                 JD
•9515 REM MELODY STRINGS                  JJ
•9516 REM                                 JD
•9517 REM EACH PHRASE HAS ONLY ONE DU%(PH
 %) STRING, NO MATTER HOW MANY VOICES     CE
•9518 REM EACH PHRASE HAS ONE ME$(PH%,VC%
 ) & ONE MV$(PH%,VC%) STRING PER VOICE    NB
•9519 REM PHRASE 0                        IP
•9520 MD$(0)="[9"0"]4[9"0"]4"             FA
•9521 ME$(0)="G[s F]GE[s D]ECBCGEFGABCDEF
 D"                                       NL
•9522 MV$(0)="6[6" "]565[5" "]6[4" "]"    HN
•9529 REM PHRASE 1                        IO
•9530 MD$(1)="[9"0"]4[8"0"]6"             NA
•9531 ME$(1)="FEFD[s C]DB[s A]BGG[s F]GAG
 FEDC"                                    OF
•9532 MV$(1)="6[5" "]5[3" "]6[8" "]"      PF
•9539 REM PHRASE 2                        JB
•9540 MD$(2)="[7"0"]15[7"0"]15"           PN
•9541 ME$(2)="GC@GC@GC@GCDCB@CD@"         AO
•9542 MV$(2)="34 34 34 34  3 4  "         FO
•9549 REM PHRASE 3                        JA
•9550 MD$(3)="[7"0"]15[7"0"]15"           EO
•9551 ME$(3)="GB@GB@GB@GBCBA@BC@"         AA
•9552 MV$(3)="3[10" "]43[3" "]4 "         PM
•9559 REM PHRASE 4                        JD
•9560 MD$(4)="[9"1"]5[9"1"]5"             PA
•9561 ME$(4)="[3"D"][3"A"][3"C"]B[3"D"][3
 "A"][3"C"]B"                             IB
•9562 MV$(4)="5  4  5  45  4  5  4"       LG
•9569 REM PHRASE 5                        JC
•9570 MD$(5)="[9"1"]5[8"1"]8"             KK
•9571 ME$(5)="[3"D"][3"A"][3"C"]BD[s C]DE
 DCBAG"                                   KG
•9572 MV$(5)="5  4  5  45[5" "]4  "       AI
•9898 REM CONVERT STRINGS TO USABLE FORM  IG
•9899 REM                                 JD
•9900 FOR PH=0 TO ES%                     EI
•9905 A$=ME$(PH):ME$(PH)=""               JB
•9910 FOR I=1 TO LEN(A$)                  OE
•9920 X%=ASC(MID$(A$,I,1))                IP
•9930 IF X%<72 THEN X%=X%-64:IF X%<0 THEN
  X%=0                                    ED
•9931 IF X%>192AND X%<200 THEN X%=X%-178  GP
•9932 IF X%=176 THEN X%=8                 IF
•9933 IF X%=191 THEN X%=9                 FN
•9934 IF X%=188 THEN X%=10                II
•9935 IF X%=172 THEN X%=11                IM
•9936 IF X%=177 THEN X%=12                LA
•9937 IF X%=187 THEN X%=13                IE
•9938 IF X%=165 THEN X%=14                HL
•9939 IF X%>21 THEN X%=0                  DL
•9940 V$=MID$(MV$(PH),I,1):IF V$<>" " THE
 N Y%=21*VAL(V$)                          LJ
•9950 X%=X%+Y%                            MJ
•9970 ME$(PH)=ME$(PH)+CHR$(X%)            CP
•9975 NEXT:NEXT                           EF
•9980 PH=0                                HP
•9990 RETURN                              IM
```

BROKEN MELODY

```
•1 REM "BROKEN MELODY"                    JC
•2 REM THREE VOICES WAIT FOR USER INPUT B
 ETWEEN PHRASES                           HL
•3 REM USE THIS ROUTINE FOR A SERIES OF R
 EWARDS                                   NG
•4 REM                                    JD
•5 REM PLAYS "I'M ON MY WAY" (FROM "PAINT
  YOUR WAGON" BY LERNER & LOEWE)          MK
•6 REM                                    JD
•10 GOSUB 9000:GOTO 100                   LC
•60 FOR N=1 TO LEN(MD$(PH))               FJ
•61 FOR VC=0 TO EV%                       GG
•62 POKE GR(VC),UG%(VC):REM NORMAL NOTES;
  DON'T POKE UG% FOR LEGATO               AE
•63 FOR I=0 TO 1                          JB
•64 POKE FR(VC,I),PI%(ASC(MID$(ME$(PH,VC)
 ,N,1)),I)                                BD
•65 NEXT:NEXT                             EF
•66 FOR VC=EV% TO 0 STEP -1:POKE GR(VC),G
 %(VC):NEXT                               MB
•67 FOR I=0 TO DU%(VAL(MID$(MD$(PH),N,1))
 ):NEXT                                   JB
•68 REM FOR VC=0 TO EV%:POKE GR(VC),UG%(V
 C):NEXT:REM STACCATO NOTES               BO
•69 NEXT:PH=PH+1:IF PH>ES% THEN PH=0      IJ
•70 FOR VC=0 TO EV%:POKE GR(VC),UG%(VC):N
 EXT:RETURN                               EP
•100 PRINT "PRESS SHIFT FOR PHRASE "PH    JB
•110 PRINT "ANY OTHER KEY TO STOP"        LG
•120 IF PEEK(203)<>64 THEN END            DG
•130 IF PEEK(653)=0 THEN 120              GC
•140 GOSUB 60                             PC
•190 GOTO 100                             CF
•8997 REM                                 JD
•8998 REM SET UP SOUND SHAPE              FD
•8999 REM                                 JD
•9000 DIM MD$(23),ME$(23,2),MV$(23,2),G%(
```

```
IP  2),GR(2),FR(2,1),AD(2)
EN  ·9001 DIM DU%(9),PI%(168,1),AK%(2),DY%(2)
ED  ,SN%(2),RE%(2),WF%(2)
GP  ·9007 REM
IF  ·9008 REM ATTACK--VOICES 0,1,2
FN  ·9009 REM NUMBER FROM 0 TO 15; LOWER NUMB
II  ER=SHARPER ATTACK
IM  ·9010 AK%(0)=0:AK%(1)=0:AK%(2)=0
LA  ·9015 FOR I=0 TO 2:AK%(I)=AK%(I)*16:NEXT
IE  ·9017 REM
HL  ·9018 REM DECAY--VOICES 0,1,2
DL  ·9019 REM NUMBER FROM 0 TO 15; LOWER NUMB
E   ER=FASTER DECLINE
LJ  ·9020 DY%(0)=7:DY%(1)=3:DY%(2)=3
MJ  ·9027 REM
CP  ·9028 REM SUSTAIN--VOICES 0,1,2
EF  ·9029 REM NUMBER FROM 0 TO 15; LOWER NUMB
HP  ER=SOFTER VOLUME DURING SUSTAIN
IM  ·9030 SN%(0)=0:SN%(1)=0:SN%(2)=0
    ·9035 FOR I=0 TO 2:SN%(I)=SN%(I)*16:NEXT
Y   ·9037 REM
JC  ·9038 REM RELEASE--VOICES 0,1,2
B   ·9039 REM NUMBER FROM 0 TO 15; LOWER NUMB
HL  ER=FASTER DROP TO SILENCE AT END
R   ·9040 RE%(0)=0:RE%(1)=3:RE%(2)=5
NG  ·9047 REM
JD  ·9048 REM SET SOUND ADDRESSES
T   ·9049 REM
MK  ·9050 FR(0,0)=54272:FR(1,0)=54279:FR(2,0)
JD  =54286
LC  ·9055 FOR I=0 TO 2:FR(I,1)=1+FR(I,0):GR(I
FJ  )=FR(I,0)+4:AD(I)=GR(I)+1:NEXT
GG  ·9057 REM
;   ·9058 REM POKE ADSR ENVELOPES
AE  ·9059 REM
JB  ·9060 FOR I=0 TO 2:POKE AD(I),AT%(I) OR D
)   Y%(I)
BD  ·9065 POKE AD(I)+1,SN%(I) OR RE%(I):NEXT
EF  ·9066 REM
G   ·9067 REM SET UP GATES
MB  ·9068 REM WAVEFORMS, VOICES 0,1,2 (ADD VA
)   LUES):
JB  ·9069 REM TRIANGLE ON=16; SAWTOOTH ON=32;
V    PULSE ON=64 (SET WIDTH!); NOISE ON=128
BO  ·9070 WF%(0)=32:WF%(1)=64:WF%(2)=64
IJ  ·9075 FOR I=0 TO 2:G%(I)=1 OR WF%(I):UG%(
N   I)=G%(I)AND 254:NEXT
EP  ·9077 REM
JB  ·9078 REM SET PULSE WIDTHS
LG  ·9079 REM VOICES 0,1,2; LOW BYTE, HIGH BY
DG  TE
GC  ·9080 POKE GR(0)-2,200:POKE GR(0)-1,3
PC  ·9081 POKE GR(1)-2,200:POKE GR(1)-1,3
CF  ·9082 POKE GR(2)-2,200:POKE GR(2)-1,3
JD  ·9096 REM
FD  ·9097 REM SET UP PITCH ARRAY
JD  ·9098 REM EACH NOTE, IN ALL ITS OCTAVES
(   ·9099 REM C
CF  ·9100 X%=3:GOSUB 9190
    ·9101 DATA 12,1,24,2,48,4,97,8,195,16,135
OF  ,33,15,67,30,134
JD  ·9102 REM D
KG  ·9103 X%=4:GOSUB 9190
    ·9104 DATA 45,1,90,2,180,4,104,9,209,18,1
OK  62,37,69,75,139,150
CP  ·9105 REM E (F-FLAT)
FF  ·9106 X%=5:GOSUB 9190:Y%=13:GOSUB 9195
JD  ·9107 DATA 81,1,163,2,71,5,143,10,31,21,6
PK  2,42,125,84,250,168
    ·9108 REM F (E-SHARP)
GA  ·9109 X%=6:GOSUB 9190:Y%=19:GOSUB 9195
AN  ·9110 DATA 102,1,204,2,152,5,48,11,96,22,
JD  193,44,131,89,6,179
FC  ·9111 REM G
    ·9112 X%=7:GOSUB 9190
JM  ·9113 DATA 145,1,35,3,71,6,143,12,30,25,6
EG  0,50,121,100,243,200
BD  ·9114 REM A
JD  ·9115 X%=1:GOSUB 9190
OK  ·9116 DATA 195,1,134,3,12,7,24,14,49,28,9
    9,56,199,112,143,225
PJ  ·9117 REM B
BG  ·9118 X%=2:GOSUB 9190
JD  ·9119 DATA 250,1,244,3,233,7,210,15,165,3
JC  1,75,63,151,126,46,253
JD  ·9120 REM D-FLAT (C-SHARP)
    ·9121 X%=11:GOSUB 9190:Y%=17:GOSUB 9195
PG  ·9122 DATA 28,1,56,2,112,4,225,8,195,17,1
    34,35,12,71,24,142
HJ  ·9123 REM E-FLAT (D-SHARP)
JD  ·9124 X%=12:GOSUB 9190:Y%=18:GOSUB 9195
JL  ·9125 DATA 62,1,125,2,251,4,247,9,239,19,
JD  223,39,191,79,126,159
    ·9126 REM G-FLAT (F-SHARP)
EN  ·9127 X%=14:GOSUB 9190:Y%=20:GOSUB 9195
DK  ·9128 DATA 123,1,246,2,237,5,218,11,181,2
JD  3,107,47,214,94,172,189
JN  ·9129 REM A-FLAT (G-SHARP)
    ·9130 X%=8:GOSUB 9190:Y%=21:GOSUB 9195
DJ  ·9131 DATA 169,1,83,3,167,6,78,13,156,26,
    57,53,115,106,230,212
IL  ·9132 REM B-FLAT (A-SHARP)
LH  ·9133 X%=9:GOSUB 9190:Y%=15:GOSUB 9195
    ·9134 DATA 221,1,187,3,119,7,239,14,223,2
AB  9,190,59,124,119,248,238
JD  ·9135 REM C-FLAT
AC  ·9136 X%=10:GOSUB 9190
    ·9137 DATA 4,1,250,1,244,3,233,7,210,15,1
MG  65,31,75,63,151,126
JD  ·9138 REM B-SHARP
LD  ·9139 X%=16:GOSUB 9190
EP  ·9140 DATA 24,2,48,4,97,8,195,16,135,33,1
JD  5,67,30,134,255,255
DK  ·9185 GOTO 9200
JB  ·9189 REM READ PITCHES
NE  ·9190 FOR I=0 TO 147 STEP 21:READ PI%(I+X
```

```
%,0),PI%(I+X%,1):NEXT:RETURN                                    FN
·9194 REM IDENTICAL PITCHES                                      GA
·9195 FOR I=0 TO 147 STEP 21:PI%(I+Y%,0)=
 PI%(I+X%,0):PI%(I+Y%,1)=PI%(I+X%,1)                             LN
·9196 NEXT:RETURN                                                EJ
·9197 REM                                                        JD
·9198 REM SET UP DURATIONS                                       ME
·9199 REM                                                        JD
·9200 FOR I=0 TO 9:READ DU%(I):NEXT                              MB
·9205 DATA 10,128,256,384,512,640,768,102
 4,1152,1280                                                     KF
·9296 REM                                                        JD
·9297 REM SET FILTER AND VOLUME                                  BN
·9298 REM FILTER FREQUENCY                                       DE
·9299 REM LOW BYTE (0-7) X%; HIGH BYTE (0
 -255) Y%                                                        PA
·9300 X%=0:Y%=100                                                GD
·9305 POKE 54293,X%:POKE 54294,Y%                                KJ
·9308 REM FILTER ON?                                             DD
·9309 REM VOICE 1 ON=1; 2 ON=2; 3 ON=4; 1
 &2 ON=3; 2&3 ON=6; ALL ON=7                                     AL
·9310 X%=0                                                       FM
·9318 REM FILTER RESONANCE                                       CE
·9319 REM PEAK VOLUME (0=LOW, 15=HIGH)                           FH
·9320 Y%=14                                                      JL
·9325 Y%=Y%*16:POKE 54295,X% OR Y%                               MG
·9328 REM SELECT FILTER TYPE                                     CP
·9329 REM LOW-PASS=1;BAND-PASS=2;HIGH-PAS
 S=4;LO-BAND=3;HI-BAND=6;ALL=7                                   MH
·9330 X%=1                                                       FP
·9335 X%=X%*16                                                   LC
·9337 REM                                                        JD
·9338 REM SELECT OVERALL VOLUME                                  FJ
·9339 REM 15=HIGH, 0=LOW                                         PB
·9340 Y%=15                                                      JK
·9345 POKE 54296,X% OR Y%                                        HN
·9496 REM                                                        JD
·9497 REM SET MELODIES HERE                                      PA
·9498 REM                                                        JD
·9499 REM HOW MANY VOICES? (MINUS ONE)                           GN
·9500 EV%=2                                                      KA
·9508 REM                                                        JD
·9509 REM HOW MANY PHRASES? (MINUS ONE)                          MA
·9510 ES%=8                                                      KH
·9514 REM                                                        JD
·9515 REM MELODY STRINGS                                         JJ
·9516 REM                                                        JD
·9517 REM EACH PHRASE HAS ONLY ONE DU%(PH
 ) STRING, NO MATTER HOW MANY VOICES                             AO
·9518 REM EACH PHRASE HAS ONE ME$(PH,VC)
 & ONE MV$(PH,VC) STRING PER VOICE                               IP
·9519 REM PHRASE 0                                               IP
·9520 MD$(0)="[16"0"]"                                           LE
·9521 ME$(0,0)="[3"F"]GAFG@[3"F"]GAFGE"                          AD
·9522 MV$(0,0)="6[15" "]"                                        KK
·9523 ME$(0,1)="CCDCGD[4"C"]DCGDCC"                              JN
·9524 MV$(0,1)="4545354545453545"                                PG
·9525 ME$(0,2)="FAEAGBC[c B]FADAGBC[c B]"                        NH
·9526 MV$(0,2)="3434343434343434"                                GH
·9529 REM PHRASE 1                                               IO
·9530 MD$(1)="[16"0"]"                                           KL
·9531 ME$(1,0)="[3"F"]GAFGEF[7"@"]"                              OL
·9532 MV$(1,0)="6[15" "]"                                        NL
·9533 ME$(1,1)="FCECDBCCFCECDACA"                                PJ
·9534 MV$(1,1)="45454  545454  5"                                JH
·9535 ME$(1,2)="FAEADBC[c B]FAEADFCF"                            CM
·9536 MV$(1,2)="3434343434343435"                                DH
·9539 REM PHRASE 2                                               JB
·9540 MD$(2)="[16"0"]"                                           LC
·9541 ME$(2,0)="[3"[c B]"]CD[c B]C@[3"[c
 B]"]CD[c B]CA"                                                  IL
·9542 MV$(2,0)="6  7 67 6  7 676"                                GM
·9543 ME$(2,1)="@F@FCGFF@F@FCGFF"                                MD
·9544 MV$(2,1)=" 5  4545[4" "]4545"                              HE
·9545 ME$(2,2)="[c B]DGDCEF[c E][c B]DGDC
 EF[c E]"                                                        KA
·9546 MV$(2,2)="3535353535353535"                                KB
·9549 REM PHRASE 3                                               JA
·9550 MD$(3)="[14"0"]"                                           CM
·9551 ME$(3,0)="[3"[c B]"]CD[c B]CA[c B][
 5"@"]"                                                          MC
·9552 MV$(3,0)="6  7 676[6" "]"                                  MA
·9553 ME$(3,1)="[c B]FAFGEFF[c B]FAFGF"                          JM
·9554 MV$(3,1)="45454545454545"                                  LF
·9555 ME$(3,2)="[c B]DADGCF[c E][c B]DADG
 D"                                                              MA
·9556 MV$(3,2)="35353535353535"                                  NJ
·9559 REM PHRASE 4                                               JD
·9560 MD$(4)="[16"0"]"                                           DA
·9561 ME$(4,0)="F[c B]C@C[3"@"]D[c B]C[5"
 @"]"                                                            PF
·9562 MV$(4,0)="6 7[6" "]67[5" "]"                               CF
·9563 ME$(4,1)="[3"F"]AG[c B]AADGFAG[c B]
 AA"                                                             NK
·9564 MV$(4,1)="45454545 4 54545"                                LH
·9565 ME$(4,2)="FDFFGEAF[c B][3"F"]GEAF"                         JH
·9566 MV$(4,2)="3535353534353535"                                DK
·9569 REM PHRASE 5                                               JC
·9570 MD$(5)="[18"0"]"                                           AO
·9571 ME$(5,0)="CFG@G@@GAFG[7"@"]"                               EC
·9572 MV$(5,0)="6[17" "]"                                        OG
·9573 ME$(5,1)="@BGEGFGE@BFECCAFGC"                              MA
·9574 MV$(5,1)=" 4 54545 4 5453[3" "]"                           NN
·9575 ME$(5,2)="@AECDBECGACFC[c B]AFGF"                          BI
·9576 MV$(5,2)=" 4 54  534343 2  1"                              MA
·9579 REM PHRASE 6                                               JF
·9580 MD$(6)="[16"0"]"                                           NO
·9581 ME$(6,0)="[3"F"]GAFG@[3"F"]GAFGE"                          OB
·9582 MV$(6,0)="6[15" "]"                                        NA
·9583 ME$(6,1)="CCDCGD[4"C"]DCGDCC"                              KD
·9584 MV$(6,1)="4545354545453545"                                EM
·9585 ME$(6,2)="FAEAGBC[c B]FADAGBC[c B]"                        ON
·9586 MV$(6,2)="3434343434343434"                                FF
·9589 REM PHRASE 7                                               JE
·9590 MD$(7)="[15"0"]"                                           IE
·9591 ME$(7,0)="[3"F"]GAFGEC[3"@"]C@@"                           IG
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering ***Ahoy!*** programs. Refer to these pages **before** entering any programs!

```
GH •9592 MV$(7,0)="6[11" "]7  "
IO •9593 ME$(7,1)="FCECDBCC@A@[c B]CF@"
KL •9594 MV$(7,1)="45454  5 4  5  "
OL •9595 ME$(7,2)="FAEADBC[c B]FFGRA[c E]@"
NL •9596 MV$(7,2)="34343434343435 "
PJ •9599 REM PHRASE 8
JH •9600 MD$(8)="[17"0"]"
CM •9601 ME$(8,0)="DC@C[c B]AFGDF[3"@"]F[3"@
DH "]"
JB •9602 MV$(8,0)="7[3" "]6[8" "]7[3" "]"
LC •9603 ME$(8,1)="[c B]CACA@C@CFDC[c B]A@F@
IL "
GM •9604 MV$(8,1)="5[8" "]46 5  4 "
MD •9605 ME$(8,2)="DCFCFCAC[c B]F[c B]AGF@F@
HE "
KA •9606 MV$(8,2)="545354 3435[4" "]3 "
KB •9897 REM
JA •9898 REM CONVERT STRINGS TO USABLE FORM
CM •9899 REM
MC •9900 FOR PH=0 TO ES%:FOR VC=0 TO EV%
MA •9905 A$=ME$(PH,VC):ME$(PH,VC)=""
JM •9910 FOR I=1 TO LEN(A$)
LF •9920 X%=ASC(MID$(A$,I,1))
•9930 IF X%<72 THEN X%=X%-64:IF X%<0 THEN
ED X%=0
MA •9931 IF X%>192AND X%<200 THEN X%=X%-178
NJ •9932 IF X%=176 THEN X%=8
JD •9933 IF X%=191 THEN X%=9
DA •9934 IF X%=188 THEN X%=10
•9935 IF X%=172 THEN X%=11
PF •9936 IF X%=177 THEN X%=12
CF •9937 IF X%=187 THEN X%=13
•9938 IF X%=165 THEN X%=14
NK •9939 IF X%>21 THEN X%=0
LH •9950 V$=MID$(MV$(PH,VC),I,1):IF V$<>" "
JH THEN Y%=21*VAL(V$)
DK •9960 IF X%<>0 THEN X%=X%+Y%
JC •9970 ME$(PH,VC)=ME$(PH,VC)+CHR$(X%)
AO •9975 NEXT:NEXT:NEXT
EC •9980 PH=0
OG •9990 RETURN
MA
NN
BI
```

