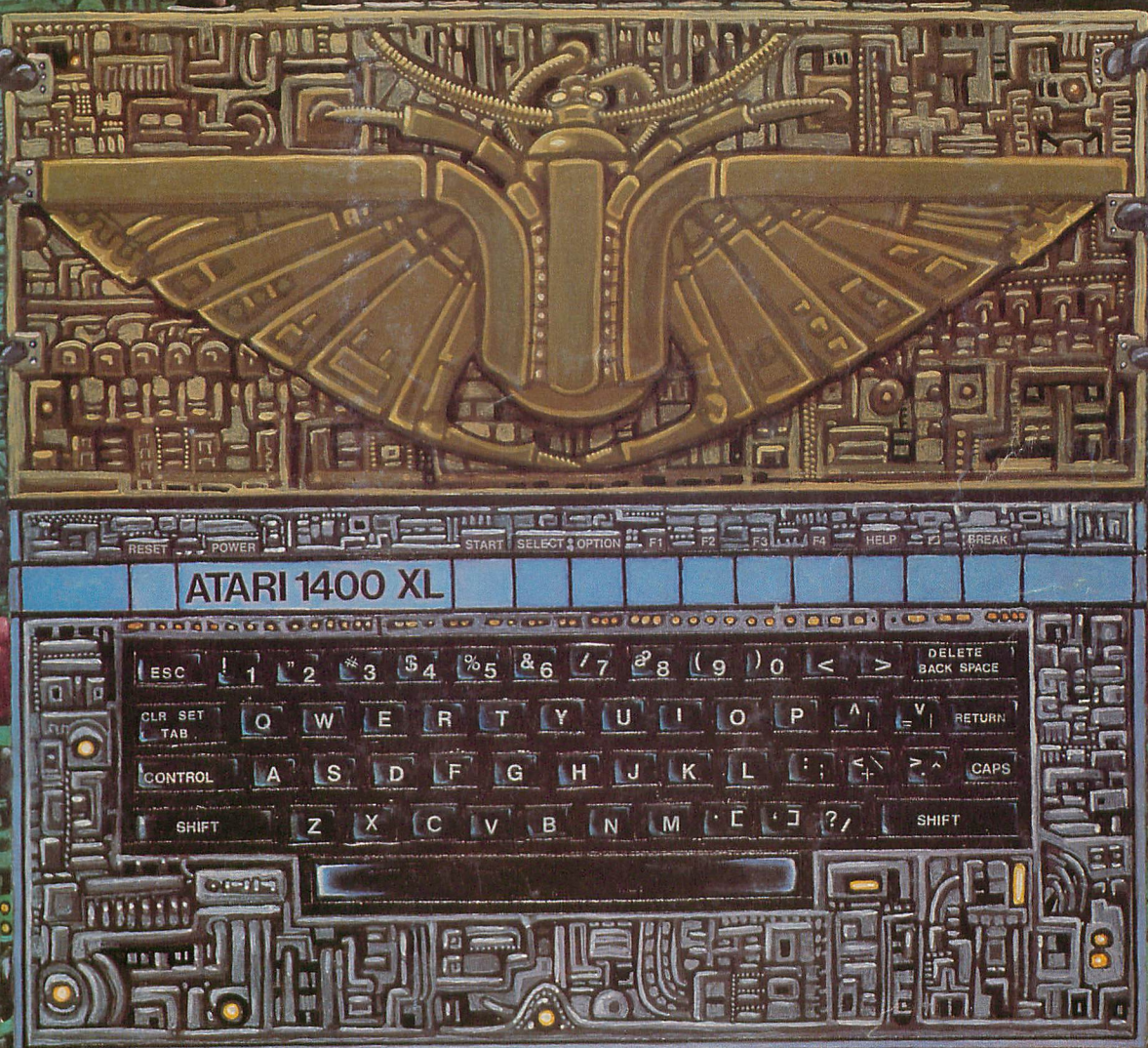


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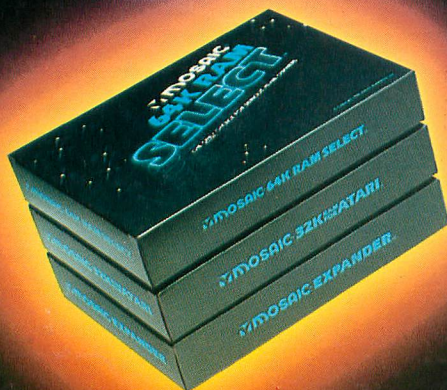


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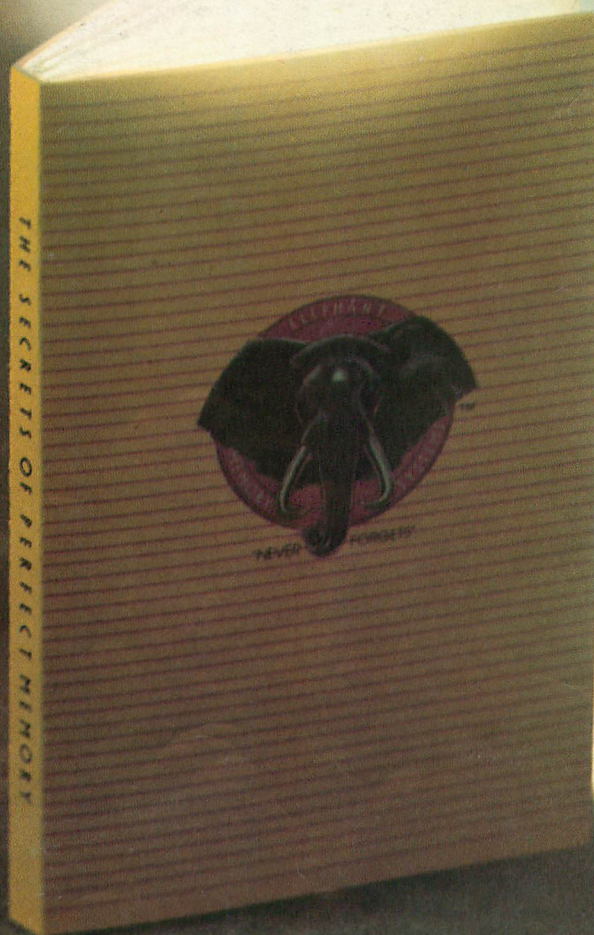
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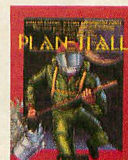
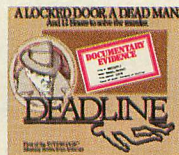
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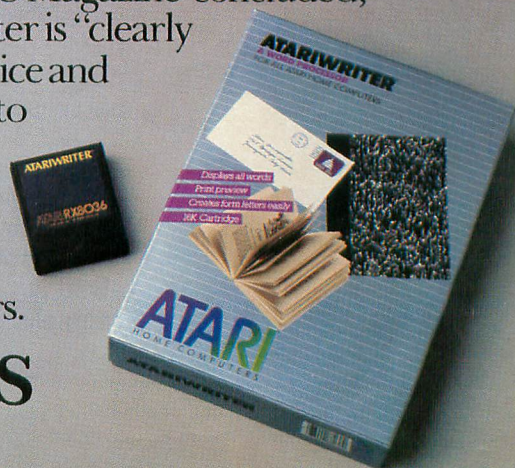
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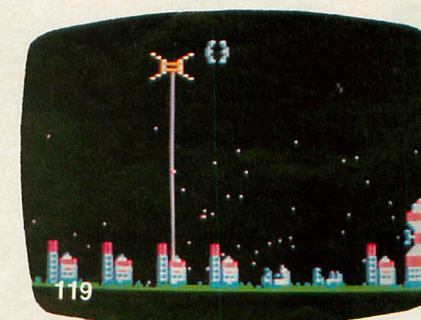
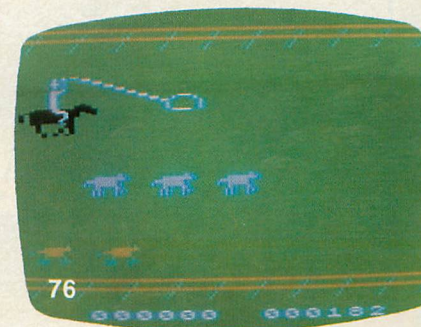
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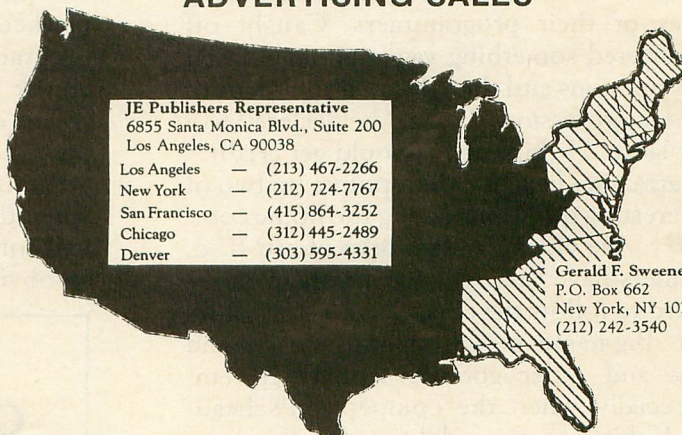
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ABOUT THE COVER

This issue, we decided to give our camera a break. Instead of force-feeding it vast amounts of light, we turned our cover over to the talents of Michael D. Law, a "mobile" artist who was kind enough to make a stopover in Massachusetts for us. Michael has done quite a bit of work in the field of science fiction and fantasy, although he has done work in other fields and is comfortable with a variety of styles. The cover for this issue was inspired by the work of Swiss surrealist H.R. Giger, whose nightmarish designs have appeared in numerous books and magazines, and were showcased in Ridley Scott's film "ALIEN." The ATARI logo may never appear in a more imaginative setting — but then again, keep watching our covers.

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EDITORIAL

by Brian Moriarty

One of the big news events at June's Consumer Electronics Show was the announcement that ATARI had signed actor Alan Alda to endorse their new XL computer line. Hundreds of ATARI executives and journalists turned up at Chicago's Westin Hotel to nibble crab legs and hear Mr. Alda express his excitement about working with ATARI. After a twenty minute speech full of grateful platitudes, Alda invited questions from the audience.

A timid hand was raised. "Do you think game authors should get credit for their work?"

Hawkeye hesitated for a moment. Obviously he was not aware of ATARI's policy against advertising the identities of their programmers. Caught off guard, he muttered something vague about ATARI soliciting his opinions and then decided to be true to the spirit of his profession. "Sure," he declared to a spray of applause. "I think they should get credit."

This embarrassing little incident points up two of the most interesting questions facing the home computer industry. Are video games works of art? If so, do programmers have the right to sign their work?

It's not hard to follow the reasoning of companies like ATARI. Big-name programmers can demand high salaries and other goodies from their employers, especially when the competition's headhunters are lurking on the sidelines. It's the same problem faced by the pioneer silent movie companies, who went to great lengths to hide the names of their actors for fear of turning them into expensive celebrities. The star system won out in the end, of course — and it helped make the movie industry what it is today.

ATARI's attitude toward software authors is amply illustrated by the new 16K cartridge version of **Eastern Front 1941**. This sophisticated war simulation was originally released through the ATARI Program Exchange, with Chris Crawford's name plastered all over the package. **Eastern Front** probably did more for Crawford's reputation as an ATARI whiz than anything else he's written. But try to find his name on the new package. Look for it in the **new owner's** manual. It's nowhere to be found!

Activision's policy seems to be a little more enlightened. Author's names are proudly displayed on the game cartridges and are even mentioned in radio and television ads. In addition, each author

receives a small but undoubtedly welcome percentage of the profits earned by their game(s). Activision protects their investment by asking every published author to sign an exclusive contract. But who'd want to desert a company that rewards its talent so much more fairly than the competition?

A more extreme example of the software star mentality is to be found in the products of Electronic Arts, a new ATARI game publisher which subscribes wholeheartedly to the theory that software is a valid form of self-expression. Their high-tech packaging even includes biographic sketches and dramatic full-size photos of their New Age Artists. EA's canny marketing technique is certain to appeal to amateur programmers, who constitute a large and influential chunk of the video game market.

The clever folks at Electronic Arts are capitalizing on a concept Hollywood has been exploiting for years: it pays to make your employees famous. Only when the prime movers like ATARI understand this will software authors begin to enjoy the credit they so obviously deserve. □

ATARI Computer Convention.

IBM and APPLE Computer owners have their own get-togethers; now ATARI users have theirs. This October, thousands of ATARI fans from around the US and Canada will be attending TARICON '83. Along with all of these ATARI computer owners, ATARI, A.N.A.L.O.G., and dozens of third party companies will also be exhibiting. In addition, well-known software designers and authors attending will present seminars on many topics.

Pre-registration: \$7.50

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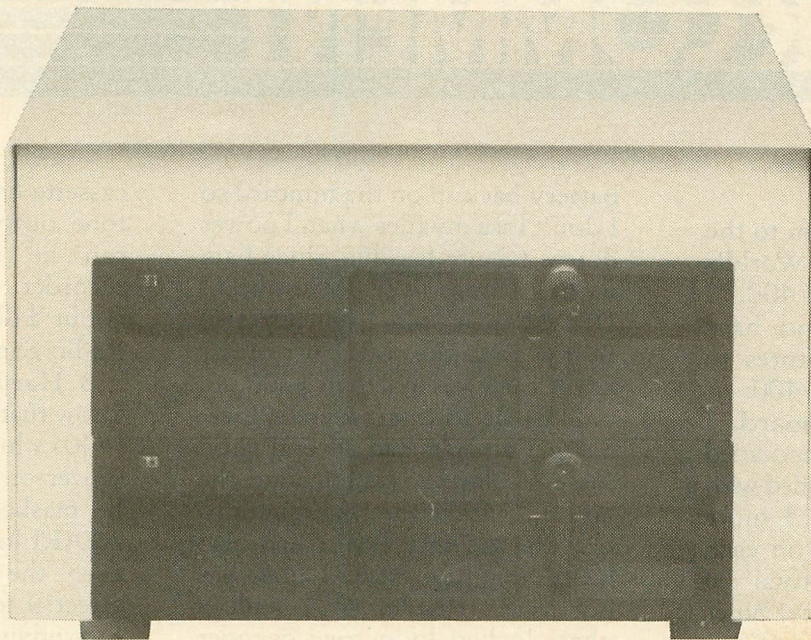
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READER COMMENT

Dear A.N.A.L.O.G.:

I would like to lay claim to the title of having "The World's Most Souped-Up ATARI 400." I am a hardware buff and have added the following features to my 6-month-old ATARI 400:

1. 256K memory board. I took the original 16K and modified it for 64K chips. Not satisfied with a measly 64K, I soldered 3 more 64K chips "piggyback" on each chip, resulting in a total of 262,144 bytes of memory! Since the 6502 can handle only 64K at a time, I use a 4K "window" at \$C000-\$CFFF to access the additional memory. To access any 4K window in the range of 0-256K (including RAM trapped under ROM), I just store the top six bits of the 18-bit address in a latch at \$D700, and the memory shows up at \$C000.

The most efficient way to use this additional memory is as a "virtual" disk. There's plenty of room for two full 90K "disks" with thousands of bytes to spare. I modified DOS 2.0S by intercepting the calls to the SIO. Because of the very clean design of DOS, only six bytes within DOS had to be changed, plus I added a couple hundred bytes external to simulate the SIO disk drive mechanism. Since I don't own a disk drive I have to load the modified DOS from tape, and "format" two drives (which takes less than a second). Now I have two virtual disks which behave just like real disks, except they're 50 times faster (e.g., I can load or save a 100-sector BASIC file in a half second or copy a full "diskette" in less than five seconds). It's really marvelous. The only thing I need to add is a

battery backup on the ramcard so I don't lose my files when I power down. (Quite feasible, since I am using low-power Mitsubishi DRAM's with pin-1 self-refresh.) By the way, the total cost of my 256K card was less than \$200.00.

2. Built-in cassette interface. Since I already had several good cassette players lying around the house, I was naturally hesitant to buy the ATARI 410. I had also heard that the ATARI unit was not very reliable, so I built a phase-locked loop tone decoder and put it inside my 400. Only the incoming tones from the

cassette have to be decoded. The tone output from the computer can be sent directly to any recorder. The circuit cost me about \$10.00 to build, using all Radio Shack parts.

3. Hardware Reset. We all know that the 6502 has a reset pin (#40) which resets the CPU to its power-on state and which cannot be masked. Then why does the ATARI lock up occasionally and even the Reset button has no effect? I found the answer to this by studying the circuit diagrams in the technical reference manual. The reason is that the reset line on

Attention Programmers!

A.N.A.L.O.G. Computing is interested in programs, articles, and software review submissions dealing with the ATARI home computers. If you feel that you can write as well as you can program, then submit those articles and reviews that have been floating around in your head, awaiting publication. This is your opportunity to share your knowledge with the growing family of ATARI computer owners. **A.N.A.L.O.G.** pays between \$30.00-\$360.00 for all articles. All submissions for publication must be typed, upper and lower case with double spacing. Program listings should be provided in printed form, and on cassette or disk. By submitting articles to **A.N.A.L.O.G. Computing**, authors acknowledge that such materials, upon acceptance for publication, become the exclusive property of **A.N.A.L.O.G.** If not accepted for publication, the articles and/or programs will remain the property of the author. If submissions are to be returned, please supply a self-addressed, stamped envelope. All submissions of any kind must be accompanied by the author's full address and telephone number. Send programs to: Editor, **A.N.A.L.O.G. Computing**, P.O. Box 23, Worcester, MA 01603.

the ATARI 400/800 computers never goes low! The only time the reset vector is used is on power-up. Until you turn the power off, the reset line remains high. What happens when you press "Reset?" Well, you actually generate an interrupt, an NMI to be exact, which can be "masked" (by ANTIC) and hence you run the possibility of lock-ups. I have eliminated this problem by adding a push-button which actually brings the reset line low. As a result, my computer never, ever locks up. I have combined this feature with an interlock switch bypass and a cartridge-area RAM write-protect switch, so I can preserve the contents of RAM even on a cold start.

4. Monkey Wrench. I read somewhere that the "Monkey Wrench" (trademark of Eastern House Software) couldn't be used on an ATARI 400 because it only fits in the right-hand cartridge slot. (I believe it is the only cartridge you can buy for the 800's "B" slot.) Well, to make a long story short, I went out and bought the thing and figured out a way to make it work on the 400. The secret is piggy-backing. You take your BASIC cartridge apart and piggyback the two ROM's onto the Monkey Wrench and add a few wires to activate the appropriate cartridge selects and RAM de-selects. Then you have a single 16K ROM package which fits (barely) in the 400 and gives you all of the features of both cartridges on one. Occasionally Monkey Wrench disappears, giving me 40K again. (BASIC can't see my 256K RAM.)

5. Serial LED Indicator. I installed a red light-emitting diode (LED) on the front panel and hooked it up through a transistor to the serial data pin. Now I can see any serial data coming into the computer, even if the serial software locks up. This is great for reading cassettes because I can "see" exactly where the data starts and stops. I can also see the noise

generated by the leader and let the tape unrecorded sections of tape. I have independent control of the motor so I generally let the tape run until the carrier (high) tone locks in, then I push RETURN to start loading data for much greater reliability. On occasion, I have had a real disk hooked up to my machine. The red LED lights up whenever a sector is read. I haven't yet figured out a way to exploit this with disks.