QUAD-PRINT

FROM PAGE 47 **MENU**

```
MA
JF •5 PRINT"[CLEAR][DOWN][RVSON][BLACK] QUAD
NO  PRINT (C) 1984 BY MICHAEL BEUTJER "
OB •10 POKE55,0:POKE56,28
NA •20 PRINT"[3"[DOWN]"][WHITE]SELECT YOUR P
KD RINTER TYPE.[DOWN][DOWN]"
EM •30 PRINT"PRESS F1 FOR EPSON RX/FX 80 OR
ON 100."
FF •40 PRINT"[DOWN]PRESS F3 FOR COMMODORE 15
JE 26."
IE •50 GETA$:IFA$=""THEN50
IG •60 IFASC(A$)=133THENB$="QP E*":PRINT"[CL
LF EAR][10"[DOWN]"][6" "]LOADING EPSON/GEMI
BP NI VERSION"
AL •70 IFASC(A$)=134THENB$="QP C*":PRINT"[CL
MK EAR][10"[DOWN]"][5" "]LOADING COMMODORE
LM 1526 VERSION"
JH •75 IFB$=""THEN50
EG •80 POKE53280,6:POKE53281,14:PRINT"[HOME]
[c 7][3"[DOWN]"]LOAD"CHR$(34)B$CHR$(34)"
KN ,8"
BN •90 PRINT"[HOME]":POKE198,5:FORX=0TO4:REA
DA:POKE631+X,A:NEXT:END
CL •500 DATA13,31,82,213,13
CA
```

1526 VERSION

```
EB •5 PRINT"[CLEAR][4"[DOWN]"][8" "]INITIALI
JH ZING[3"."]"
JD •10 GOSUB570
IG •20 POKE53280,0:POKE53281,0:POKE646,15:PR
JD INT"[CLEAR][DOWN][DOWN][12" "]QUAD-PRINT
AH  1526"
EC •30 DIMB$(4):PRINT"[DOWN][9" "](C) 1984 B
OE Y M. BEUTJER"
IP •40 IFB=0THENB=1:GOTO70
•50 PRINT"[CLEAR][DOWN] PIC 1 (UPPER LEFT
ED  ) : "B$(1):PRINT" PIC 2 (UPPER RIGHT) :
GP  "B$(2)
IF •60 PRINT" PIC 3 (LOWER LEFT ) : "B$(3):P
FN RINT" PIC 4 (LOWER RIGHT) : "B$(4)
II •70 PRINT"[DOWN][RIGHT][RVSON]  F1 = DISP
IM LAY 1 [RVSOFF][5" "][RVSON]  F2 = LOAD 1
LA [3" "]"
IE •80 PRINT"[DOWN][RIGHT][RVSON]  F3 = DISP
HL LAY 2 [RVSOFF][5" "][RVSON]  F4 = LOAD 2
DL [3" "]"
•90 PRINT"[DOWN][RIGHT][RVSON]  F5 = DISP
PG LAY 3 [RVSOFF][5" "][RVSON]  F6 = LOAD 3
CK [3" "]"
OC •100 PRINT"[DOWN][RIGHT][RVSON]  F7 = DIS
PI PLAY 4 [RVSOFF][5" "][RVSON]  F8 = LOAD
HP 4[3" "]"
IM •110 PRINT"[DOWN][RIGHT][RVSON]  [EP]  =
DUMP POS  [RVSOFF][5" "][RVSON]  [BACKAR
ROW]  = DUMP NEG "
•120 PRINT"[DOWN][RIGHT][5" "][RVSON][3"
"]*  = QUICK VIEW SCREENS "
•130 PRINT"[DOWN][RIGHT][5" "][RVSON][3"
AH "]@  = SWAP SCREENS[7" "]"
CE •140 PRINT"[DOWN][RIGHT][5" "][RVSON][3"
"][UPARROW]  = SINGLE PRINT[7" "][DOWN]"
PN •150 GETA$:IFA$<>""THEN150
AO •160 GETA$:IFA$=""THEN160
HK •170 A=ASC(A$)
GE •180 IFA=92THENSYS49209:GOTO40
EG •190 IFA=95THENSYS49205:GOTO40
GL •200 IFA=42THENA=1:GOSUB540:SYS49430:SYS4
FO 9188:GOTO300
BD
```

```
•210 IFA=64THEN330                                          CL
•220 IFA=94THEN550                                          DI
•230 IFA<133THEN160                                         EE
•240 IFA>140THEN160                                         FK
•250 A=A-132:IFA>4THENGOSUB460:GOTO40                       IB
•260 GOSUB540:SYS49430:SYS49188                             MC
•270 GETA$:IFA$<>""THEN270                                  DB
•280 GETA$:IFA$=""THEN280                                   HJ
•290 SYS49188:GOTO40                                        OB
•300 GETA$:A=ASC(A$+CHR$(0)):IFA=32THENSY
S49188:GOTO40                                               HO
•310 IFA<133ORA>136THEN300                                  MB
•320 A=A-132:GOSUB540:SYS49430:GOTO300                      BI
•330 PRINT"ENTER THE NUMBERS OF THE SCREE
NS"                                                         JB
•340 PRINT"YOU WANT TO SWAP (1-4)."                         NL
•350 INPUT"1ST SCREEN : ";A                                 IC
•360 INPUT"2ND SCREEN : ";B                                 HP
•370 IFA<1ORA>4ORB<1ORB>4THEN330                            IJ
•380 GOSUB540:SYS49430                                      AJ
•390 POKE49153,16*(2+A*2):POKE49152,16*(2
+B*2)                                                       AN
•400 POKE49155,224+(B-1)*4:POKE49154,224+
(A-1)*4                                                     LK
•410 SYS49430                                               JI
•420 POKE49152,32:POKE49153,16*(2+B*2):PO
KE49155,224+(A-1)*4:POKE49154,4                             JE
•430 SYS49430                                               JI
•440 A$=B$(A):B$(A)=B$(B):B$(B)=A$                          JG
•450 GOTO40                                                 PE
•460 REM  GET FILENAME AND LOAD IT.                         NO
•470 A=A-4:PRINT" ENTER FILENAME OF PIC"A
": ";:INPUTA$                                               AB
•480 IFLEN(A$)>16THEN470                                    JM
•490 B$(A)=A$                                               AE
•500 POKE49156,LEN(A$):POKE49152,32:POKE4
9153,16*(2+A*2)                                             OF
•520 FORX=1TOLEN(A$):POKE49156+X,ASC(MID$
(A$,X,1)):NEXT                                              NF
•530 SYS49394:POKE49155,224+(A-1)*4:POKE4
9154,28:SYS49430:RETURN                                     NB
•540 POKE49153,32:POKE49152,16*(2+A*2):PO
KE49154,224+(A-1)*4:POKE49155,4:RETURN                      MC
•550 INPUT"ENTER NO. OF PICTURE TO PRINT
(1-4) : ";A                                                 NB
•555 PRINT"PRESS P FOR POSITIVE, N FOR NE
GATIVE "                                                    DO
•560 GETA$:IFA$<"N"ORA$>"P"THEN560                          CF
•562 P=49788:IFA$="P"THENP=49792                            DF
•565 POKE49152,16*(2+A*2):SYSP:GOTO40                       PB
•570 I=49152                                                AJ
•580 READ A:IF A=256 THEN RETURN                            HN
•590 POKE I,A:I=I+1:GOTO580                                 CD
•600 DATA 0,0,0,0,0,60,162,0                                OH
•610 DATA 32,126,197,169,76,44,169,96                       LH
•620 DATA 133,138,169,44,133,0,0,0                          MD
•630 DATA 0,0,0,0,0,0,0,0                                   FG
•640 DATA 0,0,0,0,173,17,208,73                             II
•650 DATA 32,141,17,208,173,24,208,73                       IK
•660 DATA 8,141,24,208,96,169,255,208                       NP
•670 DATA 2,169,0,141,33,192,32,117                         ND
•680 DATA 193,169,0,133,251,169,64,133                      EM
•690 DATA 252,169,0,141,32,192,169,96                       KH
•700 DATA 141,31,192,169,25,141,29,192                      HJ
•710 DATA 32,121,192,169,0,133,251,169                      DD
•720 DATA 128,133,252,169,0,141,32,192                      DH
•730 DATA 169,160,141,31,192,169,25,141                     GD
•740 DATA 29,192,32,121,192,32,45,194                       IA
•750 DATA 96,32,197,193,32,178,192,165                      OI
•760 DATA 251,72,165,252,72,173,32,192                      CE
•770 DATA 133,251,173,31,192,133,252,32                     PE
•780 DATA 178,192,165,251,141,32,192,165                    HF
•790 DATA 252,141,31,192,104,133,252,104                    PH
•800 DATA 133,251,32,225,255,208,5,104                      DG
•810 DATA 104,76,117,192,206,29,192,208                     LP
•820 DATA 200,96,169,40,141,30,192,160                      EM
•830 DATA 0,162,0,120,169,46,133,1                          LJ
•840 DATA 177,251,141,34,192,169,47,133                     PH
•850 DATA 1,88,14,34,192,62,21,192                          LJ
•860 DATA 232,224,8,208,245,200,192,8                       EE
•870 DATA 208,223,24,165,251,105,8,133                      HJ
•880 DATA 251,165,252,105,0,133,252,162                     DN
•890 DATA 0,32,219,193,206,30,192,208                       HL
•900 DATA 198,96,169,1,162,8,160,0                          ED
•910 DATA 32,186,255,173,4,192,162,5                        JD
•920 DATA 160,192,32,189,255,169,0,170                      LP
•930 DATA 160,28,32,213,255,169,1,32                        DO
•940 DATA 195,255,32,204,255,96,160,0                       JC
•950 DATA 132,251,174,1,192,134,252,132                     OJ
•960 DATA 253,174,0,192,134,254,142,34                      FG
•970 DATA 192,238,34,192,200,192,32,208                     NA
•980 DATA 248,160,0,120,169,46,133,1                        FE
•990 DATA 177,253,145,251,169,47,133,1                      GD
•1000 DATA 88,200,208,239,230,252,230,254                   LG
•1010 DATA 165,254,205,34,192,208,228,173                   EE
•1020 DATA 3,192,133,252,173,2,192,133                      AB
•1030 DATA 254,162,4,120,169,40,133,1                       HP
•1040 DATA 177,253,145,251,200,208,249,23
0                                                           GL
•1050 DATA 252,230,254,202,208,242,169,47                   GG
•1060 DATA 133,1,88,96,0,169,4,170                          MB
•1070 DATA 160,255,32,186,255,169,0,32                      IA
•1080 DATA 189,255,32,192,255,176,40,169                    NE
•1090 DATA 6,168,162,4,32,186,255,169                       KI
•1100 DATA 0,32,189,255,32,192,255,176                      PK
•1110 DATA 22,169,5,168,162,4,32,186                        AK
•1120 DATA 255,169,0,32,189,255,32,192                      EG
•1130 DATA 255,176,4,32,176,193,24,96                       CB
•1140 DATA 162,6,32,201,255,169,21,32                       KH
•1150 DATA 210,255,169,13,32,210,255,32                     FL
•1160 DATA 174,255,32,204,255,162,4,32                      DD
•1170 DATA 201,255,169,13,32,210,255,32                     DJ
•1180 DATA 174,255,32,204,255,169,0,141                     DO
•1190 DATA 116,193,96,32,93,194,240,105                     KC
•1200 DATA 162,4,32,201,255,169,141,32                      FK
•1210 DATA 210,255,32,174,255,32,204,255                    DM
```

```
•1220 I
•1230 I
•1240 I
•1250 I
•1260 I
•1270 I
•1280 I
•1290 I
•1300 I
•1310 I
•1320 I
•1330 I
•1340 I
•1350 I
•1360 I
•1370 I
•1380 I
•1390 I
•1400 I
•1410 I
•1420 I
•1430 I
•1440 I
•1450 I
```

Program
tory arti

```
•5 PRIN
 ZING[3
•10 GOS
•20 POK
 INT"[C
 "
•30 DIM
 Y M. B
•40 IFB
•50 PRI
  ) : "
  "B$(2
•60 PRI
 RINT"
•70 PRI
 LAY 1
 [3" "]
•80 PRI
 LAY 2
 [3" "]
•90 PRI
 LAY 3
 [3" "]
•100 PR
 PLAY 4
 4[3" "
•110 PR
 DUMP P
 ROW]
•120 PR
```

```
IK 1220 DATA 162,5,32,201,255,162,0,189
NP 1230 DATA 21,192,77,33,192,32,210,255
ND 1240 DATA 232,224,8,208,242,32,174,255
EM 1250 DATA 162,4,32,201,255,174,116,193
KH 1260 DATA 240,9,169,32,32,210,255,202
HJ 1270 DATA 76,16,194,238,116,193,169,254
DD 1280 DATA 32,210,255,32,174,255,32,204
DH 1290 DATA 255,32,109,194,96,32,197,193
GD 1300 DATA 162,6,32,201,255,169,24,32
IA 1310 DATA 210,255,169,13,32,210,255,32
OI 1320 DATA 174,255,32,204,255,32,231,255
CE 1330 DATA 96,162,4,32,201,255,169,254
PE 1340 DATA 32,210,255,32,174,255,32,204
5 HF 1350 DATA 255,238,116,193,96,162,0,189
4 PH 1360 DATA 21,192,221,123,194,208,5,232
DG 1370 DATA 224,8,208,243,96,162,0,189
LP 1380 DATA 21,192,157,123,194,232,224,8
EM 1390 DATA 208,245,96,0,169,255,208,2
LJ 1400 DATA 169,0,141,33,192,32,117,193
PH 1410 DATA 169,0,133,251,173,0,192,133
LJ 1420 DATA 252,169,25,141,29,192,32,197
EE 1430 DATA 193,32,178,192,32,225,255,208
HJ 1440 DATA 3,76,169,194,206,29,192,208
DN 1450 DATA 237,32,45,194,96,256
HL
```

EPSON/GEMINI VERSION

Program as listed is for Epson printers. See introductory article for changes required for Gemini printers.

```
ED
JD
LP
DO 5 PRINT"[CLEAR][4"[DOWN]"][8" "]INITIALI
JC ZING[3"."]"                                  CE
OJ 10 GOSUB540                                  DB
FG 20 POKE53280,0:POKE53281,0:POKE646,15:PR
NA INT"[CLEAR][DOWN][DOWN][14" "]QUAD-PRINT
FE "                                            NE
GD 30 DIMB$(4):PRINT"[DOWN][9" "](C) 1984 B
54 LG Y M. BEUTJER"                             KK
73 EE 40 IFB=0THENB=1:GOTO70                    MM
AB 50 PRINT"[CLEAR][DOWN] PIC 1 (UPPER LEFT
HP  ) : "B$(1):PRINT" PIC 2 (UPPER RIGHT) :
23  "B$(2)                                      MF
GL 60 PRINT" PIC 3 (LOWER LEFT ) : "B$(3):P
47 GG RINT" PIC 4 (LOWER RIGHT) : "B$(4)        EP
MB 70 PRINT"[DOWN][RIGHT][RVSON]  F1 = DISP
IA LAY 1 [RVSOFF][5" "][RVSON]  F2 = LOAD 1
9 NE [3" "]"                                    NN
KI 80 PRINT"[DOWN][RIGHT][RVSON]  F3 = DISP
PK LAY 2 [RVSOFF][5" "][RVSON]  F4 = LOAD 2
AK [3" "]"                                      FJ
EG 90 PRINT"[DOWN][RIGHT][RVSON]  F5 = DISP
CB LAY 3 [RVSOFF][5" "][RVSON]  F6 = LOAD 3
KH [3" "]"                                      PB
FL 100 PRINT"[DOWN][RIGHT][RVSON]  F7 = DIS
DD PLAY 4 [RVSOFF][5" "][RVSON]  F8 = LOAD
DJ 4[3" "]"                                     CF
DO 110 PRINT"[DOWN][RIGHT][RVSON]  [EP]  =
KC DUMP POS  [RVSOFF][5" "][RVSON]  [BACKAR
FK ROW]  = DUMP NEG "                           DM
5 DM 120 PRINT"[DOWN][RIGHT][5" "][RVSON][3"
```

```
AH "]*  = QUICK VIEW SCREENS "                  OC
LN 130 PRINT"[DOWN][RIGHT][5" "][RVSON][3"
NN "]@  = SWAP SCREENS[7" "][DOWN]"             GL
JJ 140 GETA$:IFA$<>""THEN140                    AL
FE 150 GETA$:IFA$=""THEN150                     HN
DI 160 A=ASC(A$)                                GE
GJ 170 IFA=92THENSYS49209:GOTO40                EG
IE 180 IFA=95THENSYS49205:GOTO40                GL
MC 190 IFA=42THENA=1:GOSUB520:SYS49490:SYS4
FL 9188:GOTO280                                 FO
MJ 200 IFA=64THEN310                            CF
OJ 210 IFA<133THEN150                           EH
GJ 220 IFA>140THEN150                           FN
CP 230 A=A-132:IFA>4THENGOSUB440:GOTO40         FD
PP 240 GOSUB520:SYS49490:SYS49188               AK
FF 250 GETA$:IFA$<>""THEN250                    CP
JC 260 GETA$:IFA$=""THEN260                     HH
MO 270 SYS49188:GOTO40                          OB
LH 280 GETA$:A=ASC(A$+CHR$(0)):IFA=32THENSY
LB S49188:GOTO40                                HO
OM 290 IFA<133ORA>136THEN280                    LI
CH 300 A=A-132:GOSUB520:SYS49490:GOTO280        NP
IN 310 PRINT"ENTER THE NUMBERS OF THE SCREE
NF NS"                                          JB
NL 320 PRINT"YOU WANT TO SWAP (1-4)."           NL
IC 330 INPUT"1ST SCREEN : ";A                   IC
HP 340 INPUT"2ND SCREEN : ";B                   HP
ID 350 IFA<1ORA>4ORB<1ORB>4THEN310              ID
AB 360 GOSUB520:SYS49490                        AB
CE 370 POKE49153,16*(2+A*2):POKE49152,16*(2
DB +B*2)                                        AN
LK 380 POKE49155,224+(B-1)*4:POKE49154,224+
   (A-1)*4                                      KG
KG 390 SYS49490                                 JE
JE 400 POKE49152,32:POKE49153,16*(2+B*2):PO
   KE49155,224+(A-1)*4:POKE49154,4              KG
KG 410 SYS49490                                 JG
JG 420 A$=B$(A):B$(A)=B$(B):B$(B)=A$            PE
PE 430 GOTO40                                   NO
NO 440 REM  GET FILENAME AND LOAD IT.           AB
AB 450 A=A-4:PRINT" ENTER FILENAME OF PIC"A
EP ": ";:INPUTA$                                JO
JO 460 IFLEN(A$)>16THEN450                      AE
AE 470 B$(A)=A$                                 OF
OF 480 POKE49156,LEN(A$):POKE49152,32:POKE4
   9153,16*(2+A*2)                              NF
NF 500 FORX=1TOLEN(A$):POKE49156+X,ASC(MID$
FJ (A$,X,1)):NEXT                               JO
JO 510 SYS49454:POKE49155,224+(A-1)*4:POKE4
   9154,28:SYS49490:RETURN                      MC
MC 520 POKE49153,32:POKE49152,16*(2+A*2):PO
   KE49154,224+(A-1)*4:POKE49155,4:RETURN       DB
DB 530 REM     POKE IN ML ROUTINE               AJ
AJ 540 I=49152                                  KA
KA 550 READA:IFA=256THEN565                     EE
EE 560 SUM=SUM+A:POKE I,A:I=I+1:GOTO550         BF
BF 565 IFSUM<>61145THENPRINT"ERROR IN DATA
   STATEMENTS.":END:REM SUM=61166 FOR 10X
```

```
•566 RETURN                                                    IM
•570 DATA 0,0,0,0,0,0,60,162,0                                 OH
•580 DATA 32,126,197,169,76,44,169,96                          LH
•590 DATA 133,138,169,44,133,0,0,0                             MD
•600 DATA 0,0,0,0,0,0,0,0,0                                    FG
•610 DATA 0,0,0,0,173,17,208,73                                II
•620 DATA 32,141,17,208,173,24,208,73                          IK
•630 DATA 8,141,24,208,96,169,255,208                          NP
•640 DATA 2,169,0,141,33,192,169,4                             IF
•650 DATA 162,4,160,0,32,186,255,169                           MM
•660 DATA 0,32,189,255,32,192,255,162                          PJ
•670 DATA 4,32,201,255,169,0,133,251                           CD
•680 DATA 169,64,133,252,169,0,141,32                          NH
•690 DATA 192,169,96,141,31,192,162,210                        BI
•700 DATA 32,176,193,32,210,255,169,25                         BE
•710 DATA 141,29,192,32,163,192,169,0                          NM
•720 DATA 133,251,169,128,133,252,169,0                        PD
•730 DATA 141,32,192,169,160,141,31,192                        DL
•740 DATA 169,25,141,29,192,32,163,192                         MM
•750 DATA 169,27,32,210,255,169,64,32                          JI
•760 DATA 210,255,169,4,32,195,255,32                          MM
•770 DATA 204,255,96,162,200,32,176,193                        AN
•780 DATA 32,227,192,165,251,72,165,252                        IH
•790 DATA 72,173,32,192,133,251,173,31                         OE
•800 DATA 192,133,252,32,227,192,165,251                       JA
•810 DATA 141,32,192,165,252,141,31,192                        DL
•820 DATA 104,133,252,104,133,251,169,13                       GJ
•830 DATA 32,210,255,32,225,255,208,5                          CF
•840 DATA 104,104,76,144,192,206,29,192                        IA
•850 DATA 208,193,96,169,40,141,30,192                         CE
•860 DATA 160,0,162,0,120,169,46,133                           NM
•870 DATA 1,177,251,141,34,192,169,47                          JO
•880 DATA 133,1,88,14,34,192,62,21                             IM
•890 DATA 192,232,224,8,208,245,200,192                        MB
•900 DATA 8,208,223,24,165,251,105,8                           CN
•910 DATA 133,251,165,252,105,0,133,252                        FL
•920 DATA 162,0,189,21,192,77,33,192                           OO
•930 DATA 32,210,255,232,224,8,208,242                         BE
•940 DATA 206,30,192,208,187,96,169,1                          PJ
•950 DATA 162,8,160,0,32,186,255,173                           LJ
•960 DATA 4,192,162,5,160,192,32,189                           MM
•970 DATA 255,169,0,170,160,28,32,213                          PC
•980 DATA 255,169,1,32,195,255,32,204                          PE
•990 DATA 255,96,160,0,132,251,174,1                           JB
•1000 DATA 192,134,252,132,253,174,0,192                       BI
•1010 DATA 134,254,142,34,192,238,34,192                       JG
•1020 DATA 200,192,32,208,248,160,0,120                        HC
•1030 DATA 169,46,133,1,177,253,145,251                        NI
•1040 DATA 169,47,133,1,88,200,208,239                         JP
•1050 DATA 230,252,230,254,165,254,205,34                      AL
•1060 DATA 192,208,228,173,3,192,133,252                       NH
•1070 DATA 173,2,192,133,254,162,4,120                         NL
•1080 DATA 169,40,133,1,177,253,145,251                        OC
•1090 DATA 200,208,249,230,252,230,254,20
2                                                              EB
•1100 DATA 208,242,169,47,133,1,88,96                          PE
•1110 DATA 142,188,193,142,195,193,160,0                       DC
•1120 DATA 162,0,232,189,200,193,32,210                        JM
•1130 DATA 255,138,217,200,193,48,243,96                       DK
•1135 REM                                                      JD
•1136 REM                                                      JD
•1137 REM   PRINTER CONTROL CODES                              FF
•1138 REM                                                      JI
•1139 REM                                                      JD
•1140 REM *  EPSON PRINTER MODULE  *                          LG
•1150 DATA 5,27,42,6,128,2,0,0,0,0                             C.
•1160 DATA 3,27,65,8,0,0,0,256                                 GK
•1170 REM *  GEMINI PRINTER MODULE  *                         JF
•1180 DATA 4,27,76,128,2,0,0,0,0,0                             H
•1190 DATA 3,27,51,16,0,0,0,256                                LL
```

6510 SIMULATOR

FROM PAGE 77

```
•100 REM ******* 6510 SIMULATOR ********                      BD
•110 DATA ASL,BRK,CLC,CLD,CLI,CLV,DEX,DEY
 ,INX,INY,LSR,NOP,PHA,PHP,PLA                                 IL
•120 DATA PLP,ROL,ROR,RTI,RTS,SEC,SED,SEI
 ,TAX,TAY,TSX,TXA,TXS,TYA                                     LC
•130 DATA ADC,AND,CMP,CPX,CPY,EOR,LDA,LDX
 ,LDY,ORA,SBC                                                 FG
•140 DATA ADC,AND,ASL,BCC,BCS,BEQ,BIT,BMI
 ,BNE,BPL,BVC,BVS,CMP,CPX,CPY                                 EC
•150 DATA DEC,EOR,INC,JMP,JSR,LDA,LDX,LDY
 ,LSR,ORA,ROL,ROR,SBC,STA,STX                                 FC
•160 DATA STY,ASL,LSR,ROL,ROR                                  LJ
•170 DATA 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F                      BK
•180 DATA 0000,0001,0010,0011,0100,0101,0
 110,0111                                                     PG
•190 DATA 1000,1001,1010,1011,1100,1101,1
 110,1111                                                     GG
•200 DIM HEX$(8),BIT$(8),H$(16),B$(16),TE
 MP$(2),BIT(8),N$(75)                                         NC
•210 AH$="00":XH$="00":YH$="00":Z$="0":AD
 =0:SC=0:YD=0                                                 AL
•220 AB$="[8"0"]":XB$="[8"0"]":YB$="[8"0"
 ]"                                                           GF
•230 N=0:V=0:B=0:D=0:I=0:Z=0:C=0                               NN
•240 IF RIGHT$(A$,1)=" "THEN 300:REM TYPE
  A SPACE BETWEEN THE QUOTES                                  PI
•250 FOR L=1 TO 75:READ N$(L):NEXT L                           MA
•260 FOR L=1 TO 16:READ H$(L):NEXT L:FOR
 L=1 TO 16:READ B$(L):NEXT L                                  CH
•270 PRINT CHR$(147):REM CLEAR SCREEN                          EG
•280 PRINT " N  V  -  B  D  I  Z  C"                           NF
•285 PRINT N;V;" - ";B;D;I;Z;C:PRINT                           LA
•290 PRINT "A: ";AH$;"[7" "]X: ";XH$;"[7"
  "]Y: ";YH$                                                   KM
•295 PRINT AB$;"[4" "]";XB$;"[4" "]";YB$:
 PRINT                                                        OB
•300 B=0:A$="":INPUT " ";A$:REM TYPE SPAC
 E BETWEEN SECOND PAIR OF QUOTES                              MG
```

```
320 IF LEN(A$)<3 OR LEN(A$)>10 THEN 300 CD
330 IF LEN(A$)=3 THEN 420:REM GO TO IMPL
 IED-ADDRESS ROUTINES JC
340 IF MID$(A$,4,1)<>CHR$(32) THEN 300 AJ
350 IF RIGHT$(A$,1)=CHR$(32) THEN 300 PC
360 GOTO 450:REM GO TO IMMEDIATE- AND AB
 SOLUTE-ADDRESS ROUTINES BH
370 REM *** ROUTINE TO CONVERT OP$ & AD$
  TO BINARY NUMBERS *** LP
380 OD$=OP$:GOSUB 1130:FOR L=1 TO 8:BIT$
 (L)=Z$:NEXT L AG
390 FOR L=1 TO 8:B1$(L)=MID$(OB$,L,1):NE
 XT L EC
400 FOR L=1 TO 8:B2$(L)=MID$(AB$,L,1):NE
 XT L:RETURN OI
410 REM *** IMPLIED-ADDRESSING ROUTINES
 *** JL
420 FOR L=1 TO 29:IF A$=N$(L) THEN OC$=A
 $:OC=L:GOTO  1350 LN
430 NEXT L:GOTO 300 CH
440 REM *** IMMEDIATE, ABSOLUTE & ACCUMU
 LATOR ADDRESS MODES *** CP
450 OC$=LEFT$(A$,3):OP$=MID$(A$,5) NC
460 IF LEFT$(OP$,1)="#" AND MID$(OP$,2,1
 )="$" THEN  FLAG$="AH":GOTO  530 KH
470 IF LEFT$(OP$,1)="#" THEN FLAG$="AD":
 GOTO 620 IG
480 IF LEFT$(OP$,1)="$" THEN FLAG$="IH":
 GOTO 690 OK
490 IF OP$="A" THEN 790 MN
500 IF LEFT$(OP$,1)<"0" AND LEFT$(OP$,1)
 >"9" THEN 300:REM TRY AGAIN JO
510 FLAG$="ID":GOTO 840 CB
520 REM *** HEX OPERAND, ABSOLUTE ADDRES
 S *** FI
530 OP$=MID$(OP$,3) MH
540 FOR L=30 TO 40:IF OC$=N$(L) THEN OC=
 L:GOTO 560 GP
550 NEXT L:GOTO 300 CH
560 IF  LEN(OP$)>2 THEN 300 JP
570 FOR L=1 TO  LEN(OP$):X$=MID$(OP$,L,1
 ):IF X$<Z$ OR X$>"F" THEN 300 PC
580 IF X$>"9"AND X$<"A" THEN 300 AI
590 IF LEN(OP$)=1 THEN OP$=Z$+OP$ JH
600 OH$=OP$:GOSUB 1030:OP$=OD$:GOTO 670 IN
610 REM *** DECIMAL OPERAND, ABSOLUTE AD
 DRESSING *** GN
620 OP$=MID$(OP$,2) MG
630 FOR L=30TO 40:IF OC$=N$(L) THEN OC=L
 :GOTO 650 GB
640 NEXT L:GOTO 300 CH
650 IF VAL(OP$)>255 THEN 300 OK
660 FOR  L=1 TO LEN(OP$):X$=MID$(OP$,L,1
 ):IFASC(X$)<48 OR ASC(X$)>57 THEN 420 EH
670 OC=OC-29:GOTO 1420 HK
680 REM *** HEX OPERAND, IMMEDIATE ADDRE
 SS *** EA
690 OP$=MID$(OP$,2) MG
700 FOR  L=41 TO 71:IF OC$=N$(L) THEN OC
 =L:GOTO720 CN
710 NEXT L:GOTO 300 CH
720 IF LEN(OP$)>4  THEN 300 KF
730 FOR L=1 TO LEN(OP$):X$=MID$(OP$,L,1)
 :IF X$<Z$ OR X$>"F" THEN 300 PC
740 IF X$>"9" AND X$<"A" THEN 300 AI
750 NEXT L MO
760 OH$=OP$:GOSUB 1030:OP$=OD$:OP$=STR$(
 PEEK(VAL(OP$))) JF
770 OC=OC-40:GOTO 1430 IA
780 REM *** ACCUMULATOR ADDRESSING *** EG
790 OP$="A" AL
800 FOR L=72 TO75:IF OC$=N$(L) THEN OC=L
 -71: GOTO 820 OI
810 NEXT L:GOTO 300 CH
820 ON OC GOTO 1510,1760,1790,1810 IL
830 REM *** DECIMAL OPERAND, IMMEDIATE A
 DDRESS ** JC
840 IF VAL(OP$)>65535 THEN 300 JD
860 FOR L=1 TO LEN(OP$):X$=MID$(OP$,L,1)
 :IF ASC(X$)<48 OR ASC(X$)>57 THEN 300 EI
870 FOR L=41 TO 71:IF OC$=N$(L) THEN OC=
 L:GOTO 890 CP
880 NEXT L:GOTO 300 CH
890 OP$=STR$(PEEK(VAL(OP$))) IN
900 OC=OC-40:GOTO 1430 IA
910 REM *** DECIMAL-TO-HEXADECIMAL CONVE
 RSION *** JN
920 FOR L=1 TO 4:HEX$(L)="":NEXT L KJ
930 FOR L=1 TO 5:T$=RIGHT$(OD$,L):NEXT L HO
940 NR=VAL(OD$):X=4 KF
950 TMP=NR:NR=INT(NR/16):TMP=TMP-NR*16 DM
960 IF TMP<10 THEN HEX$(X)=RIGHT$(STR$(T
 MP),1):GOTO 980 BN
970 HEX$(X)=CHR$(TMP-10+ASC("A")) EA
980 IF NR<>0 THEN X=X-1:GOTO 950 PN
990 OH$=HEX$(1)+HEX$(2)+HEX$(3)+HEX$(4) JM
1000 IF LEN(OH$)=1 THEN OH$=Z$+OH$ BP
1010 RETURN IM
1020 REM *** HEXADECIMAL-TO-DECIMAL CONV
 ERSION *** GB
1030 NR=0:FOR L=1 TO LEN(OH$):HEX$(L)=MI
 D$(OH$,L,1) FF
1040 IF HEX$(L)<="9" THEN NR=NR*16+VAL(H
 EX$(L)):GOTO 1060 GO
1050 NR=NR*16+ASC(HEX$(L))-ASC("A")+10 CE
1060 NEXT L:OD$=STR$(NR):RETURN OK
1070 REM *** BINARY-TO-DECIMAL CONVERSIO
 N *** FC
1080 FOR L=8 TO 1 STEP -1:B$(L)=MID$(OB$
 ,L,1):NEXT L AL
1090 FOR L=1 TO 8:BIT(L)=VAL(B$(L)):NEXT
  L:OD=0:NR=256 NL
1100 FOR  L=1 TO8:NR=NR/2:OD=OD+BIT(L)*N
 R:NEXT L GF
1110 OD$=STR$(OD):RETURN NO
1120 REM *** DECIMAL-TO-BINARY CONVERSIO
```

```
N ***                                                    DG
•1130 OD=VAL(OP$):FOR L=8 TO 1 STEP -1:TM
 P=OD/2:NR=TMP-INT(TMP)                                  EL
•1140 IF NR=0 THEN BT$(L)=Z$:GOTO 1160                   JO
•1150 BT$(L)="1"                                         JE
•1160 OD=INT(TMP):NEXT L                                 BP
•1170 OB$=BT$(1)+BT$(2)+BT$(3)+BT$(4)+BT$
 (5)+BT$(6)+BT$(7)+BT$(8):RETURN                         DN
•1180 REM *** HEX-TO-BINARY CONVERSION **
 *                                                       AI
•1190 HEX$(1)="":HEX$(2)="":FOR L=1 TOLEN
  (OH$):HEX$(L)=MID$(OH$,L,1)                            DK
•1200 NEXT L:IF HEX$(2)="" THEN HEX$(2)=H
 EX$(1):HEX$(1)=Z$                                       OM
•1210 FOR L=1 TO 16:IF HEX$(1)=H$(L) THEN
  BIT$(1)=B$(L)                                          HC
•1220 NEXT L:FOR L=1 TO 16:IF HEX$(2)=H$(
 L) THEN BIT$(2)=B$(L)                                   IG
•1240 NEXT L:OB$=BIT$(1)+BIT$(2):PRINT:RE
 TURN                                                    AP
•1260 REM *** BINARY-TO-HEX CONVERSION **
 *                                                       HA
•1270 FOR L=1 TO 8:BIT$(L)=MID$(OB$,L,1):
 NEXT L                                                  MM
•1280 BIT$=BIT$(1)+BIT$(2)+BIT$(3)+BIT$(4
 )+BIT$(5)+BIT$(6)+BIT$(7)+BIT$(8)                       PA
•1290 T1$=LEFT$(BIT$,4):T2$=RIGHT$(BIT$,4
 ):FOR L=1 TO 16                                         NM
•1300 IF T1$=B$(L)THEN HEX$(1)=H$(L)                     IL
•1310 NEXT L:FOR L=1 TO 16:IF T2$=B$(L) T
 HEN HEX$(2)=H$(L)                                       NK
•1320 NEXT L:IF HEX$(1)="" THEN HEX$(1)=Z
 $                                                       FG
•1330 OH$=HEX$(1)+HEX$(2):RETURN                         CO
•1340 REM *** ON/GOTO DATA ***                           LE
•1350 ON OC GOTO 1510,1560,1570,1580,1590
 ,1600,1610,1650,1690,1730                               JB
•1360 NR=OC-10:ON NR GOTO 1760,1780,1780,
 1780,1780,1780,1790,1810,1830,1840                      KG
•1380 NR=NR-10:ON NR GOTO 1850,1860,1870,
 1880,1900,1920,1930,1940,1950,1840                      CF
•1400 NR=NR-10:ON NR GOTO 1850,1860,1870,
 1880,1900,1920,1930,1940,1950,1950                      BP
•1420 ON OC GOTO 1970,2100,2170,2250,2320
 ,2390,2450,2550,2650,2750,2810                          BD
•1430 ON OC GOTO 1970,2350,3250,1780,1780
 ,1780,3200,1780,1780,1780                               JO
•1440 NR=OC-10:ON NR GOTO 1780,1780,3250,
 2250,2320,3260,2390,3290,1780,1780                      EL
•1460 NR=NR-10:ON NR GOTO 2450,2550,2650,
 3320,2750,3340,3360,2810,1780,1780                      OL
•1480 NR=NR-10:ON NR GOTO 1780,3390                      BB
•1500 REM *** IMPLIED-ADDRESS OP-CODE ROU
 TINES                                                   CG
•1510 C=VAL(LEFT$(AB$,1)):AB$=MID$(AB$,2)
 +Z$:REM *** ASL ***                                     EH
•1520 OB$=AB$:GOSUB 1270:AH$=OH$:OP$=OH$:
 GOSUB 1030:N=0:Z=0                                      DF
•1530 IF LEFT$(OB$,1)="1"THEN N=1                        OP
•1540 IF VAL(OD$)=0THEN Z=1                              BO
•1550 GOTO 3390                                          FK
•1560 B=1:GOTO 3390:REM *** BRK ***                      JG
•1570 C=0:GOTO 3390:REM *** CLC ***                      EL
•1580 D=0:GOTO 3390:REM *** CLD ***                      FJ
•1590 I=0:GOTO 3390:REM *** CLI ***                      IH
•1600 V=0:GOTO 3390:REM *** CLV ***                      NN
•1610 OH$=XH$:GOSUB 1030:XD=VAL(OD$):REM
 *** DEX **                                              IF
•1620 XD=XD-1:IF XD<0 THEN XD=255                        JO
•1630 OD$=STR$(XD):GOSUB920:XH$=OH$:GOSUB
  1190:XB$=OB$                                           BF
•1640 TMP=XD:GOSUB 3410:GOTO 280                         EF
•1650 OH$=YH$:GOSUB 1030:YD=VAL(OD$):REM
 *** DEY ***                                             OO
•1660 YD=YD-1:IF YD<0 THEN YD=255                        BC
•1670 OD$=STR$(YD):GOSUB 920:YH$=OH$:GOSU
 B 1190:YB$=OB$                                          KK
•1680 TMP=YD:GOSUB 3410:GOTO 280                         FE
•1690 OH$=XH$:GOSUB 1030:XD=VAL(OD$):REM
 *** INX ***                                             BD
•1700 OD$=STR$(XD):GOSUB 920:XH$=OH$:GOSU
 B 1190:XB$=OB$                                          BF
•1710 XD=XD+1:IF XD>255 THEN XD=0                        KP
•1720 GOTO 1630                                          FN
•1730 OH$=YH$:GOSUB 1030:YD=VAL(OD$):REM
 *** INY ***                                             CO
•1740 YD=YD+1:IF YD>255 THEN YD=0                        NB
•1750 GOTO 1670                                          FJ
•1760 C=VAL(RIGHT$(AB$,1)):AB$=Z$+LEFT$(A
 B$,7):REM *** LSR ***                                   OO
•1770 GOTO 1520                                          FN
•1780 GOTO 3390:REM *** NOP,PHA,PHP,PLA A
 ND PLP ***                                              OP
•1790 GOTO 3340:REM *** ROL ***                          AC
•1810 GOTO 3360:REM *** ROR ***                          EC
•1830 N=0:V=0:B=0:D=0:I=0:Z=0:C=0:GOTO 28
 0 REM *** RTI ***                                       ND
•1840 GOT 3390:REM *** RTS ***                           LG
•1850 C=1:GOTO 3390:REM *** SEC ***                      ID
•1860 D=1:GOTO 3390;REM *** SED ***                      HG
•1870 I=1:GOTO 3390:REM *** SEI ***                      GP
•1880 XH$=AH$:XB$=AB$:OP$=AH$:GOSUB 1030:
 TMP=VAL(OD$):REM *** TAX ***                            CG
•1890 GOSUB 3410:GOTO 3390                               PI
•1900 YH$=AH$:YB$=AB$:OP$=AH$:GOSUB 1030:
 TMP=VAL(OD$):REM *** TAY ***                            CN
•1910 GOSUB 3410:GOTO 3390                               PI
•1920 XH$="00":XB$="[8"0"]":GOSUB 3410:GO
 TO 3390:REM *** TSX ***                                 LN
•1930 AH$=XH$:AB$=XB$:GOTO 1520:REM *** T
 XA ***                                                  AO
•1940 GOTO 3390:REM *** TXS ***                          DL
•1950 AH$=YH$:AB$=YB$:GOTO 1520:REM *** T
 YA ***                                                  HP
•1960 REM *** ABSOLUTE-ADDRESS OPERANDS *
 **                                                      FI
```

```
OP •1970 IF D THEN 2950:REM *** ADC ***                    NJ
BO •1980 OP=VAL(OP$):TMP$=AB$                              OM
FK •1990 GOSUB 1130:PLUS$=OB$                              HA
JG •2000 OH$=AH$:GOSUB 1030:AD$=OD$:AD=VAL(A
EL  D$):TMP=AD                                             NF
FJ •2010 AD=AD+OP+C:C=0:IF AD>255 THEN GOSUB
IH   2090                                                  DK
NN •2020 AD$=STR$(AD):OD$=AD$:GOSUB920:AH$=O
    H$                                                     BL
IF •2030 GOSUB 1190:AB$=OB$                                JK
JO •2040 N=0:IF AD>127 THEN N=1                            NO
   •2050 Z=0:IF AD=0 THEN Z=1                              FC
BF •2060 V=0                                               DL
EF •2070 IF LEFT$(TMP$,1)=LEFT$(PLUS$,1) AND
     LEFT$(TMP$,1)<>LEFT$(AB$,1)THEN V=1                   LN
OO •2080 OD$=AD$:GOSUB 1030:AH$=OH$:GOTO 280               DC
BC •2090 C=1:AD=AD-256:RETURN                              DP
   •2100 GOSUB 380:REM *** AND ***                         PJ
KK •2110 FOR L=1 TO 8:BIT$(L)="0":NEXT L                   AA
FE •2120 FOR L=1 TO 8:IF B1$(L)="1" AND B2$(
    L)="1" THEN BIT$(L)="1"                                HJ
BD •2130 NEXT L                                            MO
   •2140 AB$=BIT$(1)+BIT$(2)+BIT$(3)+BIT$(4)
BF  +BIT$(5)+BIT$(6)+BIT$(7)+BIT$(8)                       LC
KP •2150 OB$=AB$:GOSUB 1270:AH$=OH$                        LN
FN •2160 GOSUB 1030:TMP=VAL(OD$):GOSUB3410:P
    RINT:GOTO 280                                          KC
CO •2170 OH$=AH$:GOSUB 1030:AD$=OD$:AD=VAL(A
NB  D$):OP=VAL(OP$):REM *** CMP ***                        NB
FJ •2180 Z=0:IF AD=OP THEN Z=1                             NN
   •2190 N=0:IF OP>AD THEN N=1                             NA
OO •2220 C=0:IF  AD>OP OR AD=OP THEN C=1                   CN
FN •2240 GOTO 3390                                         FK
   •2250 OH$=XH$:GOSUB 1030:XD$=OD$:XD=VAL(X
OP  D$):OP=VAL(OP$):REM *** CPX ***                        CG
AC •2260 Z=0:IF XD=OP THEN Z=1                             LK
EC •2280 N=0:IF OP>XD THEN N=1                             NL
   •2300 C=0:IF XD>OP OR XD=OP THEN C=1                    GF
ND •2310 GOTO 3380                                         GD
LG •2320 OH$=YH$:GOSUB 1030:YD$=OD$:YD=VAL(Y
ID  D$):OP=VAL(OP$):REM *** CPY ***                        CN
HG •2330 Z=0:IF YD=OP THEN Z=1                             NF
GP •2340 N=0:IF OP>YD THEN N=1                             NI
   •2350 C=0:IF YD>OP OR YD=OP THEN C=1                    FN
CG •2380 GOTO 3380                                         GD
PI •2390 GOSUB 380:REM *** EOR ***                         OG
   •2400 FOR L=1 TO 8:BIT$(L)=Z$:NEXT L                   PJ
CN •2410 FOR L=1 TO 8:IF B1$(L)="1" AND B2$(
PI  L)="1" THEN BIT$(L)="0":GOTO 2440                      KO
   •2420 IF B1$(L)="1" OR B2$(L)="1" THEN BI
LN  T$(L)="1"                                              FE
   •2440 NEXT L:GOTO 2140                                  FP
AO •2450 IF D=1 THEN 2480:REM *** LDA ***                  LG
DL •2460 OD$=OP$:GOSUB 920:AH$=OH$:GOSUB 119
    0:AB$=OB$                                              IG
HP •2470 TMP=VAL(OP$):GOSUB 3410:GOTO 280                  HA
   •2480 IF FLAG$="AD" AND VAL(OP$)>99 THEN
FI   300                                                   JD
   •2490 IF FLAG$<>"AD" THEN OD$=OP$:GOSUB 9
     20:AH$=OH$:GOTO 2530                                  MD
   •2500 IF LEN(OP$)=1 THEN OP$=Z$+OP$                     JH
   •2510 AH$=OP$:OH$=AH$:GOTO 2530                         NJ
   •2520 OD$=OP$:GOSUB 920:AH$=OH$                         EB
   •2530 GOSUB 1190:AB$=OB$                                JK
   •2540 TMP=VAL(OP$):GOSUB 3410:GOTO 2470                 JN
   •2550 IF D=1 THEN 2580:REM *** LDX ***                  MM
   •2560 OD$=OP$:GOSUB 920:XH$=OH$:GOSUB 119
    0:XB$=OB$                                              NO
   •2570 TMP=VAL(OP$):GOSUB 3410:GOTO 280                  HA
   •2580 IF FLAG$="AD" AND VAL(OP$)>99 THEN
     300                                                   JD
   •2590 IF FLAG$<>"AD" THEN OD$=OP$:GOSUB 9
     20:XH$=OH$:GOTO 2630                                  GN
   •2600 IF LEN(OP$)=1 THEN OP$=Z$+OP$                     JH
   •2610 XH$=OP$:OH$=XH$:GOTO 2630                         HA
   •2620 OD$=OP$:GOSUB 920:XH$=OH$                         CM
   •2630 GOSUB 1190:XB$=OB$                                MF
   •2640 TMP=VAL(OP$):GOSUB 3410:GOTO 2570                 JK
   •2650 IF D=1 THEN 2680:REM *** LDX ***                  OJ
   •2660 OD$=OP$:GOSUB 920:YH$=OH$:GOSUB 119
    0:YB$=OB$                                              JG
   •2670 TMP=VAL(OP$):GOSUB 3410:GOTO 280                  HA
   •2680 IF FLAG$="AD" AND VAL(OP$)>99 THEN
     300                                                   JD
   •2690 IF FLAG$<>"AD" THEN OD$=OP$:GOSUB 9
     20:YH$=OH$:GOTO 2730                                  PN
   •2700 IF LEN(OP$)=1 THEN OP$=Z$+OP$                     JH
   •2710 YH$=OP$:OH$=YH$:GOTO 2730                         EL
   •2720 OD$=OP$:GOSUB 920:XH$=OH$                         CM
   •2730 GOSUB 1190:YB$=OB$                                OC
   •2740 TMP=VAL(OP$):GOSUB 3410:GOTO 2670                 JP
   •2750 GOSUB 380:REM *** ORA ***                         KE
   •2760 FOR L=1 TO8:IF B1$(L)="1" OR B2$(L)
    ="1" THEN BIT$(L)="1"                                  KC
   •2770 NEXT L:AB$="":FOR L=1 TO 8:AB$=AB$+
     BIT$(L):NEXT L                                        PE
   •2790 OB$=AB$:GOSUB 1270:AH$=OH$                        LN
   •2800 GOSUB 1030:TMP=VAL(OD$):GOSUB3410:G
    OTO 3390                                               FB
   •2810 IF D THEN 3060:REM *** SBC ***                    NI
   •2820 OP=VAL(OP$):TMP$=AB$                              OM
   •2830 GOSUB 1130:MI$=OB$                                LJ
   •2840 OH$=AH$:GOSUB 1030:AD$=OD$:AD=VAL(A
     D$):TMP=AD                                            NF
   •2850 AD=AD-OP:IF C=0 THEN AD=AD-1                      IN
   •2860 IF AD<0 THEN AD=256+AD:C=0                        AN
   •2870 AD$=STR$(AD):OD$=AD$:GOSUB 920:AH$=
     OH$                                                   BL
   •2880 GOSUB 1190:AB$=OB$                                JK
   •2890 N=0:IF AD>127 THEN N=1                            NO
   •2900 Z=0:IF AD=0 THEN Z=1                              FC
   •2910 V=0:IF LEFT$(TMP$,1)=LEFT$(MI$,1) T
     HEN 2930                                              EE
   •2920 IF LEFT$(AB$,1)=LEFT$(TMP$,1) THEN
     V=1                                                   HI
   •2930 OD$=AD$:GOSUB 1030:AH$=OH$:GOTO 280               DC
```