6. Full PIA Handshaking. The game ports on the front of your ATARI computer are actually two complete parallel ports. (Well, almost complete.) What's missing are the handshaking signals CA1, CA2, CB1, and CB2. They have been renamed and moved over onto the serial connector on the side of the computer. CA1 and CB2 are known as "Proceed" and "Interrupt," and are not currently used. CA2 is the cassette "Motor" signal and CB2 is "Command", which is used by the SIO. I wanted full handshaking so that I could operate my MX-80 printer and other gadgets (A/D converters, etc.) from the game ports. I rewired the third game port, giving up the Pot A and Pot B lines (nobody uses paddles there anyway) and restored CB1 and CB2. (CB1 and CB2 are still available on the serial bus.) Now, I realize there are other ways to hook up printers to game ports without resorting to this type of modification. However, there is no way to take advantage of I/O interrupts unless you restore full handshaking. For example, I use an interrupt-driven A/D chip to digitize and playback speech waveforms using this specially modified port.

7. Fastchip. With all this hardware enhancement, I had to add this chip to bring the software performance up to par. However, even with this, ATARI BASIC is too slow for me.

So there you have it. The world's most powerful ATARI

400 system. I estimate that it cost me about \$500. It might surprise readers to know that I am not an engineer. I am a computer programmer by profession (Fortran, PL/I, Assembler on IBM machines) but my hobby is tinkering with hardware.

Let me close by asserting that the ATARI 400 is the hardware hacker's "dream machine." It's cheap, well-built, and stocked with interesting and useful features. Best of all, complete documentation of all hardware and firmware is available at a (somewhat) reasonable cost. ATARI is to be commended for their part in making this information available to the public.

Sincerely,
John C. Day
Ormond Beach, Florida

San Diego Computer Society To Hold 4th Annual Fair

The San Diego Computer Society will host its 4th Annual San Diego Computer Fair on Saturday and Sunday, November 5 and 6, from 9 a.m. to 5 p.m., at the Scottish Rite Center, 1895 Camino del Rio South, in San Diego's Mission Valley. The Fair will feature short technical sessions, programming and computer-games, contests, door prizes, commercial displays, and displays by computer user groups.

Guest speaker at the Saturday night banquet will be Dr. Jerrold Petrofsky, a Wright State University engineering department researcher who has devised a computerized method of transmitting electrical impulses to muscles of paraplegics, enabling them to walk again.

Registration is \$5.00, the banquet fee \$12.00, or \$17.00 for both. Reservations can be made by mailing a check or money order to: San Diego Computer Society, P.O. Box 81537, San Diego, CA 92138. For additional information, write to this address or call (619) 565-8720.

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grossly overpriced, especially when you consider the price of the actual media and documentation. And with many programs it does not exactly look like they spent a million dollars on programming. I have typed in programs from your magazine that were better than the ones that I paid \$35 for in the store!

Please do not misunderstand me though, I realize these companies are in the business for the money but they do not have to be that greedy. If the software companies would reduce the price of a \$35 program to somewhere in the low twenties I think that there would be less piracy. It is harder to justify spending the money on a copying system if the price of legally buying the program is low.

Another suggestion of mine is that companies take the 50-100 dollar premium off utility programs such as DB and word processing. If ATARI dropped the price of their great new word processor **Atariwriter**, which I happen to be writing this on, to \$39.95 I would guess that sales on the **Atariwriter** would double. These are the kind of programs that currently make piracy worthwhile.

If software companies would make piracy not worth the effort and expense, I am sure piracy would decline.

Sincerely,
Greg Waldorf
Los Angeles, CA

Dear Sirs:

I was having problems with running your program **Utility #6: Snail** in Issue #12. It seems that every time I selected a new drive, garbage came on the screen along with the Snail. Sometimes this happened when first running the program.

I couldn't figure out why this was happening until I realized that the P.M. area was not cleared out before being used. A simple FOR/NEXT Loop inserted as Line 215 takes care of the problem.

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215 FOR C=PMBASE TO PMBASE
+1024:POKE C,0:NEXT C

To speed things on, you can also turn **Antic** off by adding a POKE 559,0 after the Graphics 0 call in Line 100. This should be turned back on by adding Line 235 POKE 559,46 (delete the POKE 559,46 from Line 210 first).

I enjoy your magazine very much. As far as I'm concerned, it's the best on the market today for the ATARI. Keep up the good work!

Sincerely,
Ray A. Floyd
Caruthers, CA

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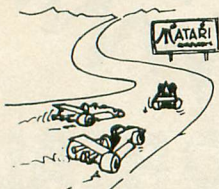
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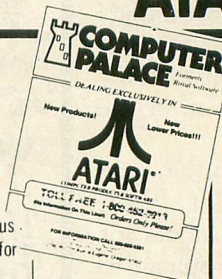
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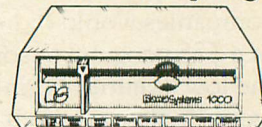
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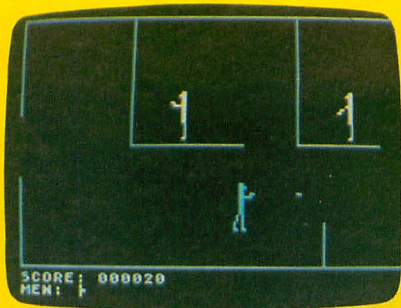
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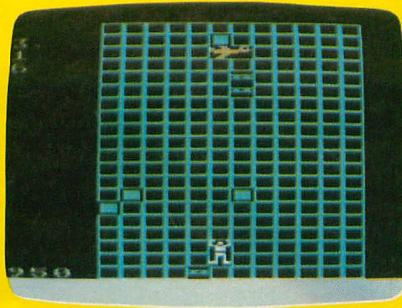
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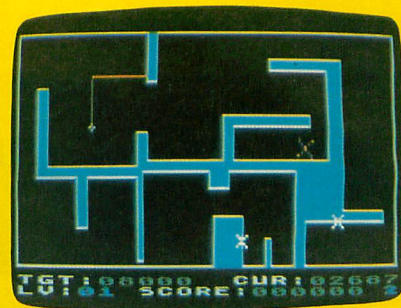
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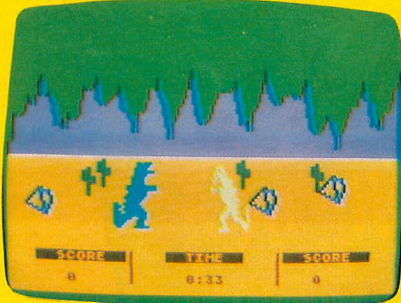
Maniac!



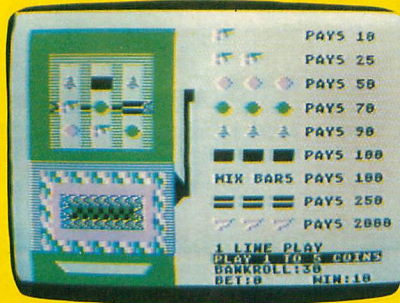
Stuntman



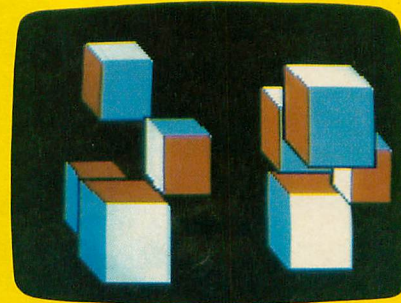
Fill 'Er Up



Dino Battle

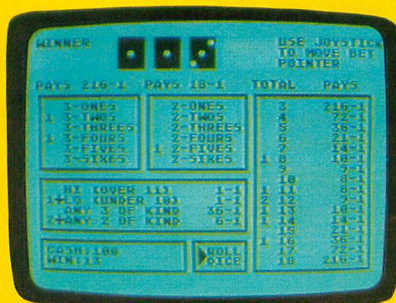


Color Slot Machine

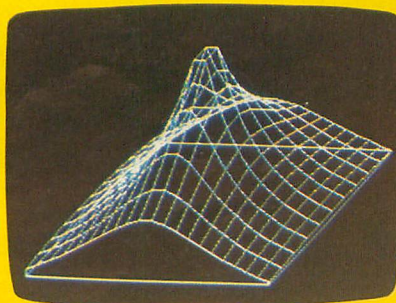


Cubes

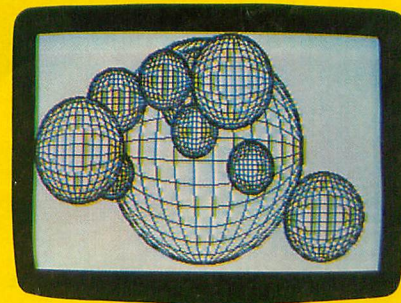
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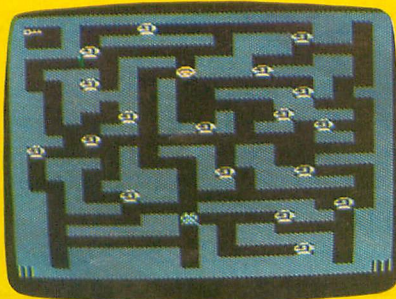
Triple Threat Dice



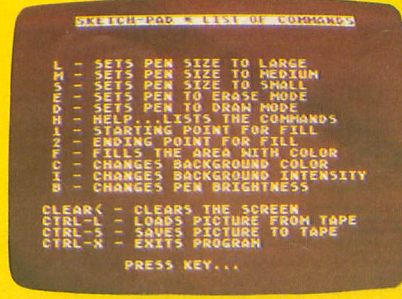
3-D Graphs



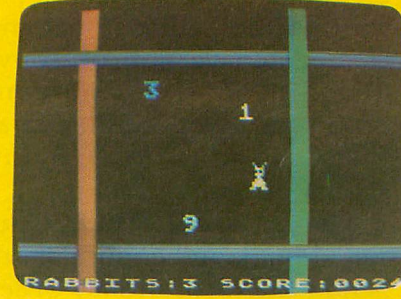
Sphere Demo



Leprechaun King



Sketch Pad



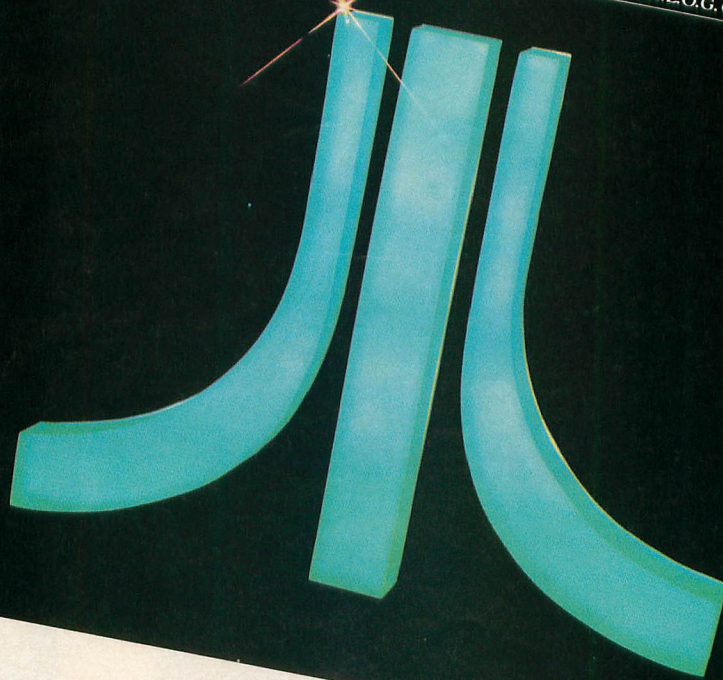
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NEW PRODUCTS

by The Program Doctors

Did you ever wonder what Alice felt like after falling through the rabbit hole, or Dorothy's amazement as she opened her door and emerged in the totally new world of her dreams? Entering the First Annual CES Software Showcase and having the chance to see all the new products for the ATARI home computers was like Wonderland, Oz and Paradise Lost all in one building. The displays were impressive with their plexiglass logos, Sony monitors, computer hardware, hi-tech furnishings and flashing lights. This building was packed and it left no doubt as to where the future of the electronics industry was headed. The following is a brief overview of the new products that will be coming out for the ATARI in the next few months.

SYNAPSE SOFTWARE will undoubtedly retain their position as the leader in third-party products during the next several months with the release of **Blue Max**, an incredible new 3-D flying game that surpasses DATASOFT's **Zaxxon** in the graphics department; **Dimension X**, a first person space game which takes **Star Raiders** one step further; plus **Drelbs**, **Shadow World** and **Rainbow Walker**, the first of many **Q*Bert** clones. They also announced a line of inter-compatible home and business application software entitled **SYN-APPS Total Application Package**. These packages include a word processor, database, spreadsheet, graphing and forecasting, stock charting and analysis,

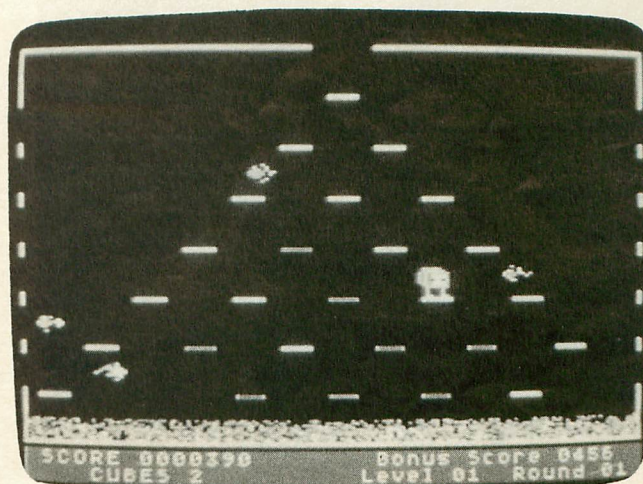


Blue Max



statistical analysis, tax preparation, mailing lists and communication software. These are areas where the ATARI is lacking, and if the SYN-APPS line lives up to its promise it will be a big push to help get us out of the game syndrome.

SIRIUS SOFTWARE continues their ATARI support with **Wavy Navy**, an interesting sea shoot 'em up; **Type Attack**, an arcade typing tutor; **Beer Run**; and an outstanding cartridge (finally), **Capture the Flag**, a 2-player version of their previous smash **Wayout**. Sirius is not forgetting the adventures, since the highly touted **Critical Mass** is going to be released soon.



Mr. Cool

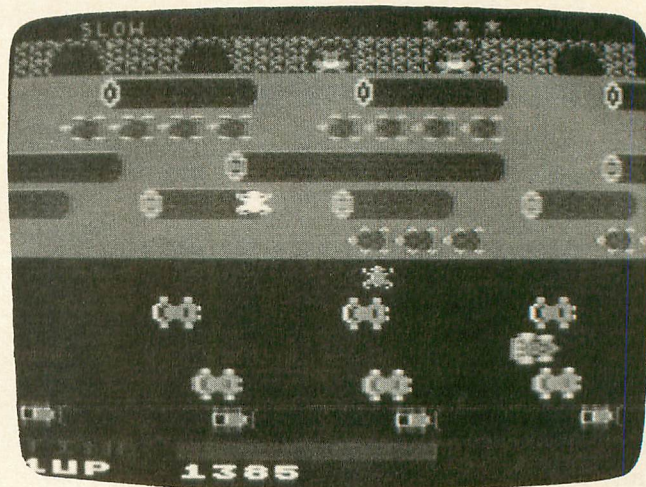
Speaking of adventures, **The Dark Crystal** has arrived; a six-sided disk adventure based upon the movie of the same name. SIERRA ON-LINE also has more **Ultima** fantasy games on the way, along with other arcade games including **Apple Cider Spider** and **Sammy Lightfoot**. **Mr. Cool** was found living in an 8K cartridge at the On-Line booth.

DATASOFT is attacking the ATARI on two fronts. "GENTRY" is a low-price line of software products with both cassette and disk versions packed in one box. Several titles will be repackaged and renamed from the original Datasoft line. **Shooting Arcade** is now **Target Practice**, and **Tumblebugs** is now **Magneto Bugs** in the Gentry line. The long-awaited **Rosen's Brigade** has also

finally arrived under the Gentry banner. Datasoft is also trying its hand at three more licensed arcade titles (**Moon Shuttle**, **Pooyan** and **Nibbler**), and are continuing their Wizard series with **Money Wizard**, **Spell Wizard** and **Word Wizard**. They have licensed the rights to market games and adventures using Heckle and Jeckle, Bruce Lee, Heathcliff and the television show *Dallas*.

FIRST STAR SOFTWARE is also going the licensed character route with Marvel Comics creations, the first of which will be a Casper the Ghost game. Also watch for **Rent Wars**, **Dangerous Cargo** and **Flip Flop**. **Bristles** will be a sure winner. In it, you attempt to paint a five-story building, despite the nasty Bucket Chamber and his crew of Half Pints raising havoc with Peter the Painter.

ROKLAN SOFTWARE is coming out with several educational and arcade games (including **Eyes**), all on cartridge. They have also bought the rights to IDSI (**Pool 1.5**) and JV Software's adventure products, and will be re-releasing them under new titles.

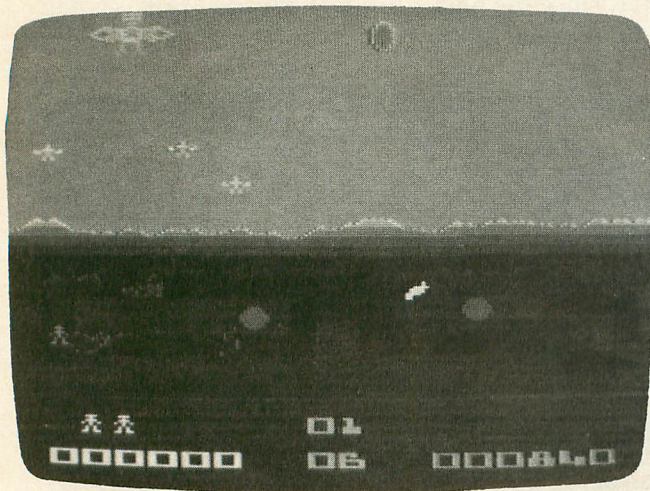


Frogger

a World War II strategy game featuring graphics, sound, and hours of playability.

Along with their main display, ATARI had a secondary exhibit showing off some of the newer ATARI PROGRAM EXCHANGE products with new packaging. Incidentally, ATARI is also converting many of their games (**Dig Dug**, **Donkey Kong**) to other popular computers.

EPYX is following up their successful **Jumpman** with several new titles, also on carts. **Jumpman Jr.** (12 new screens); **Swat Rescue**, a cops and robbers game; **Gateway To Apshai**, a sequel to their successful **Apshai** series; and **Silcon Warrior**, a 3-D space game are just a few of the many arcade games coming soon. Look for continued good products from Randy Glover, author of **Jumpman**, now the head of product development.