TO ENTER *SCREEN MAGIC...*

You must use the *Flankspeed* program. See the instructions and listing for *Flankspeed* on page 86.

```
•2940 REM *** BCD ADDITION ROUTINE ***          AC
•2950 IF FLAG$<>"AD" THEN 1980                  HP
•2960 IF LEFT$(AH$,1)>"9" OR RIGHT$(AH$,1
 )>"9" THEN 3030                                CG
•2970 AD=VAL(AH$)                               PO
•2980 OP=VAL(OP$):AD=AD+OP+C:C=0                NE
•2990 GOSUB 1030:TMP=VAL(OD$):GOSUB 3410        HK
•3000 IF AD>99 THEN GOSUB 3040                  EF
•3010 AH$=STR$(AD):IF LEN(AH$)=1 THEN AH$
 =Z$+AH$                                        JN
•3020 OH$=AH$:GOSUB 1190:AB$=OB$:GOTO 280       ID
•3030 OH$=AH$:GOSUB 1030:AD$=OD$:AD=VAL(A
 D$):GOTO 2980                                  OF
•3040 C=1:AD=AD-100:RETURN                      CF
•3050 REM *** BCD SUBTRACTION ROUTINE ***        DL
•3060 IF FLAG$<>"AD" THEN 2820                  HJ
•3070 IF LEFT$(AH$,1)>"9" OR RIGHT$(AH$,1
 )>"9" THEN 3120                                GA
•3080 AD=VAL(AH$):OP=VAL(OP$):AD=AD-OP:IF
  C=0 THEN AD=AD-1                              LB
•3100 IF AD<0 THEN GOSUB 3130                   OF
•3110 GOTO 3010                                 EP
•3120 OH$=AH$:GOSUB 1030:AD$=OD$:AD=VAL(A
 D$):GOTO 3090                                  NI
•3130 C=0:AD=100+AD:RETURN                      CB
•3140 REM *** IMMEDIATE-ADDRESS ROUTINES
 ***                                            AN
•3150 OD$=OP$:GOSUB 920:GOSUB 1190:REM **
 * ASL ***                                      CL
•3160 C=VAL(LEFT$(OB$,1)):OB$=MID$(OB$,2)
 +Z$                                            AD
•3170 GOSUB 1270:GOSUB 1030:X=VAL(OD$):N=
 0:IF X<0 THEN N=1                              GF
•3180 Z=0:IF X=0 THEN Z=1                       AC
•3190 GOTO 280                                  CG
•3200 GOSUB 1030:AD=VAL(OD$):REM *** BIT
 ***                                            IJ
•3210 GOSUB 1130:N=VAL(LEFT$(OB$,1)):V=VA
 L(MID$(OB$,2,1))                               IP
•3220 GOSUB 400:Z=1:FOR L=1 TO 8                HD
•3230 IF B1$(L)="1" AND B2$="1" THEN Z=0        HC
•3240 NEXT L:GOTO 3390                          FN
•3250 GOTO 2170                                 FB
•3260 OP=VAL(OP$):OP=OP-1:IF OP<0 THEN N:
 REM *** DEC ***                                EM
•3270 IF OP=0 THEN Z=1                          AC
•3280 GOTO 3390                                 FK
•3290 OP=VAL(OP$):OP=OP+1:IF OP<0 THEN N=
 1:REM *** INC ***                              NL
•3300 IF OP=Z THEN Z=1                          CA
•3310 GOTO 3390                                 FK
•3320 OD$=OP$:GOSUB 920:GOSUB 1190              EC
•3330 C=VAL(RIGHT$(OB$,1)):OB$=Z$+LEFT$(O
 B$,7):GOTO 3170                                DK
•3340 IF C=1 THEN J$="1":REM *** ROL ***        GF
•3341 IF C=0 THEN J$="0"                        PA
•3342 C=VAL(LEFT$(AB$,1)):AB$=RIGHT$(AB$,
 7)+J$                                          BD
•3350 OB$=AB$:GOSUB 1270:AH$=OH$:OP$=OH$:
 GOSUB 1030:N=0:Z=0                             DF
•3355 IF LEFT$(OB$,1)="1" THEN N=1              OP
•3356 IF VAL(OD$)=0THEN Z=1                     BO
•3357 GOTO 3390                                 FK
•3360 IF C=1 THEN J$="1":REM *** ROR ***        GH
•3365 IF C=0 THEN J$=Z$                         PL
•3370 C=VAL(RIGHT$(AB$,1)):AB$=J$+LEFT$(A
 B$,7)                                          DL
•3371 GOTO 3350                                 FO
•3380 REM *** PRINT LINE SPACE & GET ANOT
 HER LINE ***                                   FK
•3390 PRINT:GOTO 280                            PI
•3400 REM *** SET Z AND N FLAGS ***             HO
•3410 N=0:IF TMP>127 THEN N=1                   EE
•3420 Z=0:IF TMP=0 THEN Z=1                     MO
•3430 RETURN                                    IM
```