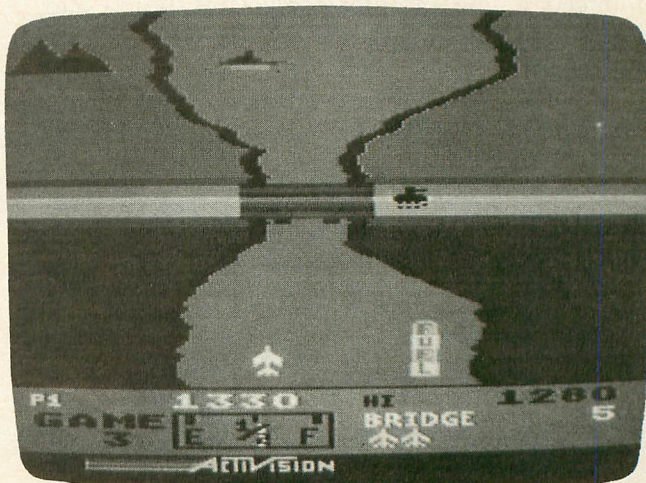


Boulders and Bombs

CBS SOFTWARE continues the cartridge barrage with **Boulders and Bombs** and several other new titles, including the arcade games **Blueprint**, **Omega Race**, **Super Fox**, **Domino Man** and **Satan's Hollow**, which have all been licensed from Bally/Midway. **Mountain King** has just been released (a good arcade game) and also on the drawing boards is **Madden Football**.

PARKER BROTHERS, the leader in licensing hot coin-op titles, is releasing several ATARI home computer carts before the holiday season. In addition to buying the cartridge rights to **Frogger** and **Astro Chase**, Parker Bros. is planning to bring us **Popeye**, **Risk**, **Monopoly**, **Chess**, **Clue**, **Lord of the Rings**, **Tutankham** and the official **Q*Bert**.

BRODERBUND (which means "Brotherhood") SOFTWARE announced **Operation Whirlwind**,



River Raid

SPINNAKER continues their development of educational titles for the ATARI with **Delta Drawing**, **Delta Music**, and **Alphabet Zoo**. More importantly, they are releasing a majority of their new and previously released titles in cartridge form.

This will allow all computer owners to enjoy these great learning games.

Also entering the ATARI computer arena is DATAMOST (with 12 titles), ACTIVISION (with **Kaboom!** and **River Raid**), and SEGA. An interesting paradox of the entire show was the emphasis on cartridges, when more and more ATARI users are buying disk drives. Speaking of drives, PERCOM was showing off two new products. A single-density drive with a parallel printer port, and a doubler which will convert any Percom single-density drive into a double-density drive.

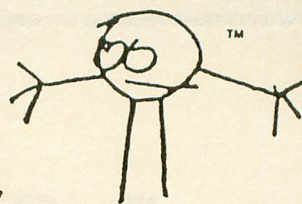
Joystick companies were at CES in force, with new models and new innovations to save your hands. WICO demonstrated their new convertible three-in-one joystick. TG had a diamond shaped model, and NEWPORT had their new 4/8 position **Newport II**. The most unique of the new controllers were two by SUNCOM; the **Joysensor** is a touch sensitive joystick with rapid fire button and a 4/8 adjustable switch, and the **Aerobic Joystick** which can be attached to an exercise bicycle (it worked great with **Baja Buggies**).

Watch this space for more detailed descriptions of these and more products as they become available over the next several months. □

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WHAT IS D:CHECK/C:CHECK

Most program listings in **A.N.A.L.O.G.** are followed by a table of numbers appearing as DATA statements, called "CHECKSUM DATA." These numbers are to be used in conjunction with D:CHECK, which appeared in issue no. 10, and C:CHECK, which appeared in issue no. 11.

D:CHECK and C:CHECK are programs by Istvan Mohos and Tom Hudson. They are designed to find and correct typing errors when entering programs from the magazine. For those readers who do not have a copy of either article, send a pre-addressed, stamped, business-sized envelope to:

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WORCESTER, MA 01603

CONTROL CHARACTERS

Some program listings reproduced in A.N.A.L.O.G. may contain "strange" characters not shown on the ATARI keyboard. These are special characters which use the CTRL, ESC and "ATARI LOGO" (INVERSE) keys. Shown below is a list of these characters and the keystrokes used to get them. □

| | | |
|--------------|----------------------------|---------------------------|
| ▼ --- CTRL , | ⌞ --- CTRL Z | ■ --- INVERSE CTRL M |
| ⌞ --- CTRL A | ⌞ --- ESC ESC | ■ --- INVERSE CTRL N |
| --- CTRL B | ↑ --- ESC CTRL UP-ARROW | ⌞ --- INVERSE CTRL O |
| └ --- CTRL C | ↓ --- ESC CTRL DOWN-ARROW | ⌞ --- INVERSE CTRL P |
| ⌞ --- CTRL D | ⌞ --- ESC CTRL LEFT-ARROW | ⌞ --- INVERSE CTRL Q |
| ⌞ --- CTRL E | → --- ESC CTRL RIGHT-ARROW | ⌞ --- INVERSE CTRL R |
| / --- CTRL F | ♦ --- CTRL . | ⌞ --- INVERSE CTRL S |
| \ --- CTRL G | ⌞ --- CTRL ; | ⌞ --- INVERSE CTRL T |
| ⌞ --- CTRL H | ⌞ --- ESC SHIFT CLEAR | ⌞ --- INVERSE CTRL U |
| ⌞ --- CTRL I | ⌞ --- ESC BACK 5 | ⌞ --- INVERSE CTRL V |
| ⌞ --- CTRL J | ⌞ --- ESC TAB | ⌞ --- INVERSE CTRL W |
| ⌞ --- CTRL K | ⌞ --- INVERSE CTRL , | ⌞ --- INVERSE CTRL X |
| ⌞ --- CTRL L | ⌞ --- INVERSE CTRL A | ⌞ --- INVERSE CTRL Y |
| ⌞ --- CTRL M | ⌞ --- INVERSE CTRL B | ⌞ --- INVERSE CTRL Z |
| ⌞ --- CTRL N | ⌞ --- INVERSE CTRL C | ⌞ --- ESC DELETE |
| ⌞ --- CTRL O | ⌞ --- INVERSE CTRL D | ⌞ --- ESC INSERT |
| ⌞ --- CTRL P | ⌞ --- INVERSE CTRL E | ⌞ --- ESC CTRL TAB (CLR) |
| ⌞ --- CTRL Q | ⌞ --- INVERSE CTRL F | ⌞ --- ESC SHIFT TAB (SET) |
| ⌞ --- CTRL R | ⌞ --- INVERSE CTRL G | ⌞ --- INVERSE SPACE |
| ⌞ --- CTRL S | ⌞ --- INVERSE CTRL H | ⌞ --- INVERSE _ |
| ⌞ --- CTRL T | ⌞ --- INVERSE CTRL I | ⌞ --- INVERSE CTRL . |
| ⌞ --- CTRL U | ⌞ --- INVERSE CTRL J | ⌞ --- INVERSE CTRL ; |
| ⌞ --- CTRL V | ⌞ --- INVERSE CTRL K | ⌞ --- INVERSE |
| ⌞ --- CTRL W | ⌞ --- INVERSE CTRL L | ⌞ --- ESC CTRL 2 |
| ⌞ --- CTRL X | | ⌞ --- ESC CTRL BACK 5 |
| ⌞ --- CTRL Y | | ⌞ --- ESC CTRL INSERT |

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OBSERVATIONAL ASTRONOMY PROGRAM



32K Cassette or Disk

by John Godbey

The **Observational Astronomy Program** can help you determine what objects are available for viewing in the night sky. You enter your latitude and longitude as well as the date or dates in which you are interested, and the computer will calculate the rising and setting times and the locations in the sky of the sun, moon, planets, and about 60 other celestial objects.

The main menu asks which of three kinds of information you desire:

1. Information on objects in the solar system
2. Information on deep sky objects
3. Information on one object over a period of time.

To select the option you desire, press the number 1, 2, or 3 key, and RETURN:

1. If you select the first option, the computer will ask you to enter the date for which you want the data. Enter the day, month, and year (last two digits only — e.g., "83" for "1983"). You can either press RETURN after each entry, or you can separate the numbers with commas, and press RETURN after the last entry.

The computer will then ask for your latitude and longitude. Enter the appropriate numbers as you did for the date.

Finally, the computer will ask for the time in which you want the data expressed. Enter the three-letter abbreviation for one of the following time zones:

Eastern Standard Time EST
 Eastern Daylight Time EDT
 Central Standard Time CST
 Central Daylight Time CDT
 Mountain Standard Time MST
 Mountain Daylight Time MDT
 Pacific Standard Time PST
 Pacific Daylight Time PDT
 Greenwich Mean Time GMT

(If any other combination of letters is entered, the program will automatically express the times in GMT.)

After you have made this entry, nothing will happen for three or four seconds while the computer begins its calculations. It will then display, for the sun, moon and each of the planets, its name, rising time, setting time, and the percentage of its disk which is illuminated ("% illum"), or its phase.

Throughout the program the times are expressed as a 24-hour clock. For example, 2:25PM is displayed as "14H25M".

You will then be asked if you wish the location of any of the planets. If you type "N" you will return to the main menu. If you type any other key, you will be asked to name the planet. Type the name in and press RETURN. The computer will then calculate and display the planet's right ascension (in hours and minutes) and declination (in degrees and minutes).

You will then be given the opportunity to get the location of another planet or return to the main menu.

If for any reason you wish to return to the main menu before the computer has completed its calculations, press and hold the START key for a few seconds.

2. If you ask for information on deep sky objects, the computer will again prompt you to enter the date, location, etc., for which you wish data. It will then calculate and display the name, the type, and the rising and setting times of about 60 deep sky objects.

If the objects have a Messier number, they are given that number as a name (e.g., M31). Otherwise, they are given their New General Catalog number (e.g., NGC253), or their popular name (e.g., Hyades).

The following abbreviations are used in displaying the type of object:

Sp Gal Spiral Galaxy
 Plan Neb Planetary Nebula
 Op Clus Open Cluster
 Dif Neb Diffuse Nebula
 Gl Clus Globular Cluster

The program will display information on 16 objects and freeze the screen. Press RETURN to continue. Remember, you can abort the calculations at any time by pressing and holding the START key for a second or two.

3. If you choose the third option on the main menu, you will be asked to enter the beginning and ending dates for which you want data. Both dates must be in the same calendar year.

For whichever object you choose, the computer will calculate and display its rising and setting times and its phases (except for the sun) for all the dates specified.

Program limitations.

The program is designed so that any incorrect response (e.g., letters when numbers are required) or range of input (e.g., an impossible value for a latitude) will return you to the menu which asked for the input. In case of an incorrect value input, the computer will prompt you for the correct range. If, in spite of these precautions you get an error message, just press SYSTEM RESET and RUN the program again.

The program will work for any latitude and longitude and for any date in the twentieth century. It will not work for dates earlier than 1900. It will work for years later than 2000, but its accuracy will be diminished.

Remember that the primary purpose of the program is to determine the rising and setting times. It can only do this if the celestial objects do rise and set. Therefore, in performing its calculations the program assumes that the sun, moon and planets

will rise and set every day. If a latitude is chosen which is north of the Arctic Circle or south of the Antarctic Circle (roughly, greater than 65° or less than -65°), then for some dates these objects will not rise, and for some dates they will be circumpolar. In these cases the computer will ask you to vary the latitude if you want the calculations performed for the date in question.

The program calculates the rising and setting time for the center of objects. It does not correct for refraction, or the size of the sun's and moon's disk. Given these limitations, the calculated times are usually accurate to within five or ten minutes.

In calculating the positions of the planets, you can expect an accuracy to within one degree. The positions of the deep sky objects are not calculated but are stored in the program. They are rounded to the nearest minute in both right ascension and declination.

| | RISE | EST | SET | % ILLUM |
|---------|--------|-----|--------|---------|
| SUN | 5H42M | | 20H29M | --- |
| MOON | 0H24M | | 10H43M | 74 |
| MERCURY | 4H52M | | 19H46M | 91 |
| VENUS | 9H15M | | 22H58M | 40 |
| MARS | 5H1M | | 19H59M | 99 |
| JUPITER | 17H32M | | 3H14M | 99 |
| SATURN | 14H40M | | 1H44M | 99 |
| URANUS | 17H54M | | 3H24M | 99 |
| NEPTUNE | 19H32M | | 4H51M | 99 |
| PLUTO | 14H16M | | 2H52M | 99 |

DO YOU WANT THE LOCATION OF ANY
OF THE PLANETS (Y/N)?

Screen format

In performing the various calculations, the computer arrives at several intermediate results which are not displayed. If they are of interest, they could be easily displayed by altering the "print" statements. Here are a few of them:

1. All of the calculations are performed in local sidereal time, which is then converted to Greenwich sidereal time, and then to local time. These conversions are performed in subroutine 2310; and adjustments can be made there to display sidereal time, or local times other than the nine currently in the program.
2. All of the calculations are performed in ecliptic coordinates, which are then converted to right ascension and declination in subroutine 1690. The ecliptic coordinates are expressed as LA and LB, and these can be displayed if desired.
3. The program does not display the positions of the sun or moon. These are the alpha (right ascension) and delta (declination) determined in subroutine 1690. They are available after line 2060 for the sun and after line 3640 for the moon.

4. Data on deep sky objects is contained in the data statements between 4210 and 4810. Deletions and additions can be made by deleting and adding the appropriate data statements. *Caution:* In each line the third bit of data is the right ascension, and the fourth is the declination. In both cases the number following the decimal is the number of minutes, not a fractional part of a number. E.g., "30.24" as a declination is 30 degrees 24 minutes, not 30.24 degrees. □

```

1000 REM OBSERVATIONAL ASTRONOMY
1010 REM BY JOHN GODBEY
1020 REM BASED ON FORMULAS IN
1030 REM PRACTICAL ASTRONOMY
1040 REM BY PETER DUFFETT-SMITH
1050 DIM TIME$(3),M$(1),M$(10),TYPE$(1
0),NAME$(10):ZZ=0:TI=0:FLAG=0
1060 GRAPHICS 2+16:GOSUB 1370:POSITION
3,2:PRINT #6;"OBSERVATIONAL"
1070 POSITION 5,3:PRINT #6;"ASTRONOMY"
1080 POSITION 6,4:PRINT #6;"PROGRAM":POSIT
ION 9,6:PRINT #6;"BY":POSITION 4,7:PRINT #6;"J
OHN GODBEY"
1090 FOR M=1 TO 2500:NEXT M:GRAPHICS 0
:GOSUB 1370
1100 SETCOLOR 2,2,6:SETCOLOR 1,2,0:SET
COLOR 4,10,4:GOTO 1120
1110 ? "ENTER NUMBER 1,2, OR 3":FOR M
=1 TO 900:NEXT M
1120 TRAP 1110
1130 ? "WHAT DO YOU WANT TO DO?":? :
?
1140 ? "1. GET INFORMATION ON OBJECTS
IN THE SOLAR SYSTEM?":? :?
1150 ? "2. GET INFORMATION ON DEEP SKY
OBJECTS?":? :?
1160 ? "3. GET INFORMATION ON ONE OBJE
CT OVER A PERIOD OF TIME?":? :?
1170 ? "ENTER NUMBER":INPUT WHICH:IF
WHICH<1 OR WHICH>3 THEN 1110
1180 ON WHICH GOSUB 4940,5320,5450
1190 GOTO 1120
1200 TRAP 1200:PRINT "K":PRINT "ENTER THE DAY,
MONTH, AND YEAR":PRINT
1210 PRINT "FOR WHICH YOU WANT DATA (D
D,MM,YY)":INPUT DD,MM,YY:LET MMM=M
M
1220 IF DD>31 OR DD<1 OR MM<1 OR MM>12
OR YY<0 THEN ? "BAD DATE, TRY AGAIN"
:FOR I=1 TO 500:NEXT I:GOTO 1200
1230 PRINT
1240 LET MMM=MM
1250 TRAP 1250:PRINT "WHAT WILL BE THE
OBSERVER'S":PRINT
1260 PRINT "GEOGRAPHICAL LATITUDE":IN
PUT THETA:PRINT
1270 IF THETA<-90 OR THETA>90 THEN ? "
LATITUDE RANGE: -90 AND +90 DEGREES":
FOR I=1 TO 500:NEXT I:GOTO 1250
1280 TRAP 1280
1290 PRINT:PRINT "WHAT WILL BE THE OB
SERVER'S":PRINT
1300 PRINT "LONGITUDE? (IF THE LONGITU
DE IS EAST,)"
1310 PRINT:PRINT "ENTER IT AS A NEGAT
IVE NUMBER":INPUT LONG
1320 IF LONG<-180 OR LONG>180 THEN ? "
LONGITUDE MUST BE BETWEEN -180 AND
+180":FOR I=1 TO 500:NEXT I:GOTO 1290
1330 TRAP 1330:PRINT:PRINT "IN WHAT T
IME SHOULD THE":PRINT
1340 PRINT "DATA BE EXPRESSED (GMT,EST
,CDT,etc.)"
1350 INPUT TIME$
1360 RETURN
1370 REM DISABLE BRK KEY
1380 I=PEEK(16):IF I>127 THEN I=I-128:
POKE 16,I:POKE 53774,I:RETURN

```

```

1390 END
1400 REM SUBROUTINE DETERMINES NUMBER
OF DAYS IN YEAR TO THE SELECTED DATE
1410 IF (YY/4)=INT(YY/4) THEN A=62:GOT
0 1430
1420 A=63
1430 IF MM>2 THEN GOTO 1460
1440 B=INT((MM-1)*A)/2+DD
1450 GOTO 1470
1460 B=INT((MM+1)*30.6)-A+DD
1470 RETURN
1480 REM SUBROUTINE DETERMINES ECLIPTI
C COORDINATES OF SUN
1490 IF YY<80 THEN D=-365*(80-YY)-INT(
(80-YY)/4)+B:GOTO 1510
1500 D=365*(YY-80)+INT((YY-80)/4)+B+1
1510 N=(360/365.2422)*D
1520 IF N<0 THEN GOTO 1590
1530 IF N<360 THEN GOTO 1620
1540 IF N>360 THEN GOTO 1560
1550 GOTO 1620
1560 N=N-360
1570 IF N<360 THEN GOTO 1620
1580 GOTO 1560
1590 N=N+360
1600 IF N>0 THEN GOTO 1620
1610 GOTO 1590
1620 M=N+278.83354-282.596403
1630 IF M<0 THEN M=M+360
1640 DEG
1650 E=(360/3.1415927)*0.01671*SIN(M)
1660 LA=M+E+278.83354:LB=0
1670 IF LA>360 THEN LA=LA-360
1680 RETURN
1690 REM SUBROUTINE CHANGES ECLIPTICAL
COORDINATES TO RIGHT ASCENSION AND DE
CLINATION
1700 DEG
1710 Z=23.441884
1720 X=COS(LA)
1730 Y=SIN(LA)*COS(Z)-(SIN(LB)/COS(LB)
*SIN(Z))
1740 ALPHA=ATN(Y/X)
1750 W=SIN(LB)*COS(Z)+COS(LB)*SIN(LA)*
SIN(Z)
1760 DELTA=ATN(W/SQR(-W*W+1))
1770 IF X>0 AND Y>0 THEN GOTO 1830
1780 IF X>0 AND Y<0 THEN GOTO 1860
1790 IF X<0 AND Y>0 THEN GOTO 1890
1800 IF ALPHA>0 AND ALPHA<90 THEN ALPH
A=ALPHA+180
1810 IF ALPHA<-270 AND ALPHA>-360 THEN
ALPHA=ALPHA-180
1820 GOTO 1910
1830 IF ALPHA<-90 AND ALPHA>-180 THEN
ALPHA=ALPHA+180
1840 IF ALPHA>180 AND ALPHA<270 THEN A
LPHA=ALPHA-180
1850 GOTO 1910
1860 IF ALPHA>90 AND ALPHA<180 THEN AL
PHA=ALPHA-180
1870 IF ALPHA<-180 AND ALPHA>-270 THEN
ALPHA=ALPHA+180
1880 GOTO 1910
1890 IF ALPHA<0 AND ALPHA>-90 THEN ALP
HA=ALPHA+180
1900 IF ALPHA>270 AND ALPHA<360 THEN A
LPHA=ALPHA-180
1910 IF ALPHA<0 THEN ALPHA=ALPHA+360
1920 ALPHA=ALPHA/15
1930 RETURN
1940 REM CONVERTS DECIMALS TO HOURS, M
INUTES, SECONDS
1950 H=INT(V)
1960 M=INT((V-INT(V))*60)
1970 S=60*((V-INT(V))*60-INT((V-INT(V)
)*60))
1980 S=INT(S)
1990 RETURN
2000 REM SUBROUTINE CALCULATES RISING
AND SETTING TIME OF SUN
2010 FLAG=1
2020 GOSUB 2140
2030 ST5=ST5:STRT=STR
2040 LA=LA+0.985647
2050 GOSUB 1690:GOSUB 2140
2060 IF STRT>24 THEN STRT=STRT-24:STR=

```



```

5TR-24
2070 IF 5T5T>24 THEN 5T5T=5T5T-24:5T5=
5T5-24
2080 TR=(24.07*5T5T)/(24.07+5T5T-5TR)
2090 T5=(24.07*5T5T)/(24.07+5T5T-5T5)
2100 IF TR>24 THEN TR=TR-24
2110 IF T5>24 THEN T5=T5-24
2120 FLAG=0
2130 RETURN
2140 REM SUBROUTINE CALCULATES RISING
AND SETTING TIME
2150 DEG
2160 TRAP 2280
2170 G=(C-SIN(THETA)/COS(THETA))*SIN(D
ELTA)/COS(DELTA)
2180 IF WHICH<2 THEN IF G>1 OR G<-1
THEN GOTO 2280
2190 IF G>1 THEN PRINT M$;" DOESN'T R
ISE.":POP:GOTO 5420
2200 IF G<-1 THEN ? M$;" IS CIRCUMPOL
AR":POP:GOTO 5420
2210 H=(C-ATN(G/SQR(-G*G+1))+90)/15
2220 STR=24+ALPHA-H
2230 ST5=ALPHA+H
2240 IF FLAG=1 THEN RETURN
2250 IF STR>24 THEN STR=STR-24
2260 IF ST5>24 THEN ST5=ST5-24
2270 RETURN
2280 ? "THE COMPUTER CANNOT PERFORM TH
E":? "CALCULATIONS WITH THE NUMBERS"
2290 ? "IT HAS BEEN GIVEN. TRY AGAIN W
ITH":? "A LATITUDE NEARER THE EQUATOR."
"
2300 FOR M=1 TO 1000:NEXT M:POP:GOTO
1120
2310 REM SUBROUTINE CONVERTS LST TO GS
T, GST TO GMT, AND GMT TO LOCAL TIME
2320 GST=LONG/15+LST
2330 IF GST<0 THEN GST=GST+24
2340 IF GST>24 THEN GST=GST-24
2350 JD=2-INT((1899+YY)/100)+INT((INT(
(1899+YY)/100)/4))+INT(365.25*(1899+YY
))+INT(30.6001*(13+1))+1720994.5
2360 T=(JD-2415020)/36525
2370 R=6.6460656+(2400.05126*T)+(2.581
E-05*T*T)
2380 CONB=24-R+(24*YY)
2390 TO=0.0657098*B-CONB
2400 IF TO<0 THEN TO=24+TO
2410 TO=GST-TO
2420 IF TO<0 THEN TO=24+TO
2430 GMT=0.99727*TO
2440 IF TIME$="EST" THEN TI=-5
2450 IF TIME$="CST" THEN TI=-6
2460 IF TIME$="MST" THEN TI=-7
2470 IF TIME$="PST" THEN TI=-8
2480 IF TIME$="EDT" THEN TI=-4
2490 IF TIME$="CDT" THEN TI=-5
2500 IF TIME$="MDT" THEN TI=-6
2510 IF TIME$="PDT" THEN TI=-7
2520 IF TIME$="GMT" THEN TI=0
2530 LET V=GMT+TI:IF V<0 THEN V=V+24
2540 GOSUB 1940
2550 RETURN
2560 REM SUBROUTINE CALCULATES RISING
AND SETTING TIMES OF PLANETS, AND THEI
R PHASES
2570 DEG
2580 READ NAME$:IF NAME$="END" THEN PO
P:GOTO 5180
2590 READ TP:READ EP:READ OMEGA:READ E
C:READ AX:READ I:READ O
2600 N=(360/365.2422)*D/TP
2610 IF N>360 THEN N=N-360:GOTO 2610
2620 M=N+EP-OMEGA
2630 L=N+(360/3.1415927)*EC*SIN(M)+EP
2640 IF L>360 THEN L=L-360:GOTO 2640
2650 IF L<0 THEN L=L+360:GOTO 2650
2660 V=L-OMEGA
2670 R=(AX)*(1-EC*EC)/(1+EC*COS(V))
2680 ME=(360/365.2422)*(D/1.00004)
2690 ME=ME+98.83354-102.596403
2700 LE=ME+(360/3.1415927)*0.016718*SI
N(ME)+98.83354
2710 IF LE>360 THEN LE=LE-360
2720 IF LE<0 THEN LE=LE+360
2730 VE=LE-102.596403

```

```

2740 RE=(1-0.016718*0.016718)/(1+0.016
718*COS(VE))
2750 PHI=SIN(L-O)*SIN(I)
2760 PHI=ATN(PHI/SQR(-PHI*PHI+1))
2770 Y=(SIN(L-O))*COS(I)
2780 X=COS(L-O)
2790 LL=ATN(Y/X)
2800 IF X=0 AND Y=0 THEN GOTO 2860
2810 IF X=0 AND Y<0 THEN GOTO 2890
2820 IF X<0 AND Y=0 THEN GOTO 2920
2830 IF LL<0 AND LL<90 THEN LL=LL+180
2840 IF LL<-270 AND LL>-360 THEN LL=LL
-180
2850 GOTO 2940
2860 IF LL<-90 AND LL>-180 THEN LL=LL+
180
2870 IF LL>180 AND LL<270 THEN LL=LL-1
80
2880 GOTO 2940
2890 IF LL>90 AND LL<180 THEN LL=LL-18
0
2900 IF LL<-180 AND LL>-270 THEN LL=LL
+180
2910 GOTO 2940
2920 IF LL<0 AND LL>-90 THEN LL=LL+180
2930 IF LL>270 AND LL<360 THEN LL=LL-1
80
2940 IF LL<0 THEN LL=LL+360
2950 LL=LL+O:RR=R*COS(PHI)
2960 IF NAME$="MERCURY" OR NAME$="VENU
S" THEN GOTO 2980
2970 LA=ATN(RE*SIN(LL-LE)/(RR-RE*COS(L
L-LE)))+LL:GOTO 3010
2980 A=RR*SIN(LL-LL)/(RE-RR*COS(LL-LL)
)
2990 A=ATN(A)
3000 LA=180+LE+A
3010 IF LA<0 THEN LA=LA+360:GOTO 3010
3020 IF LA>360 THEN LA=LA-360:GOTO 302
0
3030 F=INT(100*(1+COS(LA-L)))/2)
3040 LB=ATN(((RR*SIN(PHI))/COS(PHI))*SI
N(LA-LL))/(RE*SIN(LL-LE))
3050 GOSUB 1690
3060 GOSUB 2140
3070 IF ZZ=1 THEN ZZ=0:GOTO 5260
3080 LET LST=STR:GOSUB 2310
3090 LET RH=H:LET RM=M
3100 LET LST=ST5:GOSUB 2310
3110 LET SH=H:LET SM=M
3120 RETURN
3130 PRINT NAME$,RH;"H":RM;"M",SH;"H":
SM;"M",F
3140 GOTO 2580
3150 DATA MERCURY,0.24085,231.2973,77.
1442128,.2056306,.3870986,7.0043579,48
.0941733
3160 DATA VENUS,.61521,355.73352,131.2
89572,.0067826,.7233316,3.394435,76.4
997524
3170 DATA MARS,1.88089,126.30783,335.6
908166,.0933865,1.5236883,1.8498011,49
.4032001
3180 DATA JUPITER,11.86224,146.966365,
14.0095493,.0484658,5.202561,1.3041819
,100.2520175
3190 DATA SATURN,29.45771,165.322242,9
2.6653974,.0556155,9.554747,2.4893741,
113.4888341
3200 DATA URANUS,84.01247,228.0708551,
1727363288,.0463232,19.21814,.7729895,
73.8768642
3210 DATA NEPTUNE, 164.79558,260.35789
98,47.8672148,0.8090021,30.10957,1.771
6017,131.5606494
3220 DATA PLUTO,250.9,209.439,222.972,
.25387,39.78459,17.137,109.941
3230 DATA END
3240 REM MOON
3250 DEG :FLAG=1:TRAP 2280
3260 LET LAA=LA
3270 L=13.1763966*D+64.975464
3280 IF L>360 THEN L=L-360:GOTO 3280
3290 IF L<0 THEN L=L+360:GOTO 3290
3300 MM=L-0.1114041*D-349.383063
3310 IF MM>360 THEN MM=MM-360:GOTO 331
0

```


ATARI 400/800 USERS

HOW TO SURVIVE A BOMBING.



If you have irreplaceable programs on executable disks, you need to protect your investment with a back-up. Not only against the common elements that can ruin your programs, but also against unforeseen and unusual dangers...like a spilled drink or an overly zealous puppy.

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```

3320 IF MM<0 THEN MM=MM+360:GOTO 3320
3330 N=151.950429-0.0529539*D
3340 EV=1.2739*SIN(2*L-2*LA-MM)
3350 AE=0.1858*SIN(M)
3360 MMP=MM+EV-AE-AT
3370 EC=6.2886*SIN(MMP)
3380 AF=0.214*SIN(2*MMP)
3390 LP=L+EV+EC-AE+AF
3400 V=0.6583*SIN(2*(LP-LA))
3410 LPP=LP+V
3420 F=INT(100*(1-COS(LPP-LA))/2)
3430 NP=N-0.16*SIN(M)
3440 Y=SIN(LPP-NP)*COS(5.145396)
3450 X=COS(LPP-NP)
3460 LAM=ATN(Y/X)
3470 IF X>=0 AND Y>=0 THEN GOTO 3530
3480 IF X>=0 AND Y<0 THEN GOTO 3560
3490 IF X<0 AND Y>=0 THEN GOTO 3590
3500 IF LAM>0 AND LAM<90 THEN LAM=LAM+
180
3510 IF LAM<-270 AND LAM>-360 THEN LAM=
LAM-180
3520 GOTO 3610
3530 IF LAM<-90 AND LAM>-180 THEN LAM=
LAM+180
3540 IF LAM>180 AND LAM<270 THEN LAM=L
AM-180
3550 GOTO 3610
3560 IF LAM>90 AND LAM<180 THEN LAM=LA
M-180
3570 IF LAM<-180 AND LAM>-270 THEN LAM=
LAM+180
3580 GOTO 3610
3590 IF LAM<0 AND LAM>-90 THEN LAM=LAM
+180
3600 IF LAM>270 AND LAM<360 THEN LAM=L
AM-180
3610 LAM=LAM+NP
3620 LBM=SIN(LPP-NP)*SIN(5.145396)
3630 LBM=ATN(LBM/SQR(-LBM*LBM+1))
3640 LET LA=LAM:LET LB=LBM:GOSUB 1690
3650 LET ALPHA1=ALPHA:LET DELTA1=DELTA
3660 DLB=0.05*COS(LPP-NP)
3670 DLA=0.55+0.06*COS(MMP)
3680 LB=LBM+DLB*12
3690 LA=LAM+DLA*12
3700 GOSUB 1690
3710 LET ALPHA2=ALPHA:LET DELTA2=DELTA
3720 U=ATN(0.996647*SIN(THETA)/COS(TH
ETA))
3730 PS=0.996647*SIN(U)
3740 PC=COS(U)
3750 PP=(1-0.0549*0.0549)/(1+0.0549*CO
S(MMP+EC))
3760 Q=60.268322*PP
3770 DELTAP=(DELTA1+DELTA2)/2
3780 H=-(SIN(THETA)/COS(THETA))*SIN(D
ELTAP)/COS(DELTA2)
3790 H=-ATN(H/SQR(-H*H+1))+90
3800 DL=ATN((PC*SIN(H))/(Q*COS(DELTA2)
-PC*COS(H)))
3810 HP=H+DL
3820 DL=DL/15
3830 ALPHA1P=ALPHA1-DL
3840 J=Q*SIN(DELTA1)-PS
3850 J=J/(Q*COS(DELTA1)*COS(H)-PC)
3860 J=J*COS(HP)
3870 DELTA1P=ATN(J)
3880 ALPHA2P=ALPHA2-DL
3890 J=Q*SIN(DELTA2)-PS
3900 J=J/(Q*COS(DELTA2)*COS(H)-PC)
3910 J=J*COS(HP)
3920 DELTA2P=ATN(J)
3930 LET ALPHA=ALPHA1P:LET DELTA=DELTA
1P:GOSUB 2140
3940 LET ST1R=STR:LET ST1S=STS
3950 LET ALPHA=ALPHA2P:LET DELTA=DELTA
2P:GOSUB 2140
3960 LET ST2R=STR:LET ST2S=STS
3970 IF ST1S>24 THEN ST1S=ST1S-24:ST2S
=ST2S-24
3980 IF ST1R>24 THEN ST1R=ST1R-24:ST2R
=ST2R-24
3990 TR=(12.03*ST1R)/(12.03+ST1R-ST2R)
4000 TS=(12.03*ST1S)/(12.03+ST1S-ST2S)
4010 IF TR>24 THEN TR=TR-24
4020 IF TS>24 THEN TS=TS-24

```

```

4030 FLAG=0
4040 LET LST=TR:GOSUB 2310
4050 LET RH=H:LET RM=M
4060 LET LST=TS:GOSUB 2310
4070 LET SH=H:LET SM=M
4080 RETURN
4090 REM CALCULATES RISING AND SETTING
TIME OF SELECTED DEEP SKY OBJECTS
4100 MM=MMM
4110 READ N$:IF N$="END" THEN GOTO 482
0
4120 READ TYPE$:READ A:READ DC
4130 ALPHA=INT(A)+(100)*(A-INT(A))/60
4140 DELTA=INT(DC)+(100)*(DC-INT(DC))/
60
4150 GOSUB 2140
4160 LET LST=STR:GOSUB 2310
4170 LET RH=H:LET RM=M
4180 LET LST=TS:GOSUB 2310
4190 LET SH=H:LET SM=M
4200 RETURN
4210 DATA M31,SP, GAL.,0.40,41.00
4220 DATA NGC253,SP, GAL.,0.45,-25.34
4230 DATA M33,SP, GAL.,1.31,30.24
4240 DATA M76,PLAN NEB,1.39,51.19
4250 DATA NGC752,OP CLUS,1.35,37.25
4260 DATA M34,OP CLUS,2.39,42.34
4270 DATA M45,OP CLUS,3.44,23.58
4280 DATA HYADES,OP CLUS,4.17,15.31
4290 DATA M38,OP CLUS,5.26,35.48
4300 DATA IC434,DIF NEB,5.39,-2.26
4310 DATA M1,NOVA,5.32,21.59
4320 DATA M42/43,DIF NEB,5.33,-5.22
4330 DATA M37,OP CLUS,5.49,32.33
4340 DATA M35,OP CLUS,6.06,24.20
4350 DATA NGC2237,DIF NEB,6.30,4.54
4360 DATA M50,OP CLUS,7.01,-8.16
4370 DATA NGC 2392,PLN NEB,7.26,21.01
4380 DATA M46,OP CLUS,7.40,-14.42
4390 DATA M47,OP CLUS,7.34,-14.21
4400 DATA NGC2438,PLN NEB,7.40,-14.36
4410 DATA NGC2440,PLN NEB,7.40,-18.05
4420 DATA M44,OP CLUS,8.38,19.52
4430 DATA M81,SP GAL,9.52,69.18
4440 DATA M82,GAL,9.52,69.56
4450 DATA NGC3227,SP GAL,10.21,20.07
4460 DATA NGC3242,PLN NEB,10.22,-18.23
4470 DATA M97,PLN NEB,11.12,55.18
4480 DATA M106,SP GAL,12.17,47.35
4490 DATA NGC4565,SP GAL,12.34,26.16
4500 DATA M104,SP GAL,12.37,-11.21
4510 DATA M64,SP GAL,12.54,21.57
4520 DATA NGC5139,GL CLUS,13.24,-47.13
4530 DATA M51,SP GAL,13.28,47.27
4540 DATA M3,GL CLUS,13.40,28.38
4550 DATA M5,GL CLUS,15.16,2.16
4560 DATA NGC5907,SP GAL,15.15,56.31
4570 DATA M4,GL CLUS,16.21,-26.24
4580 DATA M13,GL CLUS,16.40,36.33
4590 DATA M12,GL CLUS,16.45,-1.52
4600 DATA M10,GL CLUS,16.55,-4.02
4610 DATA M92,GL CLUS,43.12,6.1
4620 DATA M8,DIF NEB,18.02,-24.20
4630 DATA M9,GL CLUS,17.16,-18.28
4640 DATA NGC6543,PL NEB,17.59,66.38
4650 DATA M20,NEB,17.59,-23.02
4660 DATA NGC6572,PL NEB,18.10,6.50
4670 DATA M17,DIF NEB,18.18,-16.12
4680 DATA M25,OP CLUS,18.29,-19.17
4690 DATA M22,GL CLUS,18.34,-23.57
4700 DATA M11,OP CLUS,18.48,-6.20
4710 DATA M57,PL NEB,18.51,32.58
4720 DATA COL399,OP CLUS,19.23,20.05
4730 DATA M55,GL CLUS,19.37,-31.03
4740 DATA NGC6818,PL NEB,19.41,-14.17
4750 DATA NGC6822,IR GAL,19.42,-14.53
4760 DATA M27,PL NEB,19.57,22.35
4770 DATA NGC6960,NOVA,20.49,31.00
4780 DATA NGC7009,PL NEB,21.01,-11.34
4790 DATA M15,GL CLUS,21.28,11.57
4800 DATA M2,GL CLUS,21.31,-1.03
4810 DATA END
4820 ? :? "HIT RETURN WHEN THROUGH":IN
PUT N$:"?"
4830 TRAP 4830: ? :? "DO YOU WANT THE L
OCATION OF ANY?"
4840 ? :? "OF THE DEEP SKY OBJECTS(Y/N)