SCREEN MAGIC

FROM PAGE 33

First byte: C000 Last byte: C8E7 SYS to Start: RUN

```
C000: A9 80 8D 8A 02 20 44 E5 8E
C008: A9 00 8D 21 D0 8D 15 D0 A4
C010: A9 0B 8D 20 D0 8D 86 02 59
C018: A0 08 A2 17 A9 12 20 D2 29
C020: FF 18 20 F0 FF A9 B4 20 C7
C028: D2 FF CA E0 FF D0 F2 20 8A
C030: 66 E5 A9 0D 8D EB C8 A9 1F
C038: C7 85 FE A9 C7 85 FF 20 9B
C040: 68 C0 20 68 C0 A9 D9 85 BB
C048: FE A9 C7 85 FF 20 68 C0 87
C050: 20 68 C0 A9 00 8D EB C8 85
C058: A9 EB 85 FE A9 C7 85 FF 69
C060: 20 68 C0 A0 00 4C 76 C0 CD
C068: A0 00 B1 FE 20 D2 FF C8 75
C070: CD EB C8 D0 F5 60 B9 AA 7E
C078: C7 99 C0 3E C8 C0 1D D0 50
C080: F5 A9 00 99 C0 3E C8 C0 42
C088: 40 D0 F8 A9 2E 8D 00 D0 C8
C090: A9 70 8D 01 D0 A9 07 8D 48
C098: 27 D0 A9 00 8D 10 D0 A9 52
C0A0: FB 8D F8 07 20 60 C3 A9 18
C0A8: 01 8D 15 D0 AD 00 DC C9 71
C0B0: 7F F0 F9 20 70 C3 AD 00 1D
C0B8: DC 49 FF 8D EB C8 29 10 5A
C0C0: C9 10 F0 6F AD EB C8 29 86
C0C8: 0F C9 01 F0 72 C9 02 F0 C2
C0D0: 6B C9 04 F0 64 C9 08 F0 22
C0D8: 5D 20 E4 FF C9 56 F0 62 AE
C0E0: C9 85 F0 76 C9 89 F0 75 51
C0E8: C9 86 F0 74 C9 8A F0 73 57
C0F0: C9 87 F0 51 C9 88 F0 5F 27
```

```
C0F8: C9 8C F0 58 C9 14 F0 48 AF
C100: C9 13 F0 47 C9 1D F0 2E 1B
C108: C9 9D F0 2D C9 91 F0 2F 09
C110: C9 11 F0 28 C9 39 F0 36 2E
C118: C9 20 F0 17 C9 93 F0 31 89
C120: C9 5F F0 42 C9 41 F0 49 C1
C128: C9 C1 F0 58 C9 58 F0 67 77
C130: 4C B6 C0 4C 82 C2 4C 0A DB
C138: C2 4C 46 C2 4C D4 C1 4C 7F
C140: B2 C1 4C 2E C5 4C 8F C3 94
C148: 4C A4 C3 4C EA C3 4C FC 41
C150: C3 4C 07 C4 4C 58 C4 4C E1
C158: C6 C4 4C 02 C6 4C 3B C6 47
C160: 4C 76 C6 4C C5 C6 AD 45 B5
C168: C7 49 01 8D 45 C7 4C B6 18
C170: C0 AD 44 C7 49 01 8D 44 07
C178: C7 F0 19 AD 41 C7 8D EE 7D
C180: C8 4C B6 C0 AD 43 C7 49 0F
C188: 01 8D 43 C7 F0 06 AD 27 ED
C190: D0 8D EF C8 4C B6 C0 20 8B
C198: 44 E5 A9 00 8D 15 D0 8D 6D
C1A0: 8A 02 A9 0E 8D 86 02 8D 88
C1A8: 20 D0 A9 06 8D 21 D0 20 E8
C1B0: 74 A4 A9 08 8D EA C8 20 DC
C1B8: 66 C3 CE 01 D0 CE EA C8 06
C1C0: AD EA C8 D0 F2 AD 01 D0 65
C1C8: C9 28 D0 05 A9 E8 8D 01 B1
C1D0: D0 4C B6 C0 AD 01 D0 C9 AE
C1D8: E8 F0 27 A9 08 8D EA C8 CC
C1E0: 20 66 C3 EE 01 D0 CE EA A5
C1E8: C8 AD EA C8 D0 F2 AD 01 85
C1F0: D0 C9 F0 D0 05 A9 30 8D B9
C1F8: 01 D0 A9 00 8D 1B D0 4C 3A
C200: B6 C0 A9 01 8D 1B D0 4C E7
C208: DB C1 A9 08 8D EA C8 20 B8
C210: 66 C3 EE 00 D0 AD 00 D0 78
C218: F0 12 CE EA C8 AD EA C8 FE
C220: D0 ED AD 00 D0 C9 56 F0 6E
C228: 0B 4C 43 C2 A9 01 8D 10 CD
C230: D0 4C 1A C2 AD 10 D0 F0 A9
C238: 0A A9 00 8D 10 D0 A9 5E 62
C240: 8D 00 D0 4C B6 C0 A9 08 14
C248: 8D EA C8 20 66 C3 CE 00 A2
C250: D0 AD 00 D0 F0 12 CE EA 5C
C258: C8 AD EA C8 D0 ED AD 00 EE
C260: D0 C9 0E F0 0B 4C 7F C2 93
C268: A9 00 8D 10 D0 4C 56 C2 E5
C270: AD 10 D0 D0 0A A9 01 8D 12
C278: 10 D0 A9 4E 8D 00 D0 4C FB
C280: B6 C0 20 07 C3 AD 10 D0 71
C288: D0 09 AD 00 D0 C9 56 F0 F1
C290: 1B 90 1C AD 41 C7 81 FE 8F
C298: AD 27 D0 81 FC AD 45 C7 77
C2A0: D0 42 AD 44 C7 D0 1F AD 0B
C2A8: 43 C7 D0 29 4C C4 C0 AD 2D
C2B0: 01 D0 C9 49 90 08 A1 FE CE
C2B8: 8D 41 C7 4C C4 C0 A1 FC BF
C2C0: 8D 27 D0 4C C4 C0 AC 41 06
C2C8: C7 AE EE C8 8E 41 C7 8C 1B
C2D0: EE C8 4C A7 C2 AC 27 D0 E3
C2D8: AE EF C8 8E 27 D0 8C EF 43
C2E0: C8 4C AC C2 AD 00 D0 C9 AD
C2E8: D6 B0 B7 AD 10 D0 D0 B2 3A
C2F0: AD F1 C8 69 18 38 E5 FE F7
C2F8: 0A A8 AD 41 C7 91 FE AD A0
C300: 27 D0 91 FC 4C A2 C2 38 70
C308: AD 01 D0 E9 30 4A 4A 4A 80
C310: 8D E7 C8 0A 0A 6D E7 C8 80
C318: A2 00 8E E7 C8 0A 0A 2E 3C
C320: E7 C8 0A 2E E7 C8 85 FE 3E
C328: 8D F1 C8 AD E7 C8 69 04 3C
C330: 85 FF AD 10 D0 8D E9 C8 84
C338: 38 AD 00 D0 E9 16 8D E8 65
C340: C8 AD E9 C8 E9 00 4A 6E 0C
C348: E8 C8 AD E8 C8 4A 4A 65 53
C350: FE 85 FE 85 FC A5 FF 69 65
C358: 00 85 FF 69 D4 85 FD 60 FF
C360: A0 C8 88 D0 FD 60 AE 42 72
C368: C7 20 60 C3 CA D0 FA 60 6B
C370: A0 28 A9 0B 99 BF DB A9 CC
C378: A0 99 BF 07 88 C0 00 D0 93
C380: F1 60 A2 18 18 20 F0 FF B6
C388: AD 27 D0 8D 86 02 60 EE 93
C390: 21 D0 AD 21 D0 29 0F C9 24
C398: 0B F0 03 4C B6 C0 EE 21 6B
C3A0: D0 4C B6 C0 20 07 C3 AD CD
C3A8: 10 D0 D0 09 AD 00 D0 C9 AB
C3B0: 5E F0 09 90 28 A9 20 81 0D
C3B8: FE 4C 46 C2 A9 56 8D 00 9A
C3C0: D0 A9 01 8D 10 D0 AD 01 59
C3C8: D0 69 07 C9 F0 F0 06 8D 49
C3D0: 01 D0 4C B5 C3 A9 30 8D CF
C3D8: 01 D0 4C B5 C3 A9 56 8D FD
C3E0: 00 D0 A9 01 8D 10 D0 4C 17
C3E8: 46 C2 A9 5E 8D 00 D0 A9 02
C3F0: 00 8D 10 D0 A9 30 8D 01 C7
C3F8: D0 4C B6 C0 AD 41 C7 69 AD
C400: 7F 8D 41 C7 4C B6 C0 A9 83
C408: 08 85 FE A9 04 85 FF A2 6A
C410: 17 A0 1F A9 20 91 FE 88 C9
C418: D0 F9 18 A5 FE 69 28 85 B6
C420: FE A5 FF 69 00 85 FF CA 7E
C428: E0 FF D0 E5 4C EA C3 E0 9B
C430: 40 F0 1F A9 00 8D 21 D0 A9
C438: A0 09 20 82 C3 A9 C7 85 3F
C440: FF A9 8E 85 FE A9 00 8D 34
C448: EB C8 20 68 C0 20 E4 FF 4B
C450: F0 FB 20 70 C3 4C B6 C0 55
C458: A0 09 20 82 C3 A9 C7 85 5F
C460: FF A9 5E 85 FE A9 00 8D 24
C468: EB C8 20 68 C0 A0 10 20 37
C470: 82 C3 20 76 C5 AD F2 C8 7C
C478: F0 43 A9 01 8D F0 C8 20 BE
C480: 5E C5 A2 01 20 C9 FF AD DF
C488: 21 D0 20 D2 FF 20 BD C5 11
C490: A2 18 A0 1F B1 FE 20 D2 AE
```

```
C498: FF B1 FC 20 D2 FF 88 D0 93
C4A0: F3 20 CC C5 CA D0 EB A9 78
C4A8: 01 20 C3 FF 20 CC FF A9 24
C4B0: 2E 8D 00 D0 A9 70 8D 01 E5
C4B8: D0 A6 90 D0 06 20 70 C3 EB
C4C0: 4C B6 C0 4C 2F C4 A0 09 6E
C4C8: 20 82 C3 A9 C7 85 FF A9 CF
C4D0: 76 85 FE A9 00 8D EB C8 B7
C4D8: 20 68 C0 A0 10 20 82 C3 39
C4E0: 20 76 C5 AD F2 C8 F0 D5 6D
C4E8: A9 00 8D F0 C8 20 5E C5 1E
C4F0: A2 01 20 C6 FF 20 E4 FF 80
C4F8: 8D 21 D0 20 BD C5 A9 18 DD
C500: 8D EC C8 A9 1F 8D ED C8 50
C508: 20 E4 FF AC ED C8 91 FE 01
C510: 20 E4 FF AC ED C8 91 FC 07
C518: CE ED C8 AD ED C8 D0 E8 BB
C520: 20 CC C5 CE EC C8 AD EC F1
C528: C8 D0 D8 4C A7 C4 A0 09 FC
C530: 20 82 C3 A0 00 B9 46 C7 FE
C538: C9 00 F0 07 20 D2 FF C8 B5
C540: 4C 35 C5 20 E4 FF C9 00 56
C548: F0 F9 C9 30 90 F5 C9 3A B7
C550: B0 F1 38 E9 2F 8D 42 C7 DB
C558: 20 70 C3 4C B6 C0 AD F2 11
C560: C8 A0 C8 A2 F3 20 BD FF 07
C568: A9 01 A2 08 AC F0 C8 20 44
C570: BA FF 20 C0 FF 60 A9 00 16
C578: 8D F2 C8 20 E4 FF F0 FB B3
C580: C9 0D F0 1C C9 14 F0 19 4C
C588: C9 20 90 EF C9 60 B0 EB B9
C590: AC F2 C8 99 F3 C8 20 D2 42
C598: FF EE F2 C8 C0 0F D0 DB BF
C5A0: 60 AD F2 C8 C9 00 F0 D3 F8
C5A8: A9 9D 20 D2 FF A9 20 20 CC
C5B0: D2 FF A9 9D 20 D2 FF CE 8C
C5B8: F2 C8 4C 7B C5 A9 08 85 39
C5C0: FE 85 FC A9 04 85 FF A9 1F
C5C8: D8 85 FD 60 18 A5 FE 69 AB
C5D0: 28 85 FE A5 FF 69 00 85 12
C5D8: FF 18 A5 FC 69 28 85 FC A7
C5E0: A5 FD 69 00 85 FD 60 38 0A
C5E8: A5 FE E9 28 85 FE A5 FF C9
C5F0: E9 00 85 FF 38 A5 FC E9 25
C5F8: 28 85 FC A5 FD E9 00 85 B6
C600: FD 60 20 BD C5 A2 18 A0 5D
C608: 1F B1 FE 8D EC C8 B1 FC C9
C610: 8D ED C8 88 B1 FE 8D EA 06
C618: C8 B1 FC C8 91 FC AD EA 7F
C620: C8 91 FE 88 88 D0 ED C8 12
C628: AD EC C8 91 FE AD ED C8 80
C630: 91 FC 20 CC C5 CA D0 CF DC
C638: 4C B6 C0 20 BD C5 A2 18 5A
C640: A0 01 B1 FE 8D EC C8 B1 87
C648: FC 8D ED C8 C8 B1 FE 8D 90
C650: EA C8 B1 FC 88 91 FC AD 77
C658: EA C8 91 FE C8 C8 C0 20 0F
C660: D0 EB 88 AD EC C8 91 FE 99
C668: AD ED C8 91 FC 20 CC C5 0E
C670: CA D0 CD 4C B6 C0 A0 1F 5D
C678: A2 17 A9 A0 85 FE 85 FC 83
C680: A9 07 85 FF A9 DB 85 FD BF
C688: B1 FE 8D EC C8 B1 FC 8D B8
C690: ED C8 20 E7 C5 B1 FE 8D 53
C698: E8 C8 B1 FC 8D E7 C8 20 57
C6A0: CC C5 AD E8 C8 91 FE AD D0
C6A8: E7 C8 91 FC 20 26 C7 CA C0
C6B0: D0 E3 20 CC C5 AD EC C8 7B
C6B8: 91 FE AD ED C8 91 FC 88 C4
C6C0: D0 B6 4C B6 C0 A0 1F A2 6E
C6C8: 01 20 BD C5 B1 FE 8D EC 98
C6D0: C8 B1 FC 8D ED C8 20 CC 79
C6D8: C5 B1 FE 8D E8 C8 B1 FC 3D
C6E0: 8D E7 C8 20 E7 C5 AD E8 83
C6E8: C8 91 FE AD E7 C8 91 FC 2F
C6F0: 20 0B C7 E8 E0 18 D0 E1 78
C6F8: 20 E7 C5 AD EC C8 91 FE BA
C700: AD ED C8 91 FC 88 D0 BF 0C
C708: 4C B6 C0 18 A5 FE 69 50 42
C710: 85 FE A5 FF 69 00 85 FF 29
C718: 18 A5 FC 69 50 85 FC A5 B4
C720: FD 69 00 85 FD 60 38 A5 49
C728: FE E9 50 85 FE A5 FF E9 75
C730: 00 85 FF 38 A5 FC E9 50 CA
C738: 85 FC A5 FD E9 00 85 FD CB
C740: 60 20 05 00 00 00 20 43 29
C748: 55 52 53 4F 52 20 56 45 A0
C750: 4C 4F 43 49 54 59 20 28 6E
C758: 30 2D 39 29 20 00 20 53 AB
C760: 41 56 45 3E 20 20 20 20 FB
C768: 20 20 20 20 20 20 20 20 69
C770: 20 20 20 20 20 00 20 4C 7D
C778: 4F 41 44 3E 20 20 20 20 0C
C780: 20 20 20 20 20 20 20 20 81
C788: 20 20 20 20 20 00 05 20 4E
C790: 3C 3C 3C 3C 3C 3C 20 44 5E
C798: 49 53 4B 20 45 52 52 4F D9
C7A0: 52 20 3E 3E 3E 3E 3E 3E 88
C7A8: 20 00 FF F0 00 C0 30 00 AA
C7B0: C0 30 00 C0 30 00 C0 30 83
C7B8: 00 C0 30 00 C0 30 00 C0 5B
C7C0: 30 00 C0 30 00 FF F0 12 E4
C7C8: 90 20 97 20 98 20 9B 20 A5
C7D0: 05 20 1F 20 9A 20 9F 20 AF
C7D8: 0D 12 99 20 1E 20 9E 20 AE
C7E0: 96 20 1C 20 9C 20 81 20 32
C7E8: 95 20 0D 97 D5 C9 12 D5 CA
C7F0: C9 92 B0 AE 12 B0 AE 0D 2B
C7F8: CA CB 12 CA CB 92 AD BD 36
C800: 12 AD BD 0D B3 B1 DD DB A9
C808: D6 C0 B2 AB 0D 12 B3 B1 82
C810: DD DB D6 C0 B2 AB 0D D1 9E
C818: D7 D8 D3 DA C1 40 2A 0D B0
C820: A3 B7 B8 12 A2 B9 AF A4 F6
C828: 20 0D A4 AF B9 A2 12 B8 D0
C830: B7 A3 20 0D A7 B6 12 A1 CA
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering ***Ahoy!*** programs. Refer to these pages **before** entering any programs!

```
C838: B5 B4 92 DC A8 20 0D 12 F9
C840: AA B6 92 A1 B5 B4 A6 D9 C0
C848: 12 D4 0D C5 C4 C6 D2 CE 2F
C850: CD C8 12 C7 0D 12 C5 C4 6A
C858: C6 D2 CE CD 92 C7 12 C8 C3
C860: 0D BA CC 12 BA CC BF 92 E0
C868: 2B D4 12 D9 0D D0 CF 12 14
C870: D0 CF 92 BF 2D 5B 5D 0D 56
C878: 12 A9 DF 92 AC BB 12 AC CD
C880: BB 92 3C 3E 0D DF A9 BC 9C
C888: BE 12 BC BE 92 28 29 0D C5
C890: 41 42 43 44 45 46 47 48 B6
C898: 0D 49 4A 4B 4C 4D 4E 4F BB
C8A0: 50 0D 51 52 53 54 55 56 F4
C8A8: 57 58 0D 59 5A 24 27 2E 92
C8B0: 23 30 31 0D 32 33 34 35 11
C8B8: 36 37 38 39 0D 12 20 20 F6
C8C0: 20 20 20 20 20 20 20 92 34
C8C8: 20 20 9A 53 43 52 45 45 17
C8D0: 4E 20 4D 41 47 49 43 20 C1
C8D8: 20 42 59 20 42 4F 42 20 A8
C8E0: 53 50 49 52 4B 4F 00 01 BB
```

DUCK SHOOT

FROM PAGE 35

```
·5 PRINTCHR$(142):HS=0:GOSUB1100:POKE5328
0,0                                                EK
·10 PRINT"[HOME][DOWN][DOWN]"SPC(8)"[c 6]
[s Q][WHITE][s W][c 6][s Q][WHITE][s W][
c 6][s Q][WHITE][s W][c 6][s Q][WHITE][s
 W][c 6][s Q][WHITE][s W][c 6][s Q][WHIT
E][s W][c 6][s Q][WHITE][s W][c 6][s Q][
WHITE][s W][c 6][s Q][WHITE][s W][c 6][s
 Q][WHITE][s W]
[c 6][s Q][WHITE][s W]"                            AE
·20 PRINTSPC(7)"[WHITE][s W][RVSON][YELLO
W][sEP][RVSOFF][20" "][RVSON][c *][RVSOF
F][c 6][s Q]"                                      AC
·30 PRINTSPC(6)"[c 6][s Q][YELLOW][RVSON]
[sEP] [RVSOFF][20" "][RVSON] [c *][RVSOF
F][WHITE][s W]"                                    LO
·40 PRINTSPC(5)"[WHITE][s W][YELLOW][RVSO
N][sEP]  [RVSOFF][20" "][RVSON]  [c *][R
VSOFF][c 6][s Q]"                                  PO
·50 PRINTSPC(4)"[s Q][YELLOW][RVSON][sEP]
[3" "][RVSOFF][20" "][RVSON][3" "][c *][
RVSOFF][WHITE][s W]"                               BK
·60 PRINTSPC(4)"[WHITE][s W][YELLOW][RVSO
N][4" "][RVSOFF][20" "][RVSON][4" "][RVS
OFF][c 6][s Q]"                                    LG
·70 PRINTSPC(4)"[s Q][YELLOW][RVSON][4" "
][RVSOFF][20" "][RVSON][4" "][RVSOFF][WH
ITE][s W]"                                         OI
·80 PRINTSPC(4)"[WHITE][s W][YELLOW][RVSO
N][4" "][RVSOFF][20" "][RVSON][4" "][RVS
OFF][c 6][s Q]"                                    LG
·90 PRINTSPC(4)"[c 6][s Q][YELLOW][RVSON]
  [RVSOFF][sEP][22"[c T]"][c *][RVSON]
[RVSOFF][WHITE][s W]"                              KM
·100 PRINTSPC(4)"[WHITE][s W][YELLOW][sEP
][26"[c T]"][c *][c 6][s Q]"                       DI
·110 PRINTSPC(5)"[WHITE][28"[s Z]"]"               IK
·120 PRINTSPC(5)"[WHITE][s Z][s Z][RED][R
VSON][3" "][RVSOFF][WHITE][s Z][s Z][RED
][RVSON] [RVSOFF][WHITE][s Z][s Z][RED][
RVSON] [RVSOFF][WHITE][s Z][RED][RVSON][
4" "][RVSOFF][WHITE][s Z][RVSON][RED] [R
VSOFF][WHITE][s Z][s Z][RED][RVSON] [RVS
OFF][WHITE][s Z
][RED][RVSON][4" "][RVSOFF][WHITE][s Z][
s Z]"                                              GL
·130 PRINTSPC(5)"[WHITE][s Z][s Z][RVSON]
[RED] [RVSOFF][WHITE][s Z][s Z][RED][RVS
ON] [RVSOFF][WHITE][s Z][RED][RVSON] [RV
SOFF][WHITE][s Z][s Z][RVSON][RED] [RVSO
FF][WHITE][s Z][RVSON][RED] [RVSOFF][WHI
TE][4"[s Z]"][RVSON][RED] [RVSOFF][WHITE
][s Z][RED][RVS
ON] [RVSOFF][WHITE][s Z][s Z][RED][RVSON
] [RVSOFF][WHITE][5"[s Z]"]"                       FE
·140 PRINTSPC(5)"[WHITE][s Z][s Z][RED][R
VSON] [RVSOFF][WHITE][s Z][s Z][RED][RVS
ON] [WHITE][RVSOFF][s Z][RED][RVSON] [WH
ITE][RVSOFF][s Z][s Z][RED][RVSON] [WHIT
E][RVSOFF][s Z][RED][RVSON] [WHITE][RVSO
FF][4"[s Z]"][RED][RVSON] [WHITE][RVSOF
F][3"[s Z]"][RE
D][RVSON][4" "][WHITE][RVSOFF][s Z][s Z]
"                                                  JF
·150 PRINTSPC(5)"[WHITE][s Z][s Z][RED][R
VSON] [WHITE][RVSOFF][s Z][s Z][RED][RVS
ON] [WHITE][RVSOFF][s Z][RED][RVSON] [WH
ITE][RVSOFF][s Z][s Z][RED][RVSON] [WHIT
E][RVSOFF][s Z][RED][RVSON] [WHITE][RVSO
FF][4"[s Z]"][RED][RVSON] [WHITE][RVSOFF
][s Z][RED][RVS
ON] [WHITE][RVSOFF][5"[s Z]"][RED][RVSON
] [RVSOFF][WHITE][s Z][s Z]"                       MK
·160 PRINTSPC(5)"[WHITE][s Z][s Z][RED][R
VSON][3" "][WHITE][RVSOFF][s Z][s Z][RED
][RVSON][4" "][WHITE][RVSOFF][s Z][RED][
RVSON][4" "][WHITE][RVSOFF][s Z][RED][RV
SON] [WHITE][RVSOFF][s Z][s Z][RED][RVSO
N] [WHITE][RVSOFF][s Z][RED][RVSON][4" "
][WHITE][RVSOFF
][s Z][s Z]"                                       DH
·170 PRINTSPC(5)"[WHITE][28"[s Z]"]"               IK
·180 PRINTSPC(5)"[YELLOW][s O][4"[c T]"][
s P][CYAN]SHOOTING GALLERY[YELLOW][s O][
4"[c T]"][s P]"                                    JO
·190 PRINTSPC(5)"[c G][4" "][s N][16"[c T
```

```
]"][s M][4" "][c M]"                                                    OI
·200 PRINTSPC(5)"[YELLOW][s L][3"[c @]"][s N][RVSON][18" "][RVSOFF][s M][3"[c @]"][s @]"   ON
·210 PRINTSPC(8)"[YELLOW][c M][RVSON][20"[c U]"][RVSOFF][c G]"          CM
·215 PRINTSPC(8)"[YELLOW][c M][RVSON][20" "][RVSOFF][c G]"              OM
·220 FORD1=12288TO12350:READS1:POKED1,S1:NEXT                           JM
·230 FORD2=12352TO12414:READS2:POKED2,S2:NEXT                           DF
·240 FORD3=12416TO12478:READS3:POKED3,S3:NEXT                           PE
·250 V=53248:S=54272:POKEV+39,13:POKEV+40,7:POKEV+21,3:POKES+24,15:POKES,220   IK
·255 M=56320:O=65520:SC=0:TG=0:B=0:R=0                                  BP
·260 POKES+1,68:POKES+5,15:POKES+6,215:POKES+7,120:POKES+8,100:POKES+12,15   KP
·270 POKES+13,215:P1=192:P2=193:P3=195:X1=100:Y1=100:X2=70:H=2           JO
·280 Y2=INT(RND(1)*40)+70:R=R+1:POKEV+21,3:H=H+.4:IFH>33THENH=H-2.4      GA
·285 FORX2=70TO255STEPH                                                 GE
·290 POKE2040,P1                                                        BD
·300 POKE2041,P2:P2=P2+1:IFP2>194THENP2=193                             IC
·310 GOSUB500                                                           CN
·320 IFJV=1ORJV=5ORJV=9THENY1=Y1-4:IFY1<68THENY1=Y1+4                   HP
·330 IFJV=2ORJV=6ORJV=10THENY1=Y1+4:IFY1>118THENY1=Y1-4                  NK
·340 IFJV=4ORJV=5ORJV=6THENX1=X1-4:IFX1<90THENX1=X1+4                    LL
·350 IFJV=8ORJV=9ORJV=10THENX1=X1+4:IFX1>240THENX1=X1-4                  NO
·355 IFFR=0ANDPEEK(V+30)AND1=1THEN600                                   BO
·360 POKEV,X1:POKEV+1,Y1                                                GE
·370 POKEV+2,X2:POKEV+3,Y2                                              FL
·400 NEXTX2:IFR>3THENPOKEV+21,1:GOTO900                                 MP
·410 GOTO280                                                            CG
·500 JV=PEEK(M)                                                         LN
·510 FR=JVAND16                                                         AN
·520 JV=15-(JVAND15)                                                    GH
·530 RETURN                                                             IM
·600 POKEV+21,1:POKES+4,129:POKES+4,128:R=0                             IK
·605 IFNOTPEEK(V+30)AND1=1THEN610                                       ME
·610 POKEV+2,70:POKEV+3,90                                              OI
·630 SC=SC+1:IFSC=10ORSC=20ORSC=30ORSC=40ORSC=50ORSC=60ORSC=70ORSC=80THEN700   OH
·650 GOTO280                                                            CG
·700 FORL=1TO10:W=0:Y=INT(RND(1)*12)+12:X=INT(RND(1)*5)+5               NB
·701 POKE783,PEEK(783)AND254:POKE781,X:POKE782,Y:SYSO:PRINT"[RED][s W]"   FE
·705 GOSUB500                                                           CN
·706 IFJV=1ORJV=5ORJV=9THENY1=Y1-4:IFY1<68THENY1=Y1+4                   HP
·707 IFJV=2ORJV=6ORJV=10THENY1=Y1+4:IFY1>118THENY1=Y1-4                  NK
·708 IFJV=4ORJV=5ORJV=6THENX1=X1-4:IFX1<90THENX1=X1+4                    LL
·709 IFJV=8ORJV=9ORJV=10THENX1=X1+4:IFX1>240THENX1=X1-4                  NO
·720 IFFR=0ANDPEEK(V+31)AND1=1THEN800                                   KP
·730 W=W+1                                                              EF
·740 IFSC<40ANDW=30THENSYSO:PRINT" ":NEXTL:PRINT" "                     GA
·745 IFSC=>40ANDW=25THENSYSO:PRINT" ":NEXTL:PRINT" "                    OI
·750 POKEV,X1:POKEV+1,Y1                                                GE
·760 IFL<11THEN705                                                      EB
·780 PRINT" ":GOTO280                                                   GN
·800 POKES+4,33:POKES+4,32:POKE783,PEEK(783)AND254:POKE781,X:POKE782,Y:SYSO:PRINT" "   JA
·805 TG=TG+50                                                           AC
·810 IFNOTPEEK(V+31)AND1=1THENNEXTL                                     AP
·820 POKE783,PEEK(783)AND254:POKE781,X:POKE782,Y:SYSO:PRINT" ":GOTO280  OI
·900 POKEV+21,1:CS=SC*25+TG:PRINT"[HOME][3"[DOWN]"]"SPC(14)"[CYAN]SCORE:"CS   LH
·905 IFCS>HSTHENHS=CS                                                   AE
·910 FORL=1TO10                                                         MO
·920 PRINT"[HOME][4"[DOWN]"]"SPC(14)"[c 8][RVSON]GAME[RVSOFF][3" "][RVSON]OVER[RVSOFF]":FORG=1TO50:NEXTG   AE
·930 PRINT"[HOME][4"[DOWN]"]"SPC(14)"[c 8]GAME[3" "]OVER":FORG=1TO50:NEXTG   BK
·940 NEXTL:PRINT"[HOME][8"[DOWN]"]"SPC(11)"[WHITE]HIGH SCORE:"HS        LF
·945 Y2=INT(RND(1)*25)+75                                               MI
·950 FORX2=75TO255STEP5                                                 GA
·955 POKEV+2,X2:POKEV+3,Y2                                              FL
·960 POKE2041,193                                                       DB
·970 IFA$=""THENPRINT"[HOME][6"[DOWN]"]"SPC(9)"[WHITE]HIT ANY KEY TO START":FORG=1TO50:NEXT   FD
·980 PRINT"[HOME][6"[DOWN]"]"SPC(9)"[PURPLE]HIT ANY KEY TO START":FORG=1TO50:NEXT   LI
·985 POKE2041,194                                                       DA
·990 GETA$:IFA$=""THENGOTO1000                                          DI
·1000 IFA$<>""THEN1020                                                  AF
·1010 NEXTX2:GOTO945                                                    HG
·1020 PRINT"[HOME][3"[DOWN]"]"SPC(14)"[13" "]"                          DE
·1030 PRINT"[HOME][4"[DOWN]"]"SPC(14)"[11" "]"                          DE
·1040 PRINT"[HOME][6"[DOWN]"]"SPC(9)"[20" "]"                           JK
·1045 PRINT"[HOME][8"[DOWN]"]"SPC(11)"[17" "]"                          JM
·1050 GOTO255                                                           CG
·1100 POKE53281,7:POKE53280,0                                           CI
·1120 PRINT"[CLEAR][HOME]"SPC(13)"[RED][3
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering ***Ahoy!*** programs. Refer to these pages **before** entering any programs!

```
"*"][BLACK]WELCOME[RED][3"*"]"                                  JK
·1140 PRINT"[DOWN]"SPC(14)"[BLUE]DUCK--SH
OOT"                                                            PN
·1160 PRINTSPC(8)"[BLUE]A SHOOTING GALLER
Y GAME[DOWN]"                                                   HI
·1180 PRINTSPC(5)"[BLACK]DUCKS ARE WORTH
25 PTS EACH[DOWN]"                                              HE
·1200 PRINTSPC(5)"WHEN YOU SHOOT DOWN 10
DUCKS[DOWN]"                                                    CC
·1210 PRINTSPC(5)"YOU ENTER A TIMED TARGE
T ROUND[DOWN]"                                                  BK
·1220 PRINTSPC(5)"TARGETS ARE WORTH 50 PT
S EACH[DOWN]"                                                   NC
·1230 PRINTSPC(5)"THE MORE DUCKS YOU [RED
]SHOOT[BLACK] DOWN[DOWN]"                                       GJ
·1240 PRINTSPC(5)"THE [RED]FASTER[BLACK]
THEY WILL GO[DOWN]"                                             MF
·1241 PRINTSPC(5)"WHEN YOU MISS 4 DUCKS I
N A ROW[DOWN]"                                                  NN
·1242 PRINTSPC(5)"THE GAME IS OVER[DOWN]"                       JE
·1245 PRINTSPC(5)"USE JOYSTICK--PORT #2"                        GJ
·1250 PRINT"[HOME][23"[DOWN]"]"SPC(8)"[GR
EEN]PRESS ANY KEY TO BEGIN":FORL=1TO90:N
EXT                                                             FI
·1255 PRINT"[HOME][23"[DOWN]"]"SPC(8)"[YE
LLOW]PRESS ANY KEY TO BEGIN":FORL=1TO10:
NEXT                                                            HH
·1260 GETA$:IFA$=""THEN1250                                     KE
·1270 PRINT"[CLEAR]":POKE53281,6                                KA
·1300 RETURN                                                    IM
·2000 DATA 0,0,0,0,0,0,0,0                                      FG
·2010 DATA 0,0,0,0,0,0,0,0                                      FG
·2020 DATA 0,0,0,0,0,0,40,0                                     HH
·2030 DATA 0,146,0,1,17,0,1,85                                  MC
·2040 DATA 0,1,17,0,0,146,0,0                                   LK
·2050 DATA 40,0,0,0,0,0,0,0                                     FP
·2060 DATA 0,0,0,0,0,0,0,0                                      FG
·2070 DATA 0,0,0,0,0,0,0                                        PD
·2080 DATA 0,0,0,0,0,0,0,0                                      FG
·2090 DATA 0,0,0,0,0,0,0,0                                      FG
·2100 DATA 0,160,0,1,80,0,1,31                                  NJ
·2110 DATA 0,2,213,0,5,0,2,169                                  AH
·2120 DATA 0,11,233,64,53,86,32,238                             BH
·2130 DATA 236,32,21,64,32,5,128,64                             BB
·2140 DATA 0,85,0,0,0,0,0,0                                     KC
·2150 DATA 0,0,0,0,0,0,0,0                                      PD
·2160 DATA 0,0,0,0,0,0,0,0                                      FG
·2170 DATA 0,0,0,0,0,0,0,0                                      FG
·2180 DATA 0,160,0,1,80,0,1,31                                  NJ
·2190 DATA 0,2,240,0,5,14,2,169                                 DL
·2200 DATA 0,11,233,64,53,86,32,239                             BG
·2210 DATA 188,32,21,64,32,5,128,64                             KH
·2220 DATA 0,85,0,0,0,0,0,0                                     KC
·2230 DATA 0,0,0,0,0,0,0,0                                      PD
```

SCREEN DUMPING

FROM PAGE 73

VERSION I

```
·1 REM BEFORE LOADING THIS PROGRAM YOU MU
 ST POKE44,64:POKE16384,0:NEW                                   KA
·20 B=8192 :POKE53272,24                                        CN
·25 POKE 53265,PEEK(53265) OR 32                                AL
·30 FOR I=0 TO 7999 : POKE B+I,0 : NEXT                         GC
·40 FOR J=1024 TO 2043 :POKEJ,1:NEXT                            PO
·100 FOR X = 0 TO 319 STEP .4                                   BO
·105 Y=INT(100-(100*COS(X/05))*EXP(-X/240
 ))                                                             FJ
·150 CHAR=INT(X/8)                                              PI
·155 ROW=INT(Y/8)                                               AG
·160 LINE=Y AND 7                                               BC
·165 BYTE = B + ROW*320 + CHAR*8 + LINE                         AF
·170 BIT=7-(X AND 7)                                            PJ
·175 POKE BYTE,PEEK (BYTE) OR (2[UPARROW]
 BIT)                                                           DO
·180 NEXT X                                                     NK
·190 GET A$: IF A$<>CHR$(133) THEN 190                          IH
·205 OPEN4,4,5:CMD4:PRINT CHR$(10) CHR$(1
 0)                                                             HO
·210 PRINT CHR$(27)"@":PRINT CHR$(27) CHR
 $(51) CHR$(16)                                                 AF
·215 PRINT"[10" "]";                                            FG
·220 PRINT"[54"-"]"CHR$(10)                                     JK
·225 FORL=0 TO 24:PRINT CHR$(27) CHR$(76)
  CHR$(249) CHR$(2);                                            FK
·230 FOR I=1 TO 119:PRINT CHR$(0);:NEXTI:
 PRINT CHR$(245);                                               LD
·235 FOR CR = 0 TO 39:                                          EI
·240 FOR P  = 0 TO 7:PBYT=0:E=2[UPARROW](
 7-P)                                                           HE
·245 FOR LC = 0 TO 7                                            NM
·250 PBYT = PBYT-((PEEK(B+LC) AND E)>0)*2
 [UPARROW](7-LC)                                                PI
·255 NEXT LC: PRINT CHR$(PBYT) CHR$(PBYT)
 ;                                                              AM
·260 NEXT P : B=B+8                                             CN
·265 NEXT CR: PRINT CHR$(245) CHR$(10);                         EP
·270 NEXT L:PRINT CHR$(27)"@"                                   KP
·275 PRINT"[10" "]";                                            FG
·280 PRINT"[54"-"]"                                             ON
·285 PRINT#4,:CLOSE4                                            AO
·290 END                                                        IC
```

VERSION II

```
·1 REM BEFORE LOADING THIS PROGRAM YOU MU
 ST POKE44,64:POKE16384,0:NEW                                   KA
·5 S0 = PEEK(46)*256 + PEEK(45) : S1 = S0
 -210 : S2 = S0-150 : B = 8192                                  JL
·30 SYS S1                                                      CF
·100 FOR X = 0 TO 319 STEP .4                                   BO
```

All the programs in this issue of *Ahoy!* are available on disk or cassette. See page 53.

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 85 and 86 explain these codes and provide other essential information on entering ***Ahoy!*** programs. Refer to these pages **before** entering any programs!

```
·105 Y=INT(100-(100*COS(X/05))*EXP(-X/240
))                                          FJ
·150 CHAR=INT(X/8)                          PI
·155 ROW=INT(Y/8)                           AG
·160 LINE=Y AND 7                           BC
·165 BYTE = B + ROW*320 + CHAR*8 + LINE     AF
·170 BIT=7-(X AND 7)                        PJ
·175 POKE BYTE,PEEK (BYTE) OR (2[UPARROW]
BIT)                                        DO
·180 NEXT X                                 NK
·190 GET A$: IF A$<>CHR$(133) THEN 190      IH
·195 POKE 251,0 : POKE 252,32               KO
·200 FOR I = 0 TO 7 : POKE 2048+I,2[UPARR
OW]I : NEXT                                 FP
·205 OPEN4,4,5:CMD4:PRINT CHR$(10) CHR$(1
0)                                          HO
·210 PRINT CHR$(27)"@":PRINT CHR$(27) CHR
$(51) CHR$(16)                              AF
·215 PRINT"[10" "]";                        FG
·220 PRINT"[54"-"]"CHR$(10)                 JK
·225 FORL=0 TO 24:PRINT CHR$(27) CHR$(76)
 CHR$(250) CHR$(2);                         IA
·230 SYS S2                                 CE
·265 PRINT CHR$(245) CHR$(10);              PC
·270 NEXT L:PRINT CHR$(27)"@"               KP
·275 PRINT"[10" "]";                        FG
·280 PRINT"[54"-"]"                         ON
·285 PRINT#4,:CLOSE4                        AO
·290 END                                    IC
```

Machine code to be appended to VERSION II
(see article for instructions)

```
169 24 141 24 208 169 32 13 17 208 141 17
208 169 32 133 252 160 0 132 251 169 0 145
251 200 208 251 166 252 232 134 252 224 64
208 242 169 4 133 252 132 251 169 1 145
251 200 208 251 166 252 232 134 252 224  8
208 242 96 162 0 169 0 32 210 255 232 224
120 208 246 169 245 32 210 255 169 0 141 8
8 141 9 8 141 10 8 141 11 8 169 7 56 237 9
8 170 189 0 8 141 12 8 169 7 56 237 10 8
170 189 0 8 141 13 8 172 10 8 177 251 45
12 8 240 10 173 13 8 24 109 11 8 141 11 8
174 10 8 232 142 10 8 224 8 208 212 173 11
8 32 210 255 32 210 255 169 0 141 10 8 141
11 8 174 9 8 232 142 9 8 224 8 208 171 169
0 141 9 8 169 8 24 101 251 133 251 144 5
166 252 232 134 252 174 8 8 232 142 8 8
224 40 208 141 96
```

SPEEDY

FROM PAGE 56

```
·2 GOTO85                                   PL
·4 P=-22:GOTO39                             GG
·5 P=+22:GOTO39                             FB
·7 P=-1:GOTO39                              AK
·8 P=-23:GOTO39                             FB
·9 P=+21:GOTO39                             GG
·11 P=+1:GOTO39                             BF
·12 P=-21:GOTO39                            EL
·13 P=+23:GOTO39                            FE
·15 POKEE-2,241:O=O+7:POKEE,241:F=F+1:IFF
=ZTHEN52                                    ED
·16 POKEE,135:POKEE-2,0:GOTO48              CP
·30 PRINT"[CLEAR]":V=36878:POKEV,15:POKEV
-9,255:POKEV+1,8:E=36876:A=7911:B=30720:
Z=Z+5:P=0                                   FI
·31 TT=INT(RND(1)*400)+7746:POKETT,3        EP
·32 FORT=1TOZ+EC*2:POKEE,135:TT=INT(RND(1
)*418)+7746:POKETT+B,4:POKETT,2:POKEE,0:
NEXT                                        GI
·34 FORT=1TOZ:POKEE,241:TT=INT(RND(1)*418
)+7746:IFPEEK(TT)=1THENF=F+1                BD
·35 POKETT+B,5:POKETT,1:POKEE,0:NEXT        IJ
·36 FORT=1TO500:NEXT:POKEE,135:POKEE-1,13
5                                           OB
·38 POKEA+B,2:POKEA,.:POKEG,32:D=PEEK(828
):SYS831:ONDGOTO4,5,6,7,8,9,10,11,12,13     AJ
·39 G=A:A=A+P:PRINT"[HOME][WHITE][RVSON]S
CORE=";O;" CLONES=";S:Q=PEEK(A):IFQ=1THE
N15                                         LJ
·41 IFQ=2THEN60                             NO
·42 IFQ=3THEN56                             NG
·43 IFA>8142THENA=A-484                     GL
·44 IFA<7724THENA=A+484                     IB
·48 GOTO38                                  PB
·52 POKEG,32:POKEA,.:POKEA+B,2:POKEE-2,24
1:FORT=1TO500:NEXT:POKEE-1,241:FORT=1TO5
00:NEXT                                     OI
·53 RL=RL+1:POKEE,241:FORT=1TO900:NEXT:PO
KEE,.:POKEE-2,.:POKEE-1,.                   MP
·54 S=S+1:P=0:F=0:GOTO30                    DP
·56 POKEE,0:POKEG,32:POKEA,.:POKEA+B,2:PO
KEE,155:GOSUB59:POKEE,0:GOSUB59:POKEE,20
0                                           MI
·57 GOSUB59:POKEE,0:GOSUB59:POKEE,241:GOS
UB59:POKEE,0:GOSUB59:POKEE,135:O=O+F*EC:
P=0                                         DH
·58 GOTO43                                  PB
·59 FORT=1TO100:NEXT:RETURN                 HC
·60 POKEG,32:POKEA,4:POKEA+B,7:FORT=15TO0
STEP-1:POKEV,T:POKEE+1,225+T:NEXT:POKEE+
1,0                                         PA
·62 S=S-1:IFS=0THEN65                       CE
·63 P=0:F=0:Z=Z-5:GOTO30                    BG
·65 O=O+RL*50:PRINT"[HOME][11"[DOWN]"] [5
"[RIGHT]"][RVSON][YELLOW]GAME OVER[BLACK
]":FORT=1TO1000:NEXT:IFO>LTHENL=O           IG
·66 POKE36879,24:PRINT"[CLEAR][DOWN][RVSO
N]YOUR[DOWN][4"[LEFT]"]SCORE=";O:PRINT"[
3"[DOWN]"][RVSON]HIGH[DOWN][4"[LEFT]"]SC
```

```
ORE=";L                                                    FJ
·67 IFO<LANDL-O<5OTHENPRINT"[DOWN][DOWN][                  BM
 RVSON]CLOSE,BUT NOT CLOSE[6" "]ENOUGH."
·68 PRINT"[DOWN][DOWN][RVSON]YOU GOT TO S                  NP
 CREEN";RL:PRINTRL*5O;"[RVSON]BONUS.":PRI
 NT"[3"[DOWN]"][RVSON]HIT A KEY TO TRY AG
 AIN"
·69 GETA$:IFA$=""THEN69                                    GE
·7O P=O:O=O:F=O:Z=O:GOTO99                                 JJ
·72 POKE36879,8:PRINT"[CLEAR][3"[DOWN]"][                  MJ
 8"[RIGHT]"][RVSON][YELLOW]S[RED]P[GREEN]
 E[CYAN]E[PURPLE]D[YELLOW]Y":PRINT"[DOWN]
 [PURPLE][8"[RIGHT]"]BY[DOWN][LEFT][LEFT]
 KEVIN[DOWN][5"[LEFT]"]DEWEY"
·73 POKE36869,24O:PRINT"[DOWN][GREEN]SKIL                  FF
 L LEVEL(1-15)";:INPUTEC
·74 IFEC<1OREC>15THEN72                                    EE
·75 GOTO3O                                                 OJ
·85 POKE52,28:POKE56,28:CLR:FOR A=828 TO                   AC
 881:READB:POKEA,B:NEXT
·86 FORI=7168TO7679:POKEI,PEEK(I+256OO):N                  MH
 EXT:FORC=7168TO72O8:READB:POKEC,B:NEXT
·9O DATA O,O,O,169,127,141,34,145,169,O,1                  EL
 41,19,145,173,32,145,74,74,41,32,141,62,
 3
·91 DATA 173,17,145,41,28,13,62,3,74, 74,                 MD
 73,15,141,6O,3,173,17,145,41,32
·92 DATA 73,32,141,61,3,169,255,141,34,14                  PJ
 5,96
·93 DATA6O,126,219,255,231,189,66,6O,255,                  IH
 126,9O,255,165,189,129,255,255,9O,126,23
 1,255
·94 DATA129,189,255,255,145,145,159,249,1                  JN
 37,137,255,137,74,44,224,7,52,82,145,O,O
·99 S=7:RL=1:GOTO72                                        BI
```