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);:INPUT W$:IF W$="N" THEN POP :GOTO
5440
4850 TRAP 4850: ? :? "WHICH OBJECT";:IN
PUT NAMES$
4860 RESTORE 4210
4870 READ W$
4880 IF W$="END" THEN ? "THAT OBJECT I
S NOT IN THE LIST":GOTO 4830
4890 READ TYPE$:READ A:READ DC
4900 IF NAMES$<N$ THEN GOTO 4870
4910 IF INT(DC)<0 THEN DC=DC+1
4920 ? W$,INT(A);"H";100*(A-INT(A));"M
",INT(DC);"DEG";100*(ABS(DC)-INT(ABS(D
C)));""
4930 GOTO 4830
4940 REM PRINTS SOLAR SYSTEM INFO
4950 REM THE SUN
4960 GOSUB 1200:GOSUB 1400:GOSUB 1480:
GOSUB 1690:GOSUB 2000
4970 LET LST=TR:GOSUB 2310
4980 LET RH=H:LET RM=M:LET LST=TS:GOSU
B 2310
4990 LET SH=H:LET SM=M
5000 ? "K"
5010 ? " " " ;DD;"/";MM;"/";Y
Y
5020 ? " " " ;TIME$
5030 PRINT " ", "RISE", "SET", "% ILLUM"
5040 PRINT " "
5050 IF PEEK(53279)=6 THEN RETURN
5060 PRINT "SUN",RH;"H";RM;"M",SH;"H";
SM;"M",F
5070 REM THE MOON
5080 GOSUB 3240
5090 IF PEEK(53279)=6 THEN RETURN
5100 PRINT "MOON",RH;"H";RM;"M",SH;"H"
;SM;"M",F
5110 LA=LAA
5120 REM THE PLANETS
5130 RESTORE 3150
5140 GOSUB 2560
5150 IF PEEK(53279)=6 THEN RETURN
5160 PRINT NAMES$,RH;"H";RM;"M",SH;"H";
SM;"M",F
5170 GOTO 5140
5180 TRAP 5180: ? :? "DO YOU WANT THE L
OCATION OF ANY"
5190 ? :? "OF THE PLANETS(Y/N)":INPUT
W$:IF W$="N" THEN RETURN
5200 TRAP 5200: ? :? "WHICH PLANET";:IN
PUT NAMES$
5210 RESTORE 3150
5220 READ W$:IF W$="END" THEN ? "THAT
OBJECT IS NOT ON THE LIST":GOTO 5180
5230 READ TP,EP,OMEGA,EC,AX,I,0
5240 IF NAMES$<N$ THEN GOTO 5220
5250 ZZ=1:GOTO 2600
5260 V=ALPHA:GOSUB 1940:HO=H:MO=M
5270 V=DELTA:GOSUB 1940
5280 ? :? NAMES$,DD;"/";MM;"/";YY
5290 ? :? HO;"H";MO;"M",H;"DEG";M;""
5300 GOTO 5180
5310 RETURN
5320 REM PRINT DEEP SKY INFO
5330 I=0
5340 RESTORE 4210
5350 GOSUB 1200:GOSUB 1400
5360 ? "K": ? " " " ;DD;"/";MM
;"/";YY
5370 PRINT " " " ;TIME$
5380 PRINT "NAME","TYPE","RISE","SET"
5390 GOSUB 4090
5400 IF PEEK(53279)=6 THEN RETURN
5410 PRINT W$,TYPE$,RH;"H";RM;"M",SH;"
H";SM;"M"
5420 I=I+1:IF I=16 THEN PRINT :PRINT "
THERE'S MORE. HIT RETURN TO CONTINUE":
INPUT W$:I=0:GOTO 5390
5430 GOTO 5390
5440 GOTO 1190
5450 REM PRINTS DATA ON ONE OBJECT OVE
R SEVERAL DAYS
5460 DEG
5470 TRAP 5470: ? "K FOR WHICH OBJECT D
O YOU WANT DATA";:INPUT NAMES$
5480 TRAP 5480: ? :? "ENTER THE FIRST D

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ATE FOR WHICH YOU WANT DATA (DD,MM,YY)
";:INPUT DDF,MMF,YYF
5490 IF DDF>31 OR DDF<1 OR MMF<1 OR MM
F>12 OR YYF<0 THEN ? "INPUT INCORRECT"
";:FOR I=1 TO 100:NEXT I:GOTO 5480
5500 TRAP 5500: ? :? "ENTER THE LAST DA
TE FOR WHICH YOU WANT DATA (DD,MM,YY)
";:INPUT DDL,MML,YYL
5510 IF DDL>31 OR DDL<1 OR MML<1 OR MM
L>12 OR YYL<0 THEN ? "INPUT INCORRECT"
";:FOR I=1 TO 100:NEXT I:GOTO 5500
5520 IF YYL=YYF THEN GOTO 5540
5530 ? "BOTH DATES MUST BE IN THE SAM
E CALENDAR YEAR. PLEASE REENTER DATA":
FOR I=1 TO 100:NEXT I:GOTO 5480
5540 ? :GOSUB 1250
5550 YY=YYF:MM=MMF:DD=DDF:GOSUB 1400
5560 BF=B
5570 YY=YYL:MM=MML:DD=DDL:GOSUB 1400
5580 BL=B
5590 IF BF>BL THEN ? "THE FIRST DATE
MUST BE EARLIER THAN THE LAST DATE":FO
R I=1 TO 100:NEXT I:GOTO 5480
5600 K=1
5610 IF YYF<80 THEN D=-365*(80-YYF)-IN
T((80-YYF)/4)+B:GOTO 5630
5620 D=365*(YYF-80)+INT((YYF-80)/4)+B+
1
5630 IF NAMES$="SUN" THEN GOTO 5660
5640 IF NAMES$="MOON" THEN GOTO 5780
5650 GOTO 5890
5660 ? "K": ? NAMES$,DDF;"/";MMF;"/";YYF
,"TO",DDL;"/";MML;"/";YYL
5670 ? "DAY #","RISE","SET"
5680 FOR B=BF TO BL
5690 GOSUB 1480:GOSUB 1690:GOSUB 2000
5700 LET LST=TR:GOSUB 2310
5710 LET RH=H:LET RM=M:LET LST=TS:GOSU
B 2310
5720 LET SH=H:LET SM=M
5730 IF PEEK(53279)=6 THEN RETURN
5740 PRINT K,RH;"H";RM;"M",SH;"H";SM;"
M"
5750 K=K+1
5760 NEXT B
5770 ? "HIT RETURN WHEN THROUGH";:INPU
T W$:RETURN
5780 ? "K": ? NAMES$,DDF;"/";MMF;"/";YYF
,"TO",DDL;"/";MML;"/";YYL
5790 ? "DAY #","RISE","SET","% ILLUM"
5800 FOR B=BF TO BL
5810 GOSUB 1480
5820 GOSUB 3240
5830 IF PEEK(53279)=6 THEN RETURN
5840 PRINT K,RH;"H";RM;"M",SH;"H";SM;"
M",F
5850 K=K+1
5860 NEXT B
5870 LA=LAA
5880 ? "HIT RETURN WHEN THROUGH";:INPU
T W$:RETURN
5890 REM
5900 ? "K": ? NAMES$,DDF;"/";MMF;"/";YYF
,"TO",DDL;"/";MML;"/";YYL
5910 ? :? "DAY #","RISE","SET","% ILLU
M"
5920 RESTORE 3150
5930 READ W$:IF W$="END" THEN ? :? NAM
E$; " IS NOT IN THE LIST":FOR W=1 TO 25
0:NEXT W:GOTO 5470
5940 READ TP,EP,OMEGA,EC,AX,I,0
5950 IF NAMES$<N$ THEN GOTO 5930
5960 FOR B=BF TO BL:GOSUB 1480
5970 GOSUB 2600
5980 IF PEEK(53279)=6 THEN RETURN
5990 ? K,RH;"H";RM;"M",SH;"H";SM;"M",F
6000 K=K+1
6010 NEXT B
6020 ? :? "HIT RETURN WHEN THROUGH";:I
NPUT W$:RETURN

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(continued on next page)

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 1150 DATA 672,250,571,204,713,664,142,
 283,451,192,690,659,476,691,465,7123
 1300 DATA 538,343,64,29,726,381,794,30
 0,422,271,190,472,206,455,250,5441
 1450 DATA 731,500,798,450,217,632,513,
 124,454,589,726,604,458,736,605,8137
 1600 DATA 416,738,242,985,265,247,85,4
 36,805,223,264,108,765,69,810,6458
 1750 DATA 563,798,456,156,273,338,860,
 733,591,703,736,599,866,739,255,8666
 1900 DATA 703,778,773,809,665,926,344,
 166,937,815,673,397,939,531,474,9930
 2050 DATA 217,971,984,906,913,449,454,
 398,787,600,253,691,408,323,355,8709
 2200 DATA 775,177,780,483,594,16,24,79
 4,96,93,280,135,728,713,977,6665
 2350 DATA 838,980,6,998,10,392,16,394,
 600,785,783,805,813,743,741,8904
 2500 DATA 756,764,573,939,971,801,584,
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 2650 DATA 395,939,991,857,445,996,459,
 494,545,411,266,417,63,43,386,7707
 2800 DATA 464,163,261,665,209,747,895,
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 2950 DATA 487,267,754,977,874,220,833,
 692,873,192,968,945,117,718,325,9242
 3100 DATA 715,324,788,837,731,264,214,
 128,830,625,353,955,489,960,70,8283
 3250 DATA 224,133,177,316,383,478,778,
 954,163,978,670,821,845,11,753,7684
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 3850 DATA 619,353,690,161,117,619,351,
 691,971,443,975,448,264,256,661,7619
 4000 DATA 636,451,456,400,488,323,491,
 329,793,876,522,916,13,627,39,7360
 4150 DATA 949,721,328,725,334,791,867,
 487,878,992,172,803,812,283,833,9975
 4300 DATA 177,614,65,815,791,141,791,5
 40,987,993,620,602,834,880,544,9394
 4450 DATA 347,452,21,6,375,215,735,536
 ,755,877,808,384,48,966,952,7477
 4600 DATA 933,925,927,71,406,574,177,2
 17,242,212,962,737,340,206,635,7564
 4750 DATA 605,745,268,608,976,826,978,
 103,730,994,904,211,646,230,41,8865
 4900 DATA 892,800,537,755,760,475,270,
 518,59,358,377,906,865,636,706,8914
 5050 DATA 505,852,354,954,509,784,439,
 816,193,964,508,844,735,722,352,9531
 5200 DATA 917,194,367,278,864,719,456,
 19,48,394,742,797,176,996,196,7163
 5350 DATA 189,516,617,828,976,512,699,
 451,752,739,450,269,868,546,416,8828
 5500 DATA 669,444,69,458,267,938,276,9
 76,290,57,7,574,655,469,332,6481
 5650 DATA 765,595,258,660,868,507,48,3
 47,524,118,544,498,406,600,556,7294
 5800 DATA 658,985,972,527,168,547,501,
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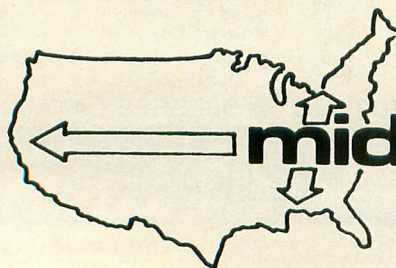
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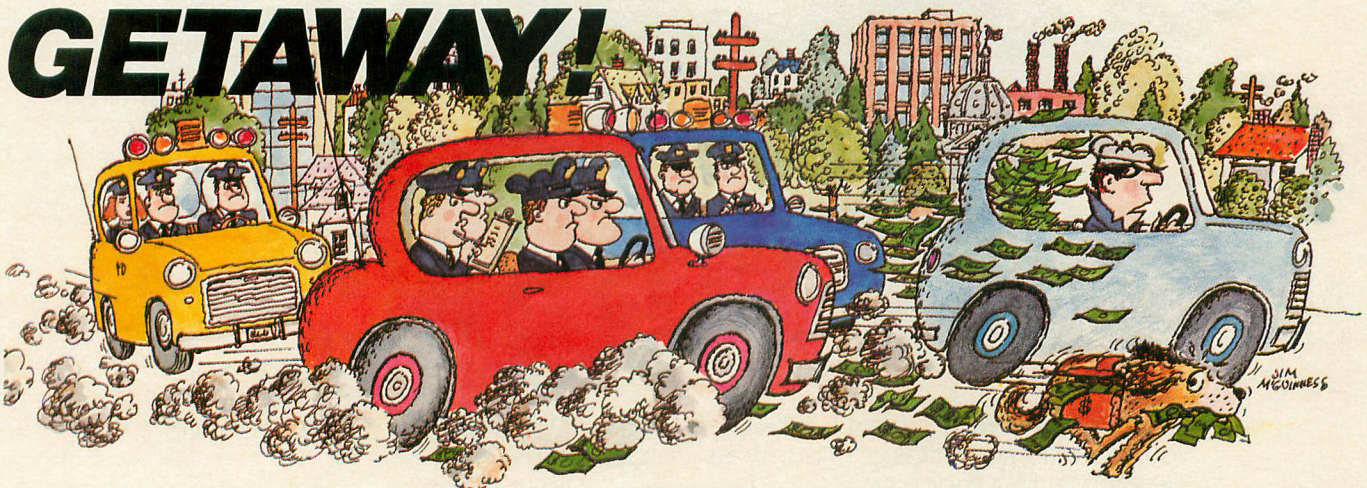
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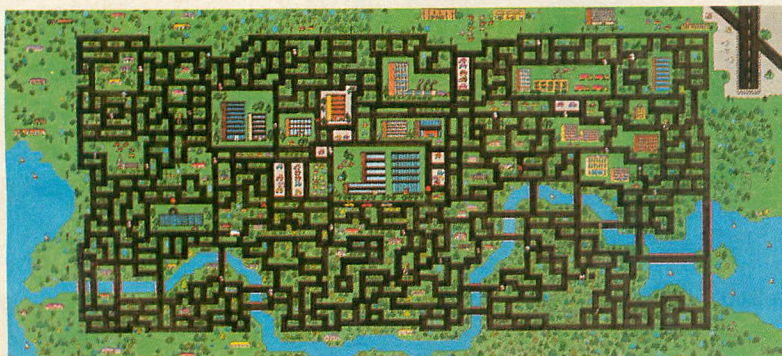
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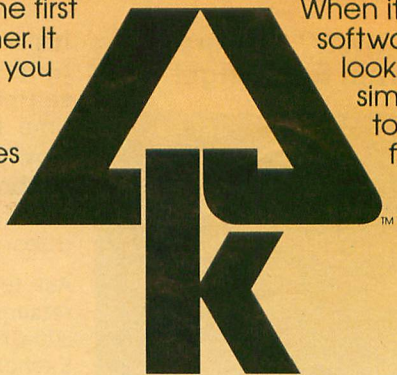


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THE NEW ATARI PERIPHERALS

by Lee Pappas

The Summer Consumer Electronics Show in Chicago saw personal computers in the limelight for the first time. While most of the computer-oriented companies had their displays set up in the new Software Showcase building, the main ATARI booth remained in the big exhibition hall at McCormick Place. The major attraction was the new XL home computer line (announced in our last issue).

The machines in the XL series are based on the now-discontinued 1200XL console, with the 6502C microprocessor, GTIA and support chips. The expanded 24K operating system includes the self-diagnostic modes found in the 1200XL along with built-in revision "B" ATARI BASIC. Thus all newly developed software should be able to run on everything from the 400 upwards. Each computer features one cartridge slot, 2 controller ports, a fullstroke keyboard and a serial I/O connector.

The 600XL and 800XL

Replacing the ATARI 400 and 800 computers are the long-awaited (and rumored) **600XL** and **800XL** systems. Both have the same 62-key full-stroke keyboard, which is similar to the 800's except that the locations of the lower right-hand shift keys and the "ATARI" inverse video key have been switched. A column of brushed metal keys on the right hand edge implements the SYSTEM RESET, OPTION, SELECT and START keys found on the 400/800, and also includes a HELP button. A power indicator LED is mounted just below the HELP key. The 600XL comes with 16K of RAM (expandable to 64K), and is roughly half the size of an 800; the 64K 800XL is slightly deeper than the 600XL, presumably to accommodate the extra RAM.

Both the 600XL and 800XL machines have a pop-away cartridge door on top and controller ports on the right side. The on/off switch, serial I/O, TV output and power jacks reside on the back, along with a new CPU expander bus allowing all kinds of neat possibilities for add-ons. The 800XL also includes a video monitor output on the back. 600XL computers should be on your dealer's shelf by the time you read this. Look for the 800XL in late September.

The 1400XL

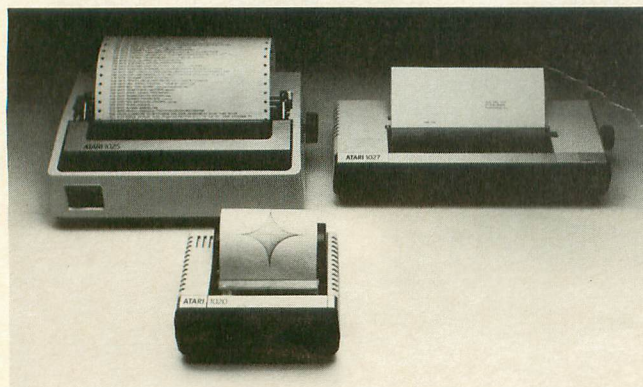
Physically, the 64K **1400XL** is identical to the 1200XL: a strip of function keys lies across the top of the keyboard, along with the HELP and inverse video keys. The cartridge slot and controller ports are still on the left hand side of the console. Additionally, the 1400XL offers a built-in direct-connect modem with telecommunications software in ROM, and a built-in voice synthesizer based on the popular Votrax chip. Modem connections, CPU expander bus and I/O jacks are on the back panel. Release of the 1400XL is scheduled for October.

The 1450XLD

The top of ATARI's XL computer line is the 64K **1450XLD** (the "D" stands for Disk). Basically, it's a 1400XL console with a dual-sided, double-density disk drive attached to the top, with extra space for one additional drive. Each drive can store up to 254K of data. Because the drive doesn't use the slow serial port for data transfer, the access speed is much faster than an external drive like the old 810. The drive housing is shielded to allow placement of a monitor on top of the computer cabinet. The 1450XLD should be out by late October and will retail for under \$1,000.

Peripherals

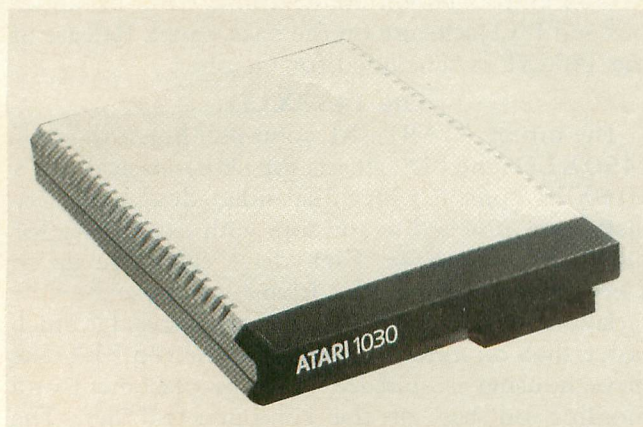
The new **ATARI 1027 Letter Quality Printer** uses 5 small "print drums" to produce highly readable copy. It accepts both single sheet and roll paper and uses a replaceable \$4.95 ink roller. The 1027 is capable of both underlining and bi-directional printing, and plugs into the serial I/O connector on all ATARI computers without the need for a separate interface module. The relatively slow print speed of 20 characters per second is more than compensated by the \$349 price tag.