MAPPING 4.4

FROM PAGE 45

```
·1 REM ********************************                   DN
·2 REM *          MAPPING 4.4           *                 HN
·3 REM *              BY                *                 IA
·4 REM *          J.M.MARCANO           *                 PB
·5 REM ********************************                   DN
·6 REM              8/29/84                               AN
·1O REM ****** CENTRAL SECTION ******                      II
·15 POKE5328O,8:POKE53281,O:D$="? ? ?"                     NF
·2O PRINTCHR$(147):FORI=1TO11:PRINT:NEXT:                  GA
 PRINTCHR$(158)SPC(17)"WAIT"
·25 FOR AD=828TO888:READVA:POKEAD,VA:NEXT                  GM
 AD
·3O FORI=49152TO49543:READC:POKEI,C:NEXT                   HE
·4O SYS49OO9:SYS49385:POKE81,197:SYS49512                  EA
 :GOSUB16O:SYS49152:GOSUB1OO:GOSUB35O
·5O REM ** ALL THE FUNCTIONS COME HERE **                  LL
·55 DEFFNF(X)=SIN(X)                                       EN
·6O GOSUB21O                                               CD
·7O ONKGOTO26O,79O,49O,28O,81O,83O,85O,6O                  LL
·1OO REM *** DIRECTORY FOR F'S KEYS ****                   FK
·11O PRINTCHR$(19)CHR$(3O):FORI=1TO2O:PRI                  OP
 NT:NEXT
·115 PRINT" F1:GRAPHIC CLEANER[7" "]F2:ST                  DB
 ORE(M+)"
·12O PRINT" F3:RANGE CHANGER[9" "]F4:RECA                  LD
 LL"
·13O PRINT" F5:FUNCTION CHANGER[6" "]F6:C                  NK
 LEAR MRY"
·14O PRINT" F7:COMPARE WITH MRY[6" "]F8:N                  HL
 O DEFINED"CHR$(19)CHR$(154)
·15O RETURN                                                IM
·16O REM **TRANSFER THE CHAR. TO SCREEN**                  BI
·17O C=55341:J=1O69:L=1O6                                  FH
·18O FORI=OTO14:POKEJ+I,L:POKEC+I,1:L=L+1                  BA
 :NEXT
·19O C=C+4O:J=J+4O:IFJ<1464THEN18O                         ML
·2OO RETURN                                                IM
·2O5 REM *** SET UP ERROR TRAPPING IN 87O                  CL
 ***
·2O6 T$="GOTO"+STR$(87O)+CHR$(O)                           MJ
·2O7 FOR AD=1 TO LEN(T$):POKE891+AD,ASC(M                  PG
 ID$(T$,AD,1)):NEXTAD
·2O8 SYS875                                                EF
·2O9 RETURN                                                IM
·21O REM ****** INPUT SUBROUTINE ******                    BK
·215 GOSUB2O5                                              CJ
·22O GETK$:IFK$=""THEN22O                                  GH
·23O IFK$=CHR$(133)ORK$=CHR$(134)ORK$=CHR                  PH
 $(135)ORK$=CHR$(136)THEN24O
·231 IFK$=CHR$(137)ORK$=CHR$(138)ORK$=CHR                  IG
 $(139)ORK$=CHR$(14O)THEN24O
·235 GOTO22O                                               BM
·24O K=ASC(K$)-132                                         NL
·25O RETURN                                                IM
·26O REM **CLEAR CHAR.** (F1 ROUTINE)                      MI
·27O SYS49385:GOTO6O                                       MA
·28O REM **CLEAR OPERATION** (F7 ROUTINE)                  ON
·285 ONNGOTO29O,295                                        NP
·29O POKE81,2O2:SYS49512:POKE81,2O2:SYS49                  JB
 416:POKE81,197:SYS49464:N=2:GOTO6O
·295 SYS49385:POKE81,2O2:SYS49464:N=1:GOT                  HM
 O6O
·3OO REM *** CLEAR DATA AREA ***                           CG
·31O FORJ=1O64TO1424STEP4O                                 NL
·32O FORI=J+23TOJ+39:POKEI,32:NEXTI:NEXTJ                  KF
 :RETURN
·33O REM *** CLEAR WORK AREA ***                           GD
·34O FORI=1544TO1743:POKEI,32:NEXT:RETURN                  CI
·35O REM *** SET UP DATA AREA ***                          FM
·36O PRINTCHR$(19)CHR$(159):PRINT:PRINTTA                  GM
 B(23)"XO=";XO
·37O PRINTTAB(23)"XM=";XM                                  NO
·38O PRINTTAB(23)"YO=";YO                                  LI
·39O PRINTTAB(23)"YM=";YM                                  OK
·4OO PRINT:PRINTTAB(23)"PIXELS:";DX                        BA
·41O PRINT:PRINTTAB(23)"DATA FROM "CHR$(1                  FD
 54);D$
```

```
·420 RETURN                                          IM
·430 REM *** SET UP THE FUNCTION AREA ***           CN
·440 FORI=0TO39:POKE1784+I,32:NEXT                   JM
·450 PRINTCHR$(19)CHR$(159):FORI=1TO18:PR
 INT:NEXT:PRINT" Y=";A$                              KH
·460 RETURN                                          IM
·470 REM **** POSITION ON WORK AREA ****            BA
·480 PRINTCHR$(19):FORI=1TO13:PRINT:NEXT:
 RETURN                                              FI
·490 REM **INPUT FUNCTION **(F5 ROUTINE)            OD
·495 GOSUB330:GOSUB470                               IH
·500 PRINTCHR$(159)"ENTER THE 2DN MEMBER
 OF THE F'N ON X "                                   GE
·505 INPUTA$:IFLEN(A$)<29THEN510                     IH
·506 PRINT"MUST HAS LESS THAN 29 CHARACTE
 RS":FORI=0TO1000:NEXT:GOTO495                       FH
·510 GOSUB330:GOSUB430:PRINTCHR$(19)CHR$(
 144):FORI=1TO14:PRINT:NEXT:PRINT;                   NE
·520 PRINT"55D[s E]FNF(X)=";A$                       MA
·530 PRINT"RUN50                                     BO
·550 POKE631,13:POKE632,13:POKE633,13:POK
 E198,3:END                                          IL
·560 REM ***INPUT RANGE SUBROUTINE***                CP
·570 PRINTCHR$(154):GOSUB330:GOSUB470:INP
 UT"X0,XM";X0,XM                                     OJ
·580 IFX0<XMTHEN600                                  LA
·590 PRINT"MUST BE X0<XM":FORI=0TO1000:NE
 XT:GOTO570                                          AH
·600 GOSUB330:GOSUB470:INPUT"Y0,YM";Y0,YM KE
·610 IFY0<YMTHEN630                                  LH
·620 PRINT"MUST BE Y0<YM":FORI=0TO1000:NE
 XT:GOTO600                                          AF
·630 GOSUB330:GOSUB470:INPUT"AMOUNT OF PI
 XELS FOR THE GRAPHIC";DX                            AK
·635 IFDX>0THENGOSUB330:RETURN                       KL
·640 PRINT"MUST BE >0":FORI=0TO1000:NEXT:
 GOTO630                                             NH
·650 REM **** FUNCTION EVALUATER ****                ME
·660 IFSGN(X0)=SGN(XM)THEN670                        NP
·665 X=-X0*119/(XM-X0):FORY=0TO79STEP5:GO
 SUB750:NEXT                                         ID
·670 IFSGN(Y0)=SGN(YM)THEN700                        AB
·675 Y=Y0*79/(YM-Y0)+79:FORX=0TO119STEP5:
 GOSUB750:NEXT                                       KG
·700 SX=(XM-X0)/DX                                   ND
·710 FORI=X0TOXMSTEPSX                               ME
·720 F=FNF(I):IFF<Y0ORF>YMTHEN740                    CH
·730 X=(I-X0)/(XM-X0)*119:Y=(Y0-F)/(YM-Y0
 )*79+79:GOSUB750                                    LA
·740 NEXT:RETURN                                     EJ
·750 REM ****** GRAPHIC MAKER ******                 FJ
·760 RO=INT(Y/8):CH=INT(X/8):LI=YAND7                BN
·770 BIT=7-(XAND7):BYT=13136+RO*120+CH*8+
 LI:POKEBYT,PEEK(BYT)OR(2[UPARROW]BIT)               LC
·780 RETURN                                          IM
·790 REM **INPUT RANGE ROUTINE**(F3-ROUTI
 NE)                                                 PI
·800 D$="USER":GOSUB560:GOSUB300:GOSUB650
 :GOSUB350:GOTO60                                    BN
·810 REM **** STORE (F2-ROUTINE) ****                KA
·815 POKE81,197                                      MC
·820 SYS49416:X1=X0:X2=XM:Y1=Y0:Y2=YM:DM=
 DX:POKE55296,5:POKE1024,13:GOTO60                   MF
·830 REM **** RECALL **** (F4-ROUTINE)               LH
·840 POKE81,197:SYS49464:IFX1=X2THENGOTO6
 0                                                   NA
·842 D$="MEMORY":GOSUB300:X0=X1:XM=X2:Y0=
 Y1:YM=Y2:DX=DM:GOSUB350:GOTO60                      IB
·850 REM **MEMORY CLEANER** (F6-ROUTINE)             MN
·860 POKE81,197:SYS49512:POKE55296,0:GOTO
 60                                                  DM
·870 REM *** ERROR TRAPPING ***                      IL
·880 GOSUB470                                        CP
·885 EN=PEEK(889):IFEN>127THENPRINTCHR$(1
 9):FORI=1TO11:PRINT:NEXT:END                        MG
·900 IFEN=11THENPRINT"CHECK THE FUNCTION.
  USE <F5>"                                          KP
·910 IFEN=20THENPRINT"DIVISION BY ZERO.[4
 " "]CHANGE RANGE"                                   BE
·920 IFEN=25THENPRINT"THE FUNCTION IS TOO
  COMPLEX. REDEFINE IT"                              KC
·930 IFEN=15THENPRINT"NUMBER TOO SMALL OR
  TOO HIGH.REDIFINE IT"                              BF
·940 IFEN=5THENPRINT"DEVICE NOT PRESENT.
 REPEAT OPERATION"                                   DN
·950 GOTO50                                          PD
·5000 REM ** MACHINE LANGUAGE ROUTINES **            JA
·5010 REM 49152-SET UP THE FORMAT                    GM
·5020 REM 49309-MOVE CHARACTERS RAM[BACKA
 RROW]ROM                                            NP
·5030 REM 49385-CLEAR THESE CHARACTERS               DI
·5040 REM 49416-STORE ROUTINE                        HH
·5050 REM 49464-RECALL ROUTINE                       LC
·5060 REM 49512-CLEAR ROUTINE                        NE
·5070 REM 00875-SET UP TRAPPING                      FI
·5950 DATA169,139,141,0,3,169,227,141,1,3
 ,165,58,141,123                                     JE
·5960 DATA3,201,255,240,39,165,57,141,122
 ,3,142,121,3,160                                    CP
·5970 DATA0,185,124,3,153,0,2,240,3,200,2
 08,245,162,255                                      OP
·5980 DATA160,1,76,134,164,169,60,141,0,3
 ,169,3,141,1                                        NH
·5990 DATA3,96,108,0,3                               MJ
·6000 DATA169,61,162,40,157,223,5,157,207
 ,6,202,208,247,169,4,162,40,157,223,217             DN
·6010 DATA157,207,218,157,31,219,202,208,
 244,169,45,162,40,157,31,7,202,208,250              PI
·6020 DATA169,72,162,0,157,44,4,157,84,4,
 157,124,4,157,164,4,157,204,4,157,244               LH
·6030 DATA4,157,28,5,157,68,5,157,108,5,1
 57,148,5,208,5,162,16,169,71,76,43,192              PA
·6040 DATA169,13,162,0,157,44,216,157,84,
 216,157,124,216,157,164,216,157,204,216             CD
·6050 DATA157,244,216,157,28,217,157,68,2
 17,157,108,217,157,148,217,208,5,162,16             KH
```

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```
·6060 DATA76,86,192,169,69,162,15,157,188
,5,202,208,250,169,82,162,15,157,4,4      HB
·6070 DATA202,208,250,169,13,162,15,157,1
88,217,157,4,216,202,208,247,96,173,14    AH
·6080 DATA220,41,254,141,14,220,165,1,41,
251,133,1,169,0,133,80,133,78,169,208     DH
·6090 DATA133,81,169,48,133,79,162,8,160,
0,177,80,145,78,136,192,0,208,247,202     LB
·6100 DATA240,7,230,81,230,79,76,189,192,
165,1,9,4,133,1,173,14,220,9,1,141,14     BD
·6110 DATA220,173,24,208,41,240,9,12,141,
24,208,96                                 MK
·6120 DATA169,80,133,80,169,0,160,0,162,5
1,134,81,145,80,136,208,251,232,224,55    NE
·6130 DATA208,244,153,80,55,200,192,177,2
08,248,96                                 FA
·6140 DATA169,80,133,78,169,51,133,79,169
,0,133,80,234,234,234,234,162,5,160,0     FM
·6150 DATA177,78,17,80,145,80,200,208,247
,230,81,230,79,202,208,240,177,78,17      GC
·6160 DATA80,145,80,200,192,177,208,245,9
6,169,80,133,78,169,51,133,79,169,0       AG
·6170 DATA133,80,234,234,234,234,162,5,16
0,0,177,80,17,78,145,78,200,208,247       AI
·6180 DATA230,81,230,79,202,208,240,177,8
0,17,78,145,78,200,192,177,208,245,96     DE
·6190 DATA169,0,133,80,234,234,234,234,16
2,5,160,0,169,0,145,80,200,208,251        JD
·6200 DATA230,81,202,208,246,145,80,200,1
92,177,208,249,96                         NK
```

TOWERS OF HANOI

FROM PAGE 17

```
·10 REM - TOWERS OF HANOI FOR COMMODORE 6
4                                         OE
·20 REM - DANIEL MILLER                   DK
·30 REM - 2815 34 STREET                  OA
·40 REM - ASTORIA, QUEENS                 AL
·50 REM - NEW YORK, NEW YORK   11103      GM
·60 REM - SEPTEMBER 1, 1983               HN
·70 REM ********************************  DD
·80 GOTO2150                              FL
·90 POKE53281,1:ZZ=1:PRINTCL$;LEFT$(DO$,2
);TAB(11);HDG$;                           NF
·100 POKE55587,10:POKE1315,49:POKE55595,1
0:POKE1323,50:POKE55603,10:POKE1331,51    DF
·110 PRINT LEFT$(DO$,20);TAB(5);A$(1);LEF
T$(DO$,9);TAB(11);A$(3);                  EB
·120 PRINTLEFT$(DO$,9);TAB(19);A$(3);LEFT
$(DO$,9);TAB(27);A$(3)                    HK
·130 REM - PLACE SPRITES ON TOWER #1      PM
·140 POKEV+14,93:POKEV+15,160:POKEV+12,93
:POKEV+13,151:POKEV+10,93:POKEV+11,142    ML
·150 POKEV+8,93:POKEV+9,133:POKEV+6,93:PO
KEV+7,124:POKEV+4,93:POKEV+5,115          II
·160 POKEV+2,93:POKEV+3,106:POKEV+0,93:PO
KEV+1,97                                  OA
·170 IF YN$="Y" THENN2=8-NUM:GOTO200      FO
·180 IF ZZ=0 THEN350                      HO
·190 PRINTLEFT$(DO$,22);TAB(8);NUM$;:INPU
T NUM:N2=8-NUM:SP=0:IF NUM=8 THEN270      KC
·200 IF NUM<2 OR NUM>8 THENPRINT LEFT$(DO
$,22);TAB(5);SP$;:GOTO190                 MH
·210 IF NUM=8 AND YN$="Y" THEN270         HA
·220 N4=N2                                LG
·230 FOR X=1 TO N4                        NB
·240 SP=SP+(2[UPARROW](N4-1))             HP
·250 N4=N4-1:NEXT X                       KC
·260 POKEV+21,(255-SP)                    GP
·270 ZZ=0:FOR TM=1 TO 250:NEXT TM:PRINTLE
FT$(DO$,22);TAB(5);SP$;                   LF
·280 T1$="":T2$="":T3$="":N3=N2+1         DB
·290 FOR X=1 TO NUM:T1$=T1$+T4$(X):T2$=T2
$+T5$(X):T3$=T3$+T6$(X):NEXT X            GN
·300 IF YN$="Y" THEN1430                  BE
·310 FOR X=1 TO NUM:Y=2[UPARROW]X-1:NEXT
X                                         NG
·320 NUM$=RV$+G2$+STR$(NUM)+RO$+SLV$(1)+R
V$+G2$+STR$(Y)+SLV$(2):Y0=Y               NL
·330 PRINTLEFT$(DO$,22);TAB(6);NUM$;:FOR
TM=1 TO 2000:NEXT TM                      LF
·340 FOR TM=1 TO 250:NEXT TM:PRINTLEFT$(D
O$,22);TAB(5);SP$;                        PF
·350 PRINTLEFT$(DO$,22);TAB(6);F9$;"[4" "
]";TAB(24);T9$;"[4" "]";                  KA
·360 PRINTLEFT$(DO$,22);TAB(6);F9$;" ";CR
$;                                        GG
·370 NUM$="":SLV$(1)="":SLV$(2)=""        OD
·380 IF ZA=2 THEN420                      FP
·390 GET TWR$(1):IF TWR$(1)="" THEN390    AO
·400 IF TWR$(1)="[F1]" THEN1330:REM - 'F1
'                                         MN
·410 IF (TWR$(1)<"1" OR TWR$(1)>"3") THEN
TWR$(1)="":GOTO390                        FB
·420 PRINT RV$+RED$+TWR$(1)+RO$;          BN
·430 GOSUB520                             CL
·440 PRINTLEFT$(DO$,22);TAB(34);" ";CR$;  DN
·450 IF ZA=2 THEN480                      FB
·460 GET TWR$(2):IF TWR$(2)="" THEN460    GI
·470 IF TWR$(2)<"1" OR TWR$(2)>"3" THENTW
R$(2)="":GOTO460                          BK
·480 PRINT RV$+RED$+TWR$(2)+RO$;          FC
·490 IF TWR$(1)<>TWR$(2) THEN510          AJ
·500 ER$=RV$+RED$+" INVALID ENTRIES"+RO$:
GOTO610                                   BL
·510 GOTO640                              CG
·520 X=1:GOSUB530:RETURN                  GM
·530 ON VAL(TWR$(X)) GOTO540,560,580      GI
·540 IF VAL(T1$)=0 THEN600                HL
·550 RETURN                               IM
·560 IF VAL(T2$)=0 THEN600                FG
```

```
·570 RETURN                                                    IM
·580 IF VAL(T3$)=0 THEN600                                     HJ
·590 RETURN                                                    IM
·600 ER$=RV$+RED$+"TOWER # "+TWR$(X)+" IS
  EMPTY"+RO$                                                   HB
·610 FOR Y=1 TO 5:PRINTLEFT$(DO$,24);TAB(
 12)ER$;:FOR TM=1 TO 250:NEXT TM                               PJ
·620 PRINTLEFT$(DO$,24);TAB(12);LEFT$(SP$
 ,18);:FOR TM=1 TO 250                                         ND
·630 NEXT TM,Y:ER$="":GOTO350                                  NE
·640 ON VAL(TWR$(1)) GOTO650,680,710                           DN
·650 FOR X=1 TO NUM:IF MID$(T1$,X,1)="1"
 THEN670                                                       GA
·660 NEXT X:LOC(1)=160:GOTO740                                 GN
·670 LOC(1)=T1(N2+X):T4$(N2+X)="0":GOTO74
 0                                                             LF
·680 FOR X=1 TO NUM:IF MID$(T2$,X,1)="1"
 THEN700                                                       BP
·690 NEXT X:LOC(1)=160:GOTO740                                 GN
·700 LOC(1)=T2(N2+X):T5$(N2+X)="0":GOTO74
 0                                                             DB
·710 FOR X=1 TO NUM:IF MID$(T3$,X,1)="1"
 THEN730                                                       DD
·720 NEXT X:LOC(1)=160:GOTO740                                 GN
·730 LOC(1)=T3(N2+X):T6$(N2+X)="0"                             KB
·740 LC=LOC(1):GOSUB880:SP(1)=SP                               NF
·750 ON VAL(TWR$(2)) GOTO760,790,820                           OK
·760 FOR X=1 TO NUM:IF MID$(T1$,X,1)="1"
 THEN780                                                       GG
·770 NEXT X:LOC(2)=160:T4$(N2+X-1)="1":GO
 TO850                                                         IG
·780 LOC(2)=T1(N2+X-1):T4$(N2+X-1)="1":GO
 TO850                                                         EP
·790 FOR X=1 TO NUM:IF MID$(T2$,X,1)="1"
 THEN810                                                       GJ
·800 NEXT X:LOC(2)=160:T5$(N2+X-1)="1":GO
 TO850                                                         MD
·810 LOC(2)=T2(N2+X-1):T5$(N2+X-1)="1":GO
 TO850                                                         LN
·820 FOR X=1 TO NUM:IF MID$(T3$,X,1)="1"
 THEN840                                                       DJ
·830 NEXT X:LOC(2)=160:T6$(N2+X-1)="1":GO
 TO850                                                         LA
·840 LOC(2)=T3(N2+X-1):T6$(N2+X-1)="1"                         AF
·850 LC=LOC(2):GOSUB880:SP(2)=SP                               DJ
·860 T1$="":T2$="":T3$="":N5=N2+1                              OH
·870 FOR X=N5 TO 8:T1$=T1$+T4$(X):T2$=T2$
 +T5$(X):T3$=T3$+T6$(X):NEXT X:GOTO960                         EF
·880 IF LC=97 THENSP=1:RETURN                                  EN
·890 IF LC=106 THENSP=2:RETURN                                 GL
·900 IF LC=115 THENSP=3:RETURN                                 FA
·910 IF LC=124 THENSP=4:RETURN                                 HB
·920 IF LC=133 THENSP=5:RETURN                                 GO
·930 IF LC=142 THENSP=6:RETURN                                 HH
·940 IF LC=151 THENSP=7:RETURN                                 HM
·950 IF LC=160 THENSP=8:RETURN                                 GN
·960 ON VAL(TWR$(1)) GOTO970,980,990                           BP
·970 SQ%=R1%(1,SP(1)):R1%(1,SP(1))=8:GOTO
 1000                                                          FH
·980 SQ%=R2%(1,SP(1)):R2%(1,SP(1))=8:GOTO
 1000                                                          KN
·990 SQ%=R3%(1,SP(1)):R3%(1,SP(1))=8                          GI
·1000 ON VAL(TWR$(2)) GOTO1010,1020,1030                       HF
·1010 R1%(1,SP(2))=SQ%:GOTO1040                                IH
·1020 R2%(1,SP(2))=SQ%:GOTO1040                                KK
·1030 R3%(1,SP(2))=SQ%                                         EE
·1040 ON VAL(TWR$(1)) GOTO1050,1060,1070                       NM
·1050 X1=93:GOTO1080                                           DC
·1060 X1=157:GOTO1080                                          HJ
·1070 X1=222                                                   NL
·1080 ON VAL(TWR$(2)) GOTO1090,1100,1110                       JF
·1090 X2=93:GOTO1120                                           EA
·1100 X2=157:GOTO1120                                          IB
·1110 X2=222                                                   NO
·1120 REM - MOVE SPRITE                                        OB
·1130 ON SQ%+1 GOTO1140,1150,1160,1170,11
 80,1190,1200,1210                                             OC
·1140 SP=0:SQ=1:GOTO1220                                       KL
·1150 SP=2:SQ=3:GOTO1220                                       MP
·1160 SP=4:SQ=5:GOTO1220                                       BD
·1170 SP=6:SQ=7:GOTO1220                                       OH
·1180 SP=8:SQ=9:GOTO1220                                       ML
·1190 SP=10:SQ=11:GOTO1220                                     CK
·1200 SP=12:SQ=13:GOTO1220                                     CK
·1210 SP=14:SQ=15                                              JN
·1220 IF VAL(TWR$(1))>VAL(TWR$(2)) THEN12
 60                                                            PE
·1230 FOR YY=LOC(1) TO 55 STEP-1:POKE V+S
 P,X1:POKE V+SQ,YY:NEXT YY                                     EA
·1240 FOR XX=X1 TO X2:POKE V+SP,XX:POKE V
 +SQ,55:NEXT XX                                                BA
·1250 FOR YY=55 TO LOC(2):POKE V+SP,X2:PO
 KE V+SQ,YY:NEXT YY:GOTO1290                                   GE
·1260 FOR YY=LOC(1) TO 55 STEP-1:POKE V+S
 P,X1:POKE V+SQ,YY:NEXT YY                                     EA
·1270 FOR XX=X1 TO X2 STEP-1:POKE V+SP,XX
 :POKE V+SQ,55:NEXT XX                                         MO
·1280 FOR YY=55 TO LOC(2):POKEV+SP,X2:POK
 EV+SQ,YY:NEXT YY                                              NM
·1290 MV=MV+1:PRINTLEFT$(DO$,24);TAB(17);
 MV$+RV$+B2$+STR$(MV)+RO$;                                     HD
·1300 IF ZA=2 THENMW=MW+1:GOTO1440:REM -
 COMPUTER'S NEXT MOVE                                          JG
·1310 GOTO350:REM - PLAYER'S NEXT MOVE                         GN
·1320 REM - COMPUTER SOLUTION                                  NO
·1330 TWR$(1)="":PRINTLEFT$(DO$,24);TAB(7
 );CMP$;                                                       HJ
·1340 GET YN$:IF YN$="" THEN1340                               ID
·1350 IF YN$="Y" THEN1370                                      BH
·1360 IF YN$<>"N" THENYN$="":GOTO1330                          JG
·1370 PRINT RV$+BL$+" "+YN$+RO$;:FOR TM=1
  TO 500:NEXT TM:IF YN$="Y" THEN1420                           JF
·1380 FOR TM=1 TO 1000:NEXT TM                                 MJ
·1390 PRINTLEFT$(DO$,24);TAB(7);SP$;LEFT$
 (DO$,24);TAB(9);EN$;                                          OD
·1400 GET RT$:IF RT$<>CHR$(13) THEN1400                        BI
```

```
FH ·1410 POKE V+21,0:PRINT CL$;:END
0  ·1420 SP=0:MV=0:MW=1:GOTO1990
KN ·1430 YN$="":ZA=2:PRINTLEFT$(DO$,24);TAB(
GI  7);SP$;
HF ·1440 BI$="":FOR X=1 TO 8:BI$(X)="0":NEXT
IH   X
KK ·1450 IF MV=Y0 THEN1380
EE ·1460 CT=FRE(0)
NM ·1470 C2=0:C3=0:C4=0:C5=0:C6=0:ZA=2
DC ·1480 DEC=MW
HJ ·1490 FOR Y=0 TO 8:IF INT(2[UPARROW]Y)>DE
NL  C THENY=Y-1:BI$(Y)="1":GOTO1510
JF ·1500 BI$(Y)="0":NEXT Y
EA ·1510 DEC=DEC-2[UPARROW]Y:IF DEC=0 THEN15
IB  30
NO ·1520 GOTO1490
OB ·1530 FOR Y=7 TO 0 STEP-1:BI$=BI$+BI$(Y):
1   NEXT Y
OC ·1540 FOR X=8 TO 1 STEP-1:IF MID$(BI$,X,1
KL  )="0" THENC2=C2+1:NEXT X
MP ·1550 C2=C2+1
BD ·1560 RI%=C2+NUM-1:ON NUM-1 GOTO1570,1580
OH  ,1590,1600,1610,1620,1630
ML ·1570 RI%=RI%+4:GOTO1640
CK ·1580 RI%=RI%+2:GOTO1640
CK ·1590 GOTO1640
JN ·1600 RI%=RI%-2:GOTO1640
2  ·1610 RI%=RI%-4:GOTO1640
PE ·1620 RI%=RI%-6:GOTO1640
S  ·1630 RI%=ABS(RI%-8)
EA ·1640 FOR X=1 TO 8:IF R1%(1,X)=RI% THENTW
V   R$(1)="1":GOTO1670
BA ·1650 NEXT X:FOR X=1 TO 8:IF R2%(1,X)=RI%
0    THENTWR$(1)="2":GOTO1670
GE ·1660 NEXT X:TWR$(1)="3"
S  ·1670 L$=TWR$(1)
EA ·1680 FOR X=1 TO 8:IF MID$(BI$,X,1)="1" T
X   HENC3=C3+1:NEXT X:GOTO1700
MO ·1690 NEXT X
K  ·1700 IF C3>1 THEN1740
NM ·1710 IF VAL(T1$)=0 THENTWR$(2)="1":GOTO3
;   50
HD ·1720 IF VAL(T2$)=0 THENTWR$(2)="2":GOTO3
     50
JG ·1730 IF VAL(T3$)=0 THENTWR$(2)="3":GOTO3
GN   50
NO ·1740 FOR X=8 TO 1 STEP-1:C4=C4+1:IF MID$
7   (BI$,X,1)="0" THENNEXT X
HJ ·1750 C6=C4
ID ·1760 FOR X=8-C4 TO 1 STEP-1:C6=C6+1:IF M
BH  ID$(BI$,X,1)="0"THENC5=C5+1:NEXT X
JG ·1770 RJ%=C6+NUM-1:ON NUM-1 GOTO1780,1790
1   ,1800,1810,1820,1830,1840
JF ·1780 RJ%=RJ%+4:GOTO1850
MJ ·1790 RJ%=RJ%+2:GOTO1850
$  ·1800 GOTO1850
OD ·1810 RJ%=RJ%-2:GOTO1850
BI ·1820 RJ%=RJ%-4:GOTO1850
·1830 RJ%=RJ%-6:GOTO1850
·1840 RJ%=ABS(RJ%-8)
·1850 FOR X=1 TO 8:IF R1%(1,X)=RJ% THENTX
 $="1":GOTO1880
·1860 NEXT X:FOR X=1 TO 8:IF R2%(1,X)=RJ%
  THENTX$="2":GOTO1880
·1870 NEXT X:TX$="3"
·1880 M$=TX$
·1890 LM$=L$+M$
·1900 IF (C5/2)=INT(C5/2) OR C5=0 THENTWR
 $(2)=TX$:GOTO1970
·1910 IF LM$="12" THENTWR$(2)="3":GOTO197
 0
·1920 IF LM$="13" THENTWR$(2)="2":GOTO197
 0
·1930 IF LM$="23" THENTWR$(2)="1":GOTO197
 0
·1940 IF LM$="21" THENTWR$(2)="3":GOTO197
 0
·1950 IF LM$="31" THENTWR$(2)="2":GOTO197
 0
·1960 IF LM$="32" THENTWR$(2)="1"
·1970 L$="":M$="":LM$="":CT=FRE(0):GOTO035
 0
·1980 REM - BUILD SPRITES
·1990 V=53248:POKEV+21,255:POKEV+23,255:P
 OKEV+29,255
·2000 POKE2040,192:POKE2041,193:POKE2042,
 194:POKE2043,195:POKE2044,196
·2010 POKE2045,197:POKE2046,198:POKE2047,
 199
·2020 POKEV+39,3:POKEV+40,15:POKEV+41,13:
 POKEV+42,9:POKEV+43,14:POKEV+44,5
·2030 POKE V+45,8:POKEV+46,0
·2040 RESTORE:N0=12288:FOR X=1 TO 8:FOR N
 =0 TO 62:READ Q:POKE N0+N,Q:NEXT N
·2050 N0=N0+64:NEXT X
·2060 T1$="[8"1"]":T2$="[8"0"]":T3$="[8"0
 "]"
·2070 FOR X=1 TO 8:T4$(X)=MID$(T1$,X,1):N
 EXT X
·2080 FOR X=1 TO 8:T5$(X)=MID$(T2$,X,1):N
 EXT X
·2090 FOR X=1 TO 8:T6$(X)=MID$(T3$,X,1):N
 EXT X
·2100 Z%=97:FOR X=1 TO 8:T1(X)=Z%:T2(X)=Z
 %:T3(X)=Z%:Z%=Z%+9:NEXT X
·2110 Y%=0:FOR X=1 TO 8:R1%(1,X)=Y%:Y%=Y%
 +1:NEXT X
·2120 FOR X=1 TO 8:R2%(1,X)=9:R3%(1,X)=9:
 NEXT X
·2130 IF YN$="Y" THEN140
·2140 GOTO90
·2150 REM - BUILD CHARACTER GRAPHICS
·2160 BLK$=CHR$(144):RED$=CHR$(28):YEL$=C
 HR$(158):B2LU$=CHR$(31):CY$=CHR$(159)
·2170 G1REY$="[c 4]":G2REY$="[c 5]":REM -
   C=(4); C=(5)
```

```
•2180 RV$=CHR$(18):RO$=CHR$(146)                    HK
•2190 CL$=CHR$(147):DW$=CHR$(17):LF$=CHR$
(157)                                               DA
•2200 FOR X=1 TO 24:DO$=DO$+DW$:NEXT X:DO
$=CHR$(19)+DO$                                      GG
•2210 A$(1)=RV$+B2$+"[30" "]"+RO$                   AO
•2220 A$(2)=RV$+YEL$+" "+DW$+LF$                    OK
•2230 FOR X=1 TO 10:A$(3)=A$(3)+A$(2):NEX
T X                                                 NM
•2240 A$(3)=A$(3)+" "+RO$                           DB
•2250 HDG$=RV$+WH$+"TOWERS OF HANOI"+RO$            GD
•2260 NUM$=RV$+B2$+"NUMBER OF RINGS (2 -
8)"+RO$                                             NJ
•2270 SP$="[30" "]"                                 PK
•2280 F9$=RV$+G1$+"FROM TOWER #"+RO$:T9$=
RV$+G1$+"TO TOWER #"+RO$                            HG
•2290 CR$=RV$+CY$+" "+RO$                           HK
•2300 SLV$(1)=RV$+G2$+" RINGS REQUIRES"+R
O$:SLV$(2)=RV$+G2$+" MOVES."+RO$                    DA
•2310 MV$=RV$+B2$+"MOVE #"+RO$                      FC
•2320 CMP$=RV$+G1$+"COMPUTER SOLUTION (Y/
N) ?"+RO$                                           AP
•2330 EN$=RV$+G1$+"PRESS <RETURN> TO END"
+RO$                                                KL
•2340 GOTO1990                                      GC
•2350 REM - DATA FOR SPRITES                        NK
•2360 REM - SPRITE 0                                NB
•2370 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,:REM 53 COMMAS               LJ
•2380 DATA 1,255,128,1,255,128,1,255,128            FH
•2390 REM - SPRITE 1                                NA
•2400 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,                              MH
•2410 DATA 3,255,192,3,255,192,3,255,192            MO
•2420 REM - SPRITE 2                                NH
•2430 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,                              MH
•2440 DATA 7,255,224,7,255,224,7,255,224            OO
•2450 REM - SPRITE 3                                NG
•2460 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,                              MH
•2470 DATA 15,255,240,15,255,240,15,255,2
40                                                  JD
•2480 REM - SPRITE 4                                NF
•2490 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,                              MH
•2500 DATA 31,255,248,31,255,248,31,255,2
48                                                  IJ
•2510 REM - SPRITE 5                                NE
•2520 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,                              MH
•2530 DATA 63,255,252,63,255,252,63,255,2
52                                                  AB
•2540 REM - SPRITE 6                                NL
•2550 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,                              MH
•2560 DATA 127,255,254,127,255,254,127,25
5,254                                               AF
•2570 REM - SPRITE 7                                NK
•2580 DATA ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,                              MH
•2590 DATA 255,255,255,255,255,255,255,25
5,255                                               NI
```

COMMODARES

Continued from page 84

is meaningless. Jim's solution checked for proper syntax as it evaluated the input. That makes the problem quite a bit tougher. We'll leave that as an additional challenge for those of you who found this one too easy.

The follow people who haven't been mentioned earlier also sent solutions to February *Commodares:* Donald H. Graham (Baltimore, MD), Paul Sturm (Weatherford, TX), Jesus Geliga-Torres (Aguadilla, PR), Dan R. King (High Rolls, NM), Thomas Lambert (Severna Park, MD), Richard Balliet (Nuangola, PA), Glenn Elliot (Rutherford, NJ), Robert Lackey (Albuquerque, NM), Jack Thompson (Kirkwood, MO), Bruce Landrum (Fayetteville, AR), Dex Peterson (LeRoy, MI), Royce Crabtree (Madisonville, KY), and Aaron Hughart (Pocatello, ID).

Once again, these are the people whose solutions to February's *Commodares* have reached us by the middle of February. Put on those thinking caps and get busy on this month's challenges. You've got a lot of work to do! □

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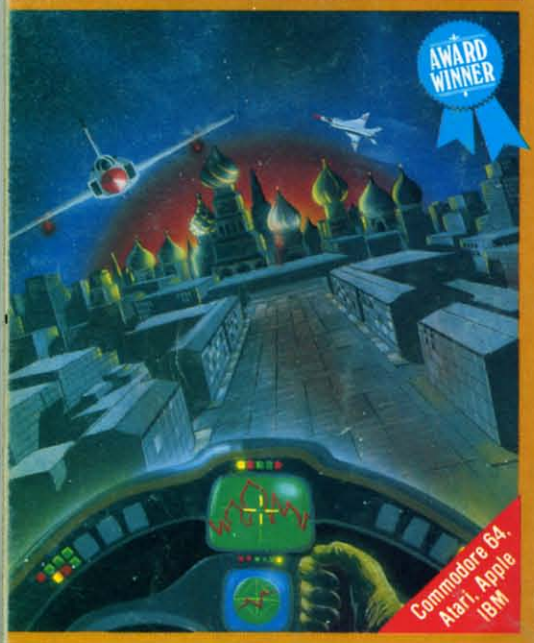
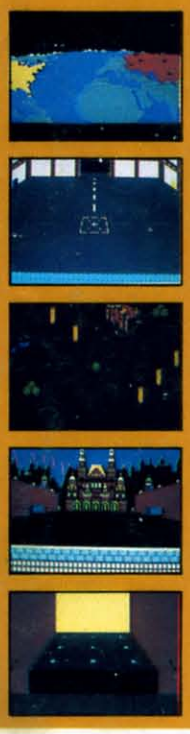
BEACH-HEAD

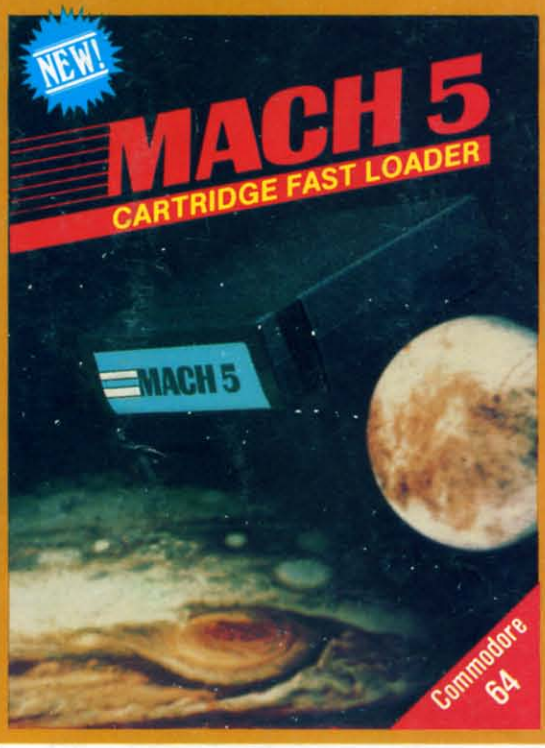
BEACH-HEAD II

RAID OVER MOSCOW





MACH 5



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