The new ATARI printer line

ATARI is also unveiling the **1050 Disk Drive** and a new **DOS III** operating system, to be released sometime this fall. Unfortunately, the need for compatibility with DOS II limits the maximum disk capacity of the 1050 to only 127K, instead of the 190K usually associated with a double-density drive. Projected price is \$449.

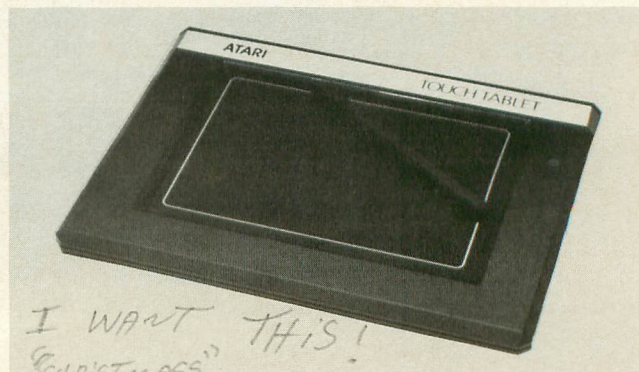
The 300-baud **1030 Direct Connect Modem** plugs into any standard modular phone jack. It comes with **Modemlink** telecommunications software which allows direct dialing through the computer keyboard. The new modem is compatible with both touch tone and rotary (pulse) phone systems, can be used with either **Telelink I** or **II**, and requires no interface. Pricing for the 1030 has yet to be announced.



1030 Direct Connect Modem

Accessories

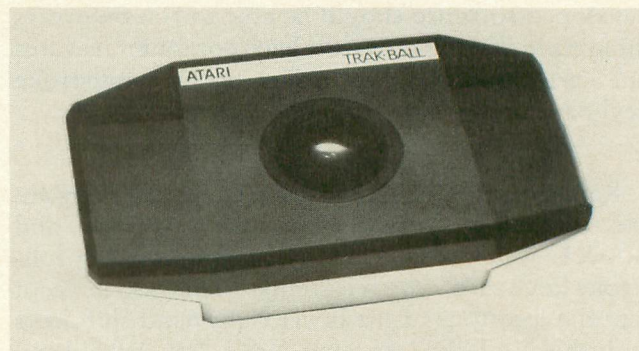
New controllers for the ATARI computers were abundant at CES. The slickest of these is the **CX77 Touch Tablet**, an electronic pad that lets you enter text or graphics into the computer with ease. The CX77 comes with a drawing stylus and all necessary software. It should be appearing before Christmas for \$79.95.



CX77 Touch Tablet

Another new product in the same category is the **ATARI Light Pen**. It allows the user to draw, write or cue directly on the screen. Some of you may remember the original ATARI light pen that made a brief appearance 2 years back. This new pen is much smaller, with performance far superior to its predecessor. Price and release date have not been announced.

Additional product intros include the **CX80 Trackball** (with huge left and right fire buttons built into its console), a remote control joystick and the **CX60 Ultimate Super Joystick**, which is slimmer and much more comfortable than the present unit. All should be out by year's end; the CX80 Track Ball will retail for \$59.95 and the remotes for \$74.95.

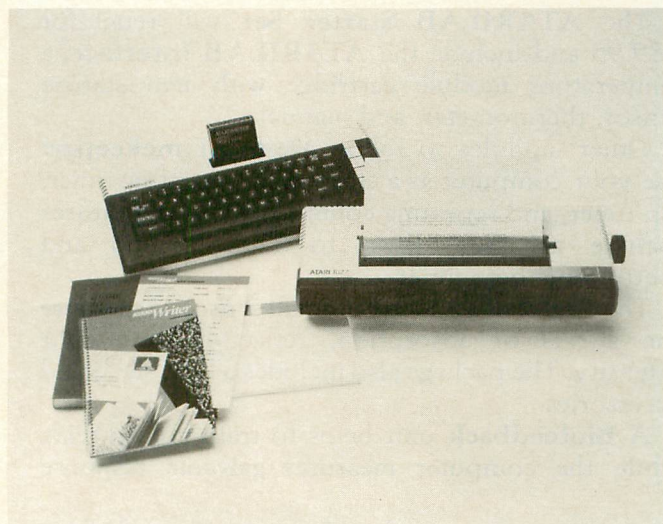


CX80 Trackball

Package deals

ATARI was promoting a number of prepackaged hardware/software systems called **ATARI-PAKs**. The **Programming System** contains a 600XL computer, 1010 Program Recorder, *Invitation To Programming* cassette series and several user manuals, including the fabulous *Inside ATARI BASIC*. List

price will be \$380. The **Entertainment System** (\$300) includes a 600XL, **Ms. Pacman**, **Donkey Kong**, a pair of joysticks, a special ROM cartridge storage case and a new book entitled *How To Win At ATARI Computer Games*. The **Writing System** combines a 600XL, 1027 Letter Quality Printer and the wonderful new **ATARIWriter** word processing cartridge for about \$600. The ATARI-PAKs should be out in time for Christmas.



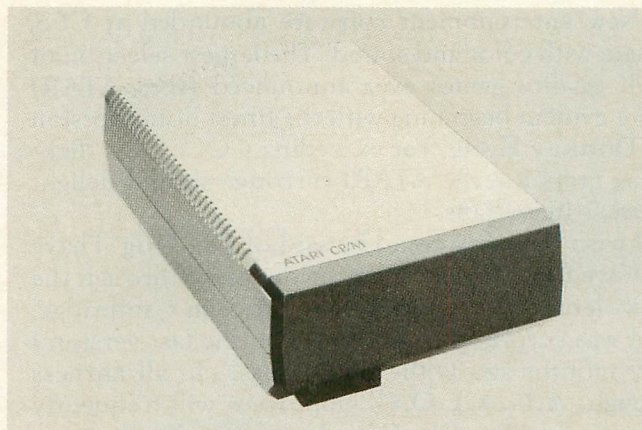
The ATARI Writing System

The new ATARI CP/M Module

One of the most exciting pieces of new ATARI hardware announced at CES is the **CP/M Expansion Module**. Contrary to our report in Issue #12, the Expansion Module is designed to work with *all* ATARI home computers, including the 400 and 800 systems. The unit connects to the serial port like a cassette or disk drive, and no additional hardware is required.

The module offers built-in 80 column video capability and houses 64K of RAM. Detailed information on how to access both features will be available. The fact that the module contains 64K doesn't mean that your 16K computer will now have 3 times more memory. The 64K block *looks* like a disk drive to the computer, and cannot be directly addressed like internal memory. Likewise, the 80 column option requires compatible software; running just any program through the module will not format it to 80 columns on the screen.

The CP/M Expansion Module also contains its own Z-80 microprocessor which is not directly accessible by the user. In effect, the CP/M Module becomes an independent computer entity, and your ATARI acts as a terminal whose memory houses the **CP/M** operating system and your specific data. When an application such as Pascal is loaded in, it will fill the memory in the CP/M module, freeing the memory in your computer for programming.



ATARI CP/M Module

Installation of the module is a simple plug-in operation. All the software your ATARI needs to "see" the CP/M unit is automatically booted in upon power-up, just like the 850 Interface Module.

ADD-ON SOFTWARE, Inc., who worked with ATARI in developing the CP/M Expansion Module, will be offering the most popular CP/M 2.2 software in ATARI disk format. At press time, agreements with many of the software licensees were not final, but the following list should be fairly accurate.

Wordstar (MicroPro International). The world's most popular word processing program because of its performance and ease of use. This program does it all, and comes with extensive documentation and support.

dBASE II (Allied Computer Services). The well-known and extremely powerful database management system.

Peachpak (Peachtree Software). A package of 8 professional accounting programs including Sales Invoicing, Accounts Receivable, Accounts Payable, PeachPay Payroll, Inventory Control and General Ledger.

Pascal/MT+ (Digital Research). An expanded version of the Pascal programming language, from the original authors of CP/M.

CBASIC (Digital Research). A feature-packed BASIC system, designed specifically to run under CP/M.

SuperWriter (Sorcim). Yet another outstanding word processing package.

SuperCalc (Sorcim). A VisiCalc Clone for electronic spreadsheeting.

Multiplan (Microsoft). Another Visi-Clone, converted from the Apple to run under ATARI CP/M.

MBASIC (Microsoft). A CP/M-based version of Microsoft BASIC.

Other titles may include **MicroSort**, **Supersoft FORTH** and the **Personal Pearl Database Manager** (as used on the OSBORNE computer).

Great new games

New entertainment software abounded at CES, ablaze with color and sound. The largest selection of high quality games ever announced from ATARI were evident beginning with the finest home version of **Donkey Kong**. Far exceeding COLECO's flickering graphics, the ATARI cartridge should delight Mario's many fans.

I wish the same could be said of **Dig Dug**. I have followed the development of the game through the now-defunct ATARI Software office in Cambridge, and was surprised to find out that the last version I saw months ago is the final release. In all fairness though, A.N.A.L.O.G. employees will frequently find me playing **Dig Dug** during our lunch/game break.

The next few months should see **Pole Position**, **Ms. Pac Man**, **Donkey Kong Jr.**, **Pengo**, **Robotron: 2084**, **Superman III**, and **Joust** on the market. Several sports games will also be introduced including **Football**, **Soccer**, and **Tennis**. In addition, **Eastern Front** is now on ROM cartridge. Be sure and read the **Donkey Kong** review this issue, along with the special preview-review of **Pole Position**.

ATARI also "previewed" **Battlezone**, **Tempest**, and **Xevious** in Chicago. In my opinion, this was somewhat misleading. Though captioned with the words *simulation*, the displays were none other than video tapes of the arcade screens played back on raster scan (TV) screens.

Serious stuff

The announcement of many new educational and application programs from ATARI show their dedication to this aspect of home computers. **Paint**, originally developed by the Capital Childrens Museum in Washington, D.C., retails for \$39.95, 48K disk. This program enables you to use your ATARI as a "canvas" and your joystick as a paintbrush. Three different programs on the disk, **SimplePaint**, **SuperPaint**, and **Art Show** allow you to create and display your "works of art."

ATARIMusic 1 and **2** teach the reading and understanding of music through drills, self-teaching lessons, and games. Both are available on cassette or disk.

Several new titles under Disney licensing include **Peter Pan's Daring Journey** and **The Mysteries of Wonderland**. The first, aimed at children 10 and up, is designed to teach language arts, social studies and mathematics. The latter implements graphics to teach children eight and older typing skills and visual discrimination. Both are cassette and disk based. These programs are in addition to the previously released **Mickey in the Great Outdoors**.

ATARILAB Science Series

Several modules for science study are under development for release shortly. The modules,

designed for ATARI by Dickinson College, allow the computer to collect, display, and analyze data in a myriad of different ways.

Utilizing colorful graphics and step-by-step instructions, these modules open up the outside world to the ATARI computers. Included with each module/cartridge is a detailed instruction manual with scientific experiments (for both beginners and advanced users), applicable sensors, and tips on how to write your own BASIC programs utilizing the modules.

The **ATARILAB Starter Set** will retail for \$89.95 and include the **ATARILAB Interface**, a temperature module cartridge with temperature sensor, thermometer, and manual.

Other modules to follow are the **Timekeeper**: use your computer as a stopwatch, repeating timer, lap timer, and repeating countdown timer. Features include accuracy down to 1/60 second and metronome beat timer.

The **Light** module uses a small sensor to measure the affects of absorption, reflection, and light intensity. The package also includes a light stand and accessories.

A **Biofeedback** unit helps to train you to relax while the computer measures galvanic response



The ATARILAB series

(skin moisture), temperature, and pulse rate. Many color displays and sounds assist in personalizing your rest-inducing program. A manual on stress management is included.

The **Mechanics** module introduces the user to surveying with the angle sensor. Additional accessories allow for the study of projectile motion and pendulum action.

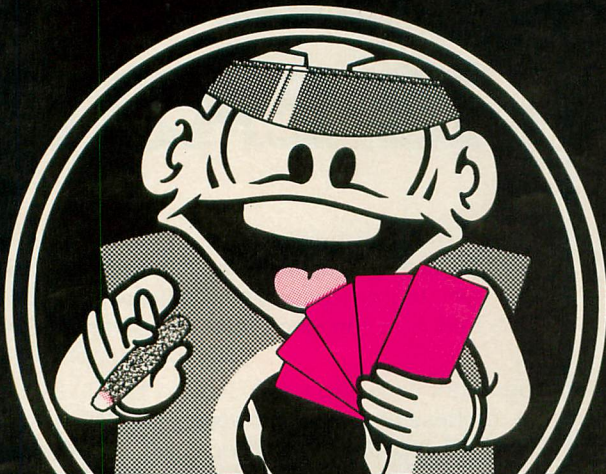
Use the **Lie Detector** to see who is telling the truth in conjunction with the manual included.

These modules will retail for \$50.00 and will be followed by additional packages all aimed at the 4th to 12th grade student. □

(ATARI XL comparison chart
continued on next page)

| FEATURE | 600XL | 800XL | 1400XL | 1450XLD |
|------------------------|-------|-------|--------|---------|
| Memory capacity | 16K* | 64K | 64K | 64K |
| Built-in BASIC Rev. B | Yes | Yes | Yes | Yes |
| Full-stroke keyboard | Yes | Yes | Yes | Yes |
| Cartridge slot | Top | Top | Side | Side |
| External processor bus | Yes | Yes | Yes | Yes |
| Serial I/O connector | Yes | Yes | Yes | Yes |
| Modulated TV output | Yes | Yes | Yes | Yes |
| Monitor/Audio outputs | No | Yes | Yes | Yes |
| Built-in DC Modem | No | No | Yes | Yes |
| Telecom software | No | No | Yes | Yes |
| Speech synthesizer | No | No | Yes | Yes |
| Function keys | None | None | 4 | 4 |
| HELP key | Yes | Yes | Yes | Yes |
| GTIA graphics chip | Yes | Yes | Yes | Yes |
| Four sound voices | Yes | Yes | Yes | Yes |
| International charset | Yes | Yes | Yes | Yes |
| Joystick ports | 2 | 2 | 2 | 2 |
| Built-in DD disk drive | No | No | No | Yes |

*Expandable to 64K



POKERSAM

by Jerry White

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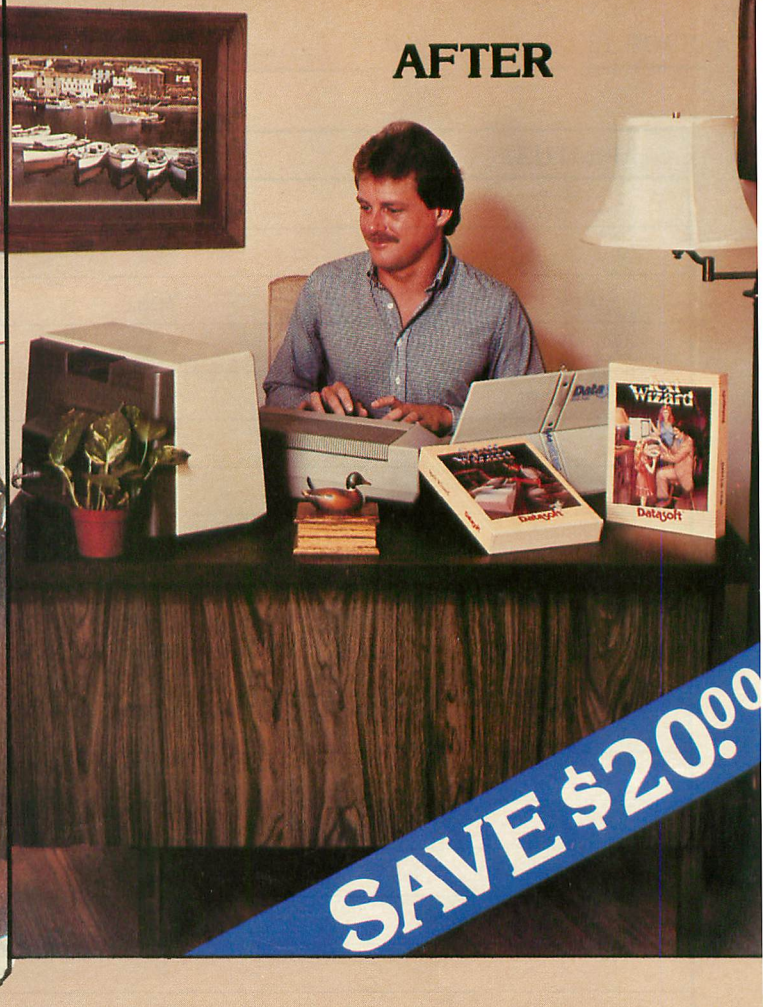
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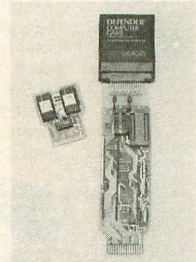
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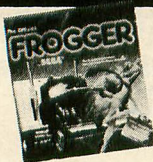
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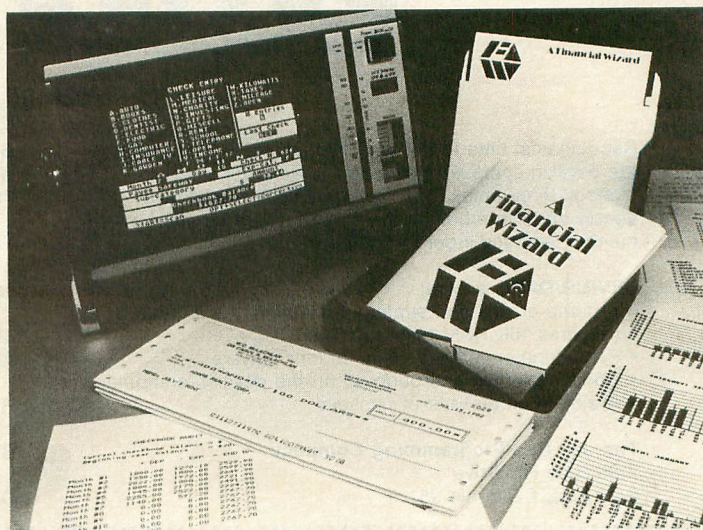
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"This is an excellent finance system—entertaining, accurate, and fun to use."

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Analog Magazine in a comprehensive study of personal finance systems for Atari computers.

"A Financial Wizard from Computari is by far the best of these programs and will be the standard of comparison for the others."

"The check entry mode is easy to use..."

"The way a Financial Wizard handles your tabulations is excellent. You can chart your actual expenses vs. your budget by month, by category or year to date."

"...where it really outshines the rest is in the check reconciliation."

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by Tom Hudson

The change to make **Livewire** default to paddles on startup is simple. The program listings below replace the old cassette and disk change listings from the original article. Just add these to the first listing in the article and RUN the program. These do not check the data, so it's a good idea to make these changes *after* the program runs properly with the old cassette and disk changes. □

```

2 REM *** DISK VERSION ***
20 DIM DAT$(91),HEX(22):FOR X=0 TO 22:
READ N:HEX(X)=N:NEXT X:GOTO 70
40 TOTAL=TOTAL+BYTE:NEXT X:READ CHKSUM:
GOTO 25
65 IF PASS=2 THEN PUT #1,224:PUT #1,2:
PUT #1,225:PUT #1,2:PUT #1,115:PUT #1,
33:CLOSE #1:END
70 ? "INSERT DISK WITH DOS, PRESS RETU
RM":DIM IN$(1):INPUT IN$:OPEN #1,8,0,
"D:AUTORUN.SYS"
90 RESTORE 90:FOR X=1 TO 16:READ N:PUT
#1,N:NEXT X:DATA 255,255,246,31,142,4
9,133,206,169,83,141,202,32,76,139,33
1080 DATA 0000000000000000000000D82065
E4A90A227F9C80CA10FB9A0185A585A44CF61F
CA20A9218DCB20A9008D2F02.22765

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FAMILY CASH FLOW**By Jerry Falkenhan****ATARI PROGRAM EXCHANGE****P.O. Box 3705****Santa Clara, CA 95055****32K Disk \$24.95**

by Bob Curtin

It's unfortunate that ATARI's "game machine" reputation has obscured the fact that it's also an honest-to-goodness computer capable of performing useful work. Software abounds for racing, blasting, crunching, or munching anything that isn't nailed down or painted, and then buried beneath the scores of titles promising the ultimate in thrills, chills, and spine-tingling action, you can occasionally find a dusty copy of something to read your tea leaves or keep track of migrating gnus.

A touch of hyperbole perhaps, but the fact remains that the state of non-game software for the ATARI is pretty grim; one has only to browse through any recent computer magazine to verify that. Games outnumber other types of programs by roughly ten to one. But what's worse is that what non-game software is available is not readily obtainable at your local ATARI dealer. You've got to mail away for the vast majority of it, which means you have no way of knowing ahead of time if the program is what you want. If it turns out to be a dud, you generally can't return it for a cash refund.

It was under this sad state of affairs that I went looking for software to help me with my home finances. After months of searching and rejecting programs which were too complicated (usually designed for business use), too expensive, or too simple for the job at hand, I happened across a copy of FAMILY CASH FLOW by Jerry Falkenhan. It's available through the ATARI PROGRAM EXCHANGE for under \$25.00 and is a steal at that price.

FAMILY CASH FLOW is written in ATARI BASIC and requires at least 32K of RAM and either one or two disk drives. If you're lucky enough to own a printer, this program will give you hard copies of the data in several different forms.

I want to end on an upbeat, so I'll give you the bad news first. FAMILY CASH FLOW does have its drawbacks. First of all, it's by no means a comprehensive financial management system. It doesn't provide the means for setting up and maintaining a budget (either weekly or monthly) nor does it have any method for keeping track of your banking (checking, savings, etc.). It's a unique approach to keeping track of your expenditures, and detailing your income, and although it does have a limited comparison of income to expenditures, it's not

sued to analyzing your budget to any depth.

Now for the good news. FCF can be used to augment just about any financial management system to provide a detailed reporting of where the bucks have gone. The program allows up to 125 individual entries a month in thirteen general categories. All thirteen categories are user definable, and if you've got two disk drives on line the amount of entries you can make per month is doubled to 250.

The entries consist of an entry number (which comes in handy as a reference number on receipts), the date, a label or description up to fifteen characters long, and of course the amount of the expenditure. All data inputs are two-step routines so that you can change your mind before committing the data to disk. Even after you've committed yourself, there are routines to allow you to change or delete entries; virtually any data is easily and quickly manipulated.

Although I hate using catch-phrases, the term "user friendly" is definitely the most apt description I can think of at the moment. Access to the various modes is accomplished through means with one-touch commands, and invalid inputs are immediately trapped, flagged, and looped back for another try. I've made a concerted effort to crash the program by using normal keyboard input and have failed miserably. About the only thing you can accomplish is to create an overflow situation by either entering an amount of a million or more, or by causing an amount greater than 999999.99 to be computed. The program still won't crash, but it'll drop all figures beyond six on the left hand side of the display. The program is so easy to use, one could almost drop in cold and use it without the documentation, which, though crudely printed, is complete, fairly well-written and three-hole punched for filing with the rest of your ATARI documentation.

The displays are clean, neat, and easy to read, with trailing zeros and right justification on all the columns. Mr. Falkenhan's made clever use of the keyboard graphics symbols in his menu displays, and the dark text on light background makes the whole package easy on the eyes.

But the joy of this program is in the using. The different modes allow you to review your income or expenditures on several different levels. In addition to the screen displays, hard copies can be had in each of the different modes, including the detail of expenditures, which eats printing paper at a frightening rate, but nonetheless allows you to make detailed comparisons of your expenses from month to month.

The income program allows up to 25 individual entries in five user definable categories. As in the expense program, a listing of the entries in each category can be gotten on command. There's also a mode for reviewing your finances on a yearly level, with

totals given for each individual month and also totals for the entire year to date.

All data storage and retrieval is automatic so that accidental overwrites of data files are not possible. It takes a bit longer to go from one mode to another because of this, but it's definitely worth it in the long run.

Ruthless honesty in the use of this program, coupled with some imagination in labelling the expenditures, could make this program perform a role which could be compared to the reference volume in an encyclopedia. For quick research the labels themselves could be used, but for more detailed reporting a reference number in the label could refer to a receipt, grocery list, etc. The possibilities are endless.

In any case, either used by itself, or in conjunction with a more comprehensive financial management system, FAMILY CASH FLOW would make a very useful addition to your software library and at a price that'll make you smile. For those of you out there who've not yet put your computer to work doing some of the chores around the house, this is a great place to start. □

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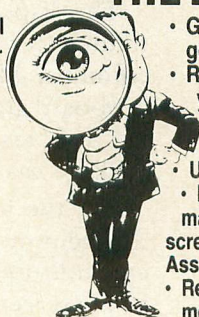


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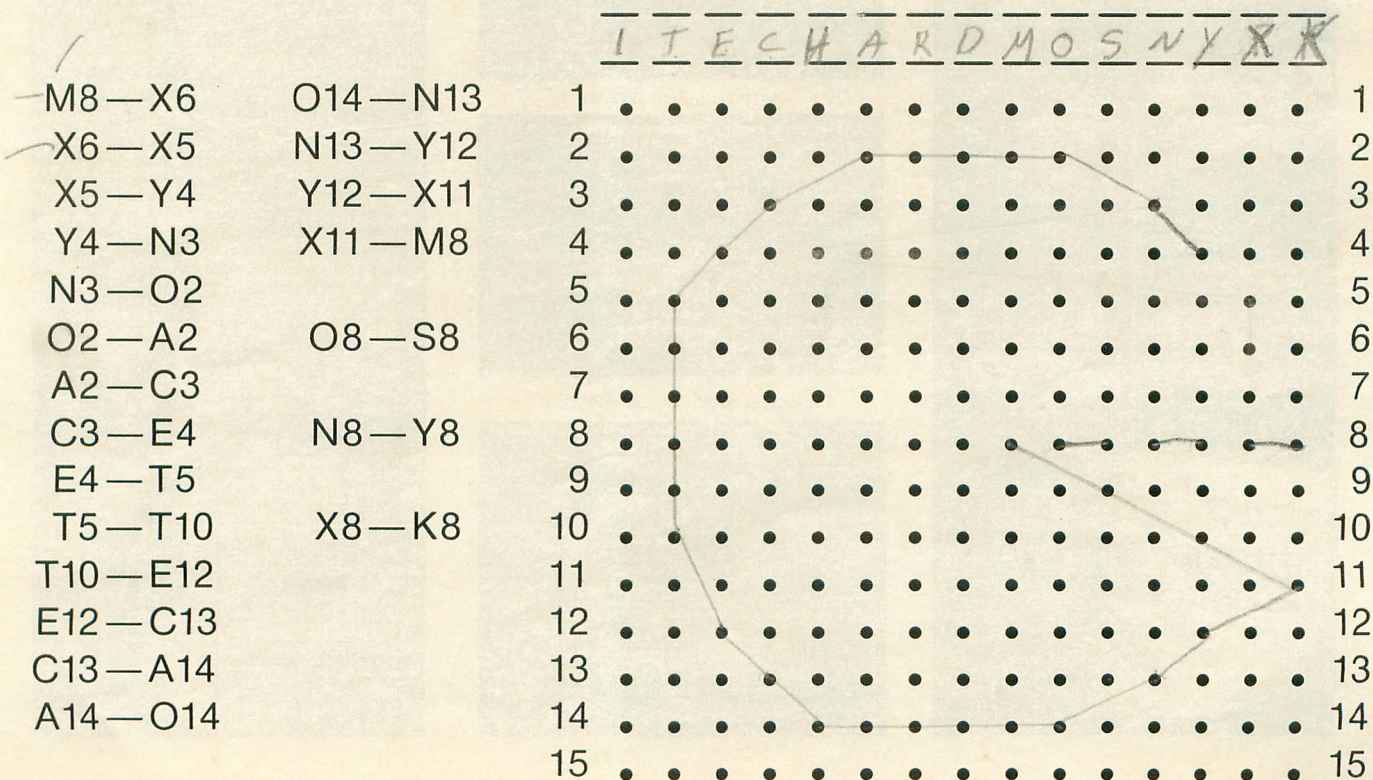
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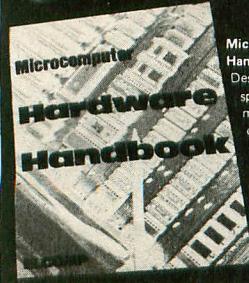
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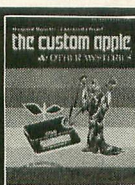
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OUR GAME

by Joel Gluck

For those of you who missed last issue's **Our Game**, there is a basic premise to this column: you and I are going to write a video game together. You send in ideas, comments, and suggestions about the game we're working on. I take all this mail and turn it into a BASIC video game, slowly, over many articles.

Of course, the game will evolve. It will change and develop until we have a real masterpiece on our hands. And by the time that happens you should be pretty confident in your own ability to write games.

We're not going to attempt anything too ambitious. BASIC on your ATARI computer just can't handle arcade-speed games. But what we'll be learning can be applied to games written in any language, on any computer.

Dreaming is free.

Last time we talked about what makes good video games good. Criticism may be fun, but gamewriting is even more fun. Where to start?

It doesn't hurt to start with an idea. You don't have any ideas, you say? Rubbish! Everybody has ideas. You just lost most of them.

Dreams generate ideas faster than Battle Creek, Michigan generates Fruit Loops. I'm not only talking about sleeping dreams. Daydreams are just as prolific. Where do all these ideas go? They die painful deaths soon after you wake up.

Try this after your next dream: instead of hurriedly leaping out of bed when the alarm goes off, lie still and consider your dream. If it sounds the least bit interesting, write something down that will remind you of the dream. A few words will do.

When you have a couple of minutes to spare, take a look at what you wrote. Think about the dream and about what ideas make it interesting. The result may be a great concept for a poem, movie, or novel, but if you're really lucky (or unlucky, depending on how you look at it), the idea may be perfect for a video game.

The problem with this method of idea-generating is that, if Freud was right about dreams, all of your video games will really be about sex. Which may not be bad at all, especially if they are subtly symbolic and not x-rated.

An alternative to using dreams is to find someplace where you can really think. I do some of my best creative thinking in the bathroom. Bathrooms are especially good for thinking about video games because square floor and wall tile allows one to easily picture the pixels that make up video screens. I guess the people at Avalon Hill or S.S.I. (makers of strategic board games) have hexagonal bathroom tiles.

Let's face it. If you put some effort into it, it's difficult *not* to come up with a few ideas. Anything can set your imagination going. See a movie. Read a book. Remember what was fun during your childhood. Imagine what might be more fun than playing **Star Raiders**. Examine commonplace events for game-like qualities.

In general, try to *observe* and *extrapolate*. This means to look at something or experience something and then try to stretch it and extend it in your mind. Ask yourself a lot of "what if" questions. Don't reject any idea as too crazy. Don't look at the world and say, "So what, it's just the world."

Writing things down really helps, especially if you've got a memory as miserable as mine. But don't try to think it all out and write it down immediately. Let the idea ferment and gurggle a bit before bottling it.

Great ideas, but...

So you have a great idea. What do you do with it? Well, you could write it down and start thinking about another idea. But what does that get you? It gets you a whole room full of little scraps of paper with ideas on them.

The courageous thing to do is to go ahead and implement the idea. "Courageous," you ask? "What in tarnation does courage have to do with turning that little scrap of paper into a full-blown video game?"

To a few truly gifted (or truly insane) people, the distance from idea to program is only a keyboard away. Most people have trouble just getting started.

Fortunately, **Our Game** comes to the rescue with a step-by-step, blow-by-blow description of the video game writing process:

- 1) Transform the idea.
- 2) Develop experimental programs and prototypes.
- 3) Write the game.
- 4) Document.

This is not meant to be the definitive method. It merely approximates what a well-organized game programmer does when he develops a computer game.

Crystalize.

By crystalization, I mean the clarification and fleshing-out of the game idea. It's one thing to say, "hey, how about a game in which aliens from Rigel land in New Jersey and start to turn all the shopping centers into giant hamsters," and another thing to explain how that constitutes a game.

Basically you have to ask yourself a lot of questions. It also helps to write down the answers. Questions like:

What would "playing the game" entail?

What is the object of the game?

How many players can play it?

How does the game end?

How does a player interact with the game?

Does the game have a plot and/or a set of characters?

What is the mood of the game?

For the aforementioned "Close Encounters on the Turnpike," our inspired game designer might first write:

"In this one player game you play the part of the Supreme Rigelian, commander of the alien forces. You control the mothership with a joystick and give your subordinate aliens simple English commands. The object of this poignant yet hilarious game is to locate and turn to giant hamsters as many shopping centers as possible before succumbing to air pollution. Game ends when either you win by 'hamstering' all of the shopping centers or lose by getting lung cancer."

Two more very important questions about the game should be asked at this point. We'll be asking them many times throughout the game-design process, so listen up:

Is it unique and original?

Is it fun?

These are not so easy to answer. The first question isn't easy because there may be a game out there you haven't heard of which is just like yours. If that is so, you can't help it, and your game may turn out different and/or better than the existing one. The second question isn't easy because you really can't know how much fun it is until you write it, play it, and have others play it.

Even so, answer the questions to the best of your knowledge. If either answer leans toward a "no," something is wrong. At this point you can either try to give your ideas an overhaul, or throw it away and start anew.

This may seem drastic. Why must games be fun and original? Put simply, a non-fun game isn't played and a non-original game does nothing for you or the world. Any person who gains satisfaction from writing yet another version of **Pac-Man** probably does not care much about games or those who play them. Either he's out to make a fast buck, or he doesn't realize that there's more to video games than what's already been done.

Computerize.

Once you have written up as many details as you can about the game "in abstract," the next step is to apply those details more closely to how the game will exist on your computer. Before we referred to things like "Mother Ships" and "shopping centers" by name only; now it is time to figure out what things look like, how things move, how things are controlled, and other, more specific details. It is time to do a lot of writing and sketching. Important aspects of the computerization include:

- 1) Display.
 - a) How and where are various objects and environments displayed?
 - b) What resolution and colors do I need?
 - c) What visual effects do I need and how can I do them?
- 2) User control.
 - a) What control devices are needed?
 - b) How can I translate the input into information usable by the program?
- 3) Sound.
 - a) What roles do sound effects and music play in the program?
 - b) How do I produce the necessary sounds?
 - c) How can I integrate sound with the game action?
- 4) Computer algorithms.
 - a) What "intelligence," if any, must the computer have during the game?
 - b) How can I program the computer to control automatic opponents or a group of objects in a reasonable way?
- 5) What are the parts of the program? Do I need:
 - a) A title page?
 - b) A series of game options?
 - c) Into what repeating procedures can the program be broken down? What are they?
- 6) What computer language and what computer would serve me best in writing this game?
- 7) Are there any options or future versions I should plan for?

This stage of design really tests your vision of the game. Ideas that won't quite make it as video games will frequently hit snags here. Besides that, this process is a lot of work. For example, if your game relies heavily on graphics, you will probably need to sketch every object that appears on the screen, not to mention the screen layout itself.

Waiting until "programming time" to make such crucial design decisions can be ruinous. It usually means back-tracking and can hurt your will to program. Things are much nicer if everything has been worked out and written up *before* you sit down to program.

As before, you should again attempt to determine if the game will be fun and original. By now it should be easier to tell whether or not the game passes the tests.

Another very important question to ask yourself is: "Is the game feasible for me to program?" If not, it is wise to seek help from any experienced programmers you know. Other good sources of information are books and magazines.

If the situation seems hopeless, try modifying your implementation of the idea to make it simpler and easier to program. You may have to remove some of the features, but anything is better than scrapping a good idea.

How much mail?

I want so much mail that the Post Office has to give **Our Game** its own zip code. On the other hand, if you don't send me any ideas, this column goes down

the tube. A vote of abstention, in this case, is a vote against.

Why would you want to send me your ideas? Well, maybe you enjoy seeing your name in print; I promise to include all the names of people whose ideas I use in these pages.

Another good reason is that **Our Game** is a great place to send all those ideas that you either have no time to develop or don't know how to implement. You may also want to send me particularly strange ideas and *dare* me to include them.

Finally, you'll be doing yourself and other ATARI owners a favor by adding your own creative thought to this column. Remember, **Our Game** is of the people, by the people, and for the people, so mail in your ideas today—and don't forget to tell your friends!

Send your ideas and suggestions (and questions and comments) to:

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Next time we'll be discussing the "prototype," and why you want to write one. □

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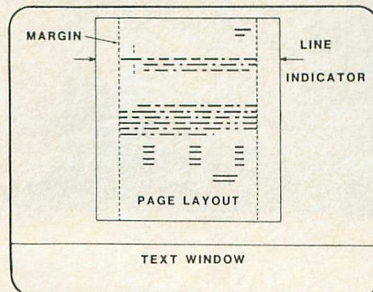
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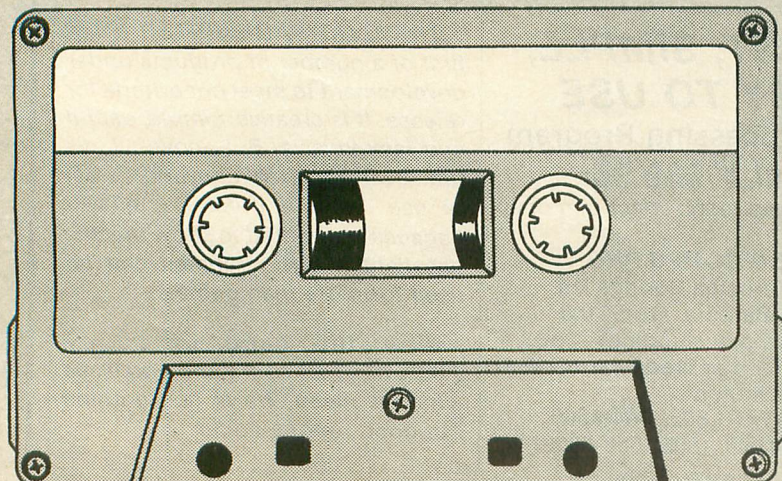
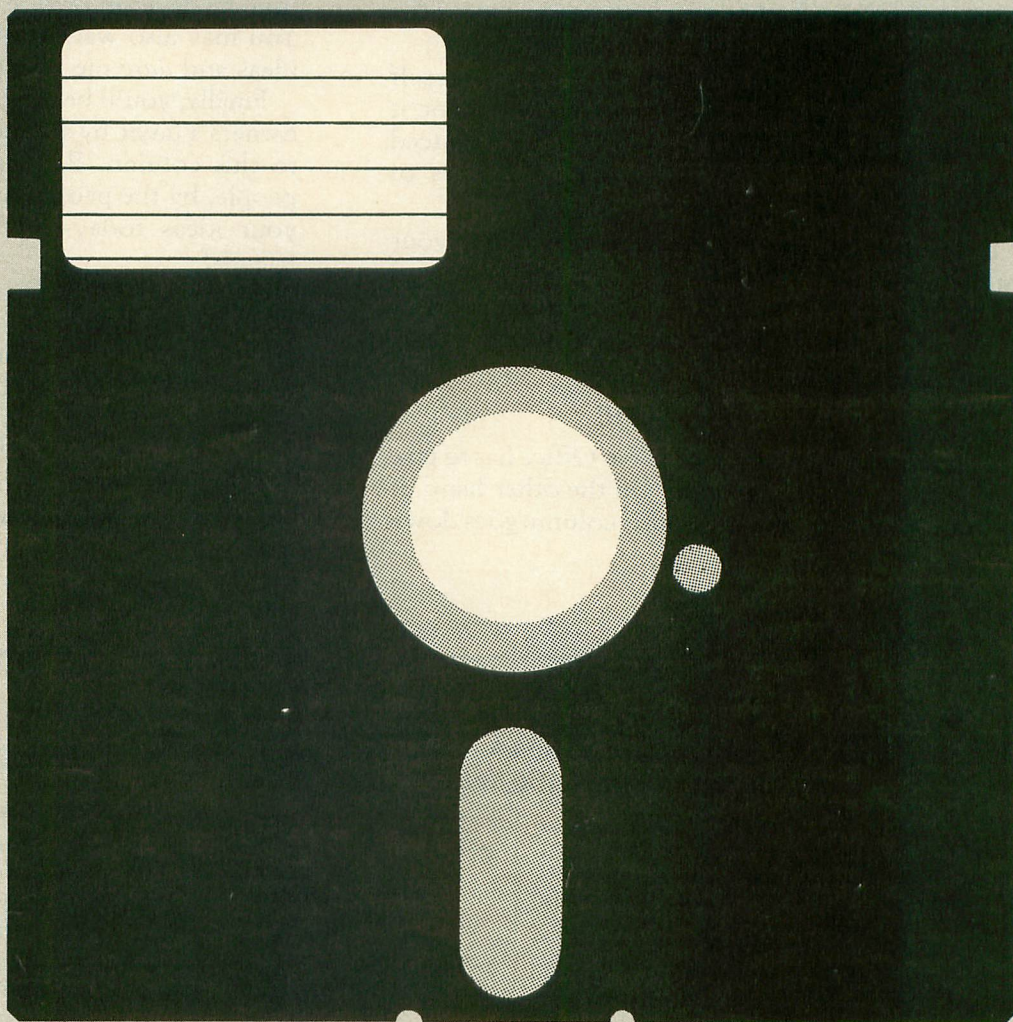
The ALOG PAGEWRITER is the first of a number of products under development to meet our criteria for release. It is creative, simple, useful and inexpensive. But above all, it's fun. It was fun to develop and it's fun to use. We did it for the ATARI because we wanted to show that the excellent ATARI graphics can be used for more than games.

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A GALLERY OF GAMES FROM ELECTRONIC ARTS

by Brian Moriarty

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by Ozark Softscape

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PINBALL CONSTRUCTION SET

by Bill Budge

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ELECTRONIC ARTS

2755 Campus Drive

San Mateo, California 94403

Electronic Arts (EA) is a San Mateo-based game company that manages its programmers like pop stars and packages its software like record albums. The corporate ads present a self-conscious grouping of "computer artists," identically clad in dark, Bohemian jerseys, blue jeans and a touch of leather; the slick copy confidently assures us that video game software will soon hold a respectable position in the hierarchy of Fine Arts. All of which strokes the egos of computer game authors (read *potential customers*), who enjoy viewing themselves as unsung cultural heroes and like nothing better than reading about the significance of their work.

Frankly, the whole idea sounds suspiciously Californian to us Yankee fahmahs up hee-yah in Massachusetts. But we decided to reserve judgement on Electronic Arts until we got a chance to play with their initial lineup of four ATARI programs.

The light and the dark.

Archon is a simplified, speeded-up and extremely violent variation on the classic game of chess. Created by Jon Freeman (who wrote **Temple of Apshai** and **Star Warrior** for Epyx), Anne Westfall and Paul Reiche, **Archon** turns your TV set into a non-stop battlefield where only the quick and cunning will survive.

The object of **Archon** is to occupy five "power points" located on a 9x9 grid of squares. Two-thirds of the grid are composed of white and black squares which retain their color throughout the game. The other squares cycle back and forth through the gray scale during the course of play. It's a good idea to keep your players on squares with a matching color (white on light squares, black on dark), because your forces are strongest on favorable squares.

Although the powers of Light and Dark are evenly matched, their individual playing pieces are quite different. The Light Side boasts a pair of lightning-fast Unicorns, an explosive Phoenix and assorted Archers, Golems, Valkyries and Knights, all under the command of a spell-casting Wizard. The Dark Side is presided over by an evil Sorceress, who wields a powerful fire-breathing Dragon, Basilisks, Manticores, Banshees and a terrifying Shapeshifter which can instantly assume the attributes of its foe. Each piece is endowed with specific capabilities which determine its effectiveness against the enemy.

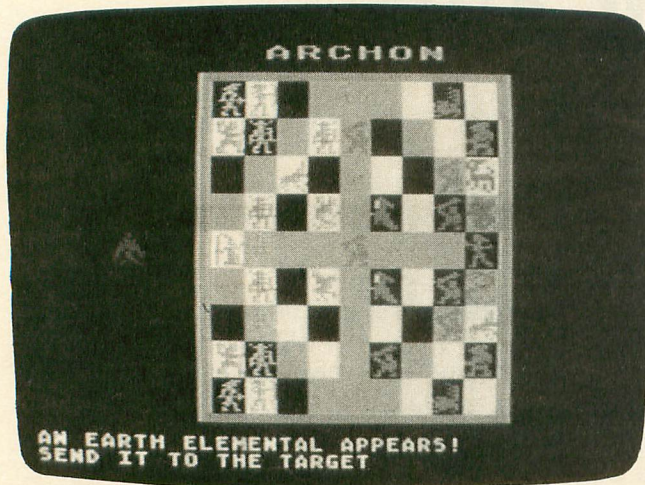
If all of this sounds like more memory work than fun, be assured that it is not. **Archon** is engineered to play like an arcade slugfest, not an adventure; it requires no charts, dice or dungeon-master, and no more strategy than a game of checkers. All you need are a couple of joysticks and a thirst for revenge!

Whenever you invade an opponent's square, the main grid is replaced by a widescreen battlefield filled with obstacles that fade and reappear without warning. You must confront the enemy directly with whatever weapons your player can muster, and earn the right to occupy the new square with your own blood. Definitely not for the faint of heart.

You can play **Archon** against the computer, or you can fight it out with a human opponent. It turns out that the computer isn't a particularly smart player. After two weeks of practice, I can beat the machine almost every time. Nevertheless, the single-player mode is useful for learning the strengths and weaknesses of each piece.

It's when you pit your skills against a good human player that **Archon** comes into its own. At lunchtime and after-hours, the offices of A.N.A.L.O.G. echo with the searing roar of dragon-fire and

shouted obscenities from angry players. **Archon** turns friend against friend, and inspires grudges that can last for days. What better compliment can you give to a computer program?



Archon

Archon is one of the most addicting two-player games ever created for the ATARI. I unconditionally recommend it to anyone with a good supply of patient, forgiving friends to play against.

The politics of M.U.L.E.

If I told you this game was a cross between **Kingdom** and **Monopoly**, you might not get too excited. Yet **M.U.L.E.** imaginatively blends the basic elements of these otherwise sedate games into a fast-moving experience that's even more fun than collecting rent on Boardwalk.

M.U.L.E. puts you and up to three other players on an unsettled alien planet. Your job is to develop and hopefully monopolize the planet's natural resources. To win, you must buy, sell, trade and/or connive your way up to the position of First Founder, aided by a mischievous herd of mechani-

cal quadrupeds known as M.U.L.E.s (Multiple Use Labor Elements).

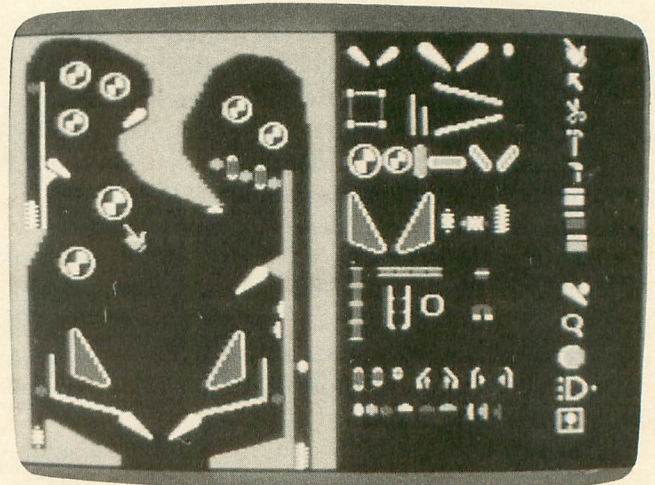
Ozark Softscape, the creators of **M.U.L.E.**, have loaded the game with interesting twists and detail. Each player is represented by a different alien species with a wide range of skills and exploitative abilities. Random events such as planetquakes, plagues, acid rains and runaway M.U.L.E.s will hamper your best efforts. There's even a Wampus running loose in the mountains, and a Pirate lurking around to swipe your goods.

The audio/visual design of **M.U.L.E.** is exceptionally well executed. Its graphics display features a number of imaginative special effects and lots of colorful animation. Best of all is the toe-tapping introductory theme: one of the niftiest examples of original computer music I've ever heard.

If a four-way game of **Monopoly** is your idea of a great Friday night, then **M.U.L.E.** is definitely for you. Its ingenious, professional design puts it far ahead of any other economic simulation game on the market. You may even find yourself learning a thing or two!

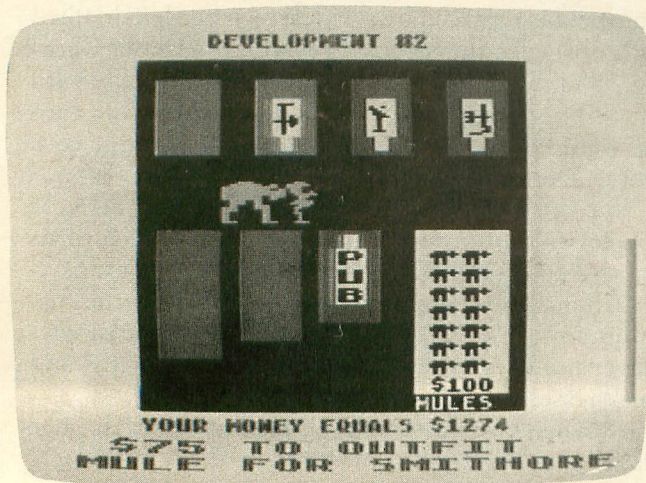
Quarters not included.

Steve Wozniak, inventor of the Apple computer, has called **Pinball Construction Set** "the best program ever written for an 8-bit machine." I can't agree with such a sweeping endorsement, but it's hard not to admire the skill and ingenuity that went into Bill Budge's most ambitious project to date.



Pinball Construction Set

The **Construction Set** is a fully integrated, graphics-oriented design tool that lets you create your own video pinball games. Virtually every important game parameter can be edited at will, including the placement and number of flippers, bumpers, gates and targets, the shape of lanes and corners, sound effects, ball speed, gravity, elasticity — you name it! Previous designs can be stored and reloaded into the editor for further revision, or saved out as a



M.U.L.E.

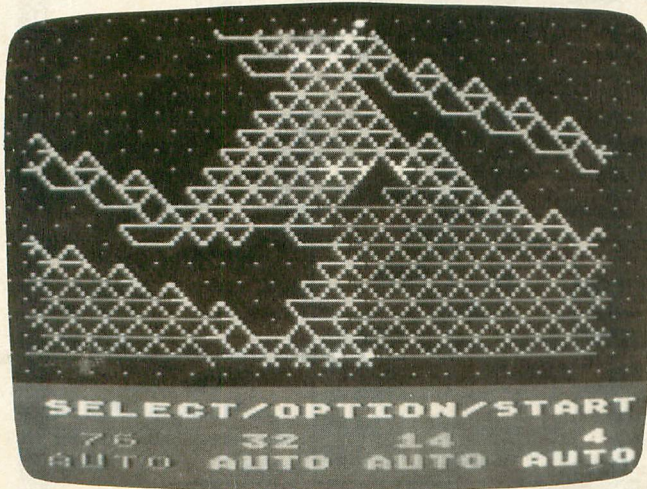
completely independent, self-booting game disk that you can give to your friends. Five complete sample games are also included on the master disk. Not a bad deal for forty bucks.

The most advanced feature of **Pinball Construction Set** is its user interface. A hand-shaped cursor is used to point at little pictures — “icons” — that suggest your different options. Touch a flipper icon with the hand and you can drag it around the playfield, dropping it wherever you like. Touch the paintbrush, dip it into a paint bucket, and you can change the color of borders and obstacles. The magnifying glass is useful for fine detail (game titles, decorations, etc.); the scissors, hammer and arrow let you move corners and borders to your heart's content.

Like many Apple conversions, **Pinball Construction Set** uses mode 8 bit-mapping and artifact colors to make the translation as simple and direct as possible. As such, it doesn't exploit the ATARI's special hardware features as fully as the other new releases from Electronic Arts. Nevertheless, the power and flexibility of the program are undeniably impressive. This package is required study for all serious software authors — and an unbeatable value if you're into video pinball.

Tomorrow's toy.

David Maynard's **Worms?** is the prettiest and most enigmatic of the Electronic Arts offerings. Inspired by the whimsical mathematics of Martin Gardner in *Scientific American*, it may be the first original software release that can legitimately be called a toy.



Worms?

Upon booting the disk, the player is greeted with a pattern of dots covering the upper two-thirds of the screen. Your paddle controls a series of four cursors (the worms), which may be “taught” to move in different patterns across the matrix of dots. Once set in motion, the worms repeat their programmed patterns according to strict mathematical rules, leaving a

trail of color as they pass and “singing” in harmonically related tones whenever they change direction. You can independently program each worm yourself, or you can ask the computer to generate its own random (but mathematically correct) pattern for any one of the worms.

Not into mathematics? Then put all four cursors on automatic pilot, shut off the room lights and enjoy, as **Worms?** explodes across your screen in a brilliant display of music and light. Study **Worms?** as it demonstrates basic principles of geometry, harmony and probability. Or put the disk away and boot your favorite “shoot the alien” game instead — for alas, **Worms?** is not for everybody.

I suggest that you preview **Worms?** at your local computer store before you buy it. People who are fascinated by Rubik's cubes, abstract math and Christmas knick-knacks that “snow” when you shake them will probably like it a lot. Others will consider it a pointless waste of money. Congratulations to Electronic Arts for daring to support this unusual and, to my mind, beautiful product.

A warning to Omnimon! users.

It's a shame to taint this otherwise favorable review with the following paragraphs. But few things get my goat more than inconsideration on the part of software publishers.

Those of you who read my review of **Omnimon!** in issue #12 know what a godsend it is for serious programmers. This ROM-resident monitor has saved me many hours of program development and debugging time, and recently made it possible for me to recover several otherwise unsalvageable text files that were lost when my word processor accidentally destroyed a disk directory. Ironically, the review you are reading is one of those salvaged files!

Three of the ATARIs in our offices are now equipped with **Omnimon!** boards, and more are on the way. Staff programmers Tom Hudson and Charlie Bachand both swear by **Omnimon!** So imagine our collective dismay when, upon booting **Archon** for the first time, we received a curt message on the monitor: “REMOVE ROM AT \$C000.”

I don't mind if software manufacturers copyguard their products. As long as an extra backup copy is provided, or a reasonable backup policy is clearly stated in the documentation (as is the case with Electronic Arts), I see no reason why companies shouldn't try to protect themselves against piracy. But there is such a thing as too much protection. Electronic Arts is clearly going way out of line when they start checking for the presence of an **Omnimon!** board. Granted, **Omnimon!** could potentially be used as a tool to “unlock” EA's elaborate disk-protection scheme. But it stands to reason that anybody smart enough to use **Omnimon!** for this purpose could use a common sector editor to accomplish the same result.

As a programmer and professional ATARI user, **Omnimon!** is far more important to me than any of EA's otherwise delightful products. Until Electronic Arts stops using this arrogant and misguided form of "protection," I cannot recommend their software to anyone who owns an **Omnimon!** board or may be considering the purchase of one. If and when EA informs me of their intention to eliminate the ROM check, I will gladly announce it in a future issue.

The verdict.

Does Electronic Arts live up to its lofty marketing? **Archon** and **M.U.L.E.** are vastly entertaining but fairly conventional games that should insure EA the income they will need to grow. **Pinball Construction Set** is a sophisticated, recognizable "name" product that may appeal more to tinkers and hackers than the general consumer. **Worms?** is EA's answer to Disney's *Fantasia*: an artsy, introspective loss leader that shows a commitment to fresh ideas and talent, and which may in time be recognized as EA's first truly significant contribution to the world of computer entertainment. All in all, a strong opening salvo from this young and distinctly Californian company. □

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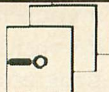


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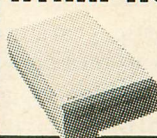


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DONKEY KONG
ATARI, Inc.
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by Tom Hudson

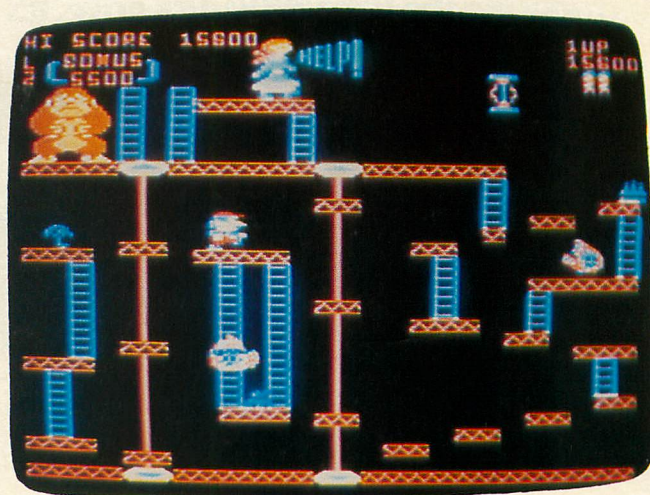
One of the nice things about ATARI personal computer systems is that they have the graphics capabilities that allow them to imitate almost any popular arcade game. Once such game is Nintendo's **Donkey Kong**.

Before playing the ATARI version, I had only played the arcade version about three times, with a high score of (*Gasp!*) 9,950 points. Not exactly what you'd call fantastic, right? Well, with my crummy track record in mind, I plugged the **Donkey Kong** cartridge into my computer and gave it my best shot.

Arcade game play at home.

I must say that the execution of **Donkey Kong** on the ATARI personal computers is about as good as it could be. The use of a 16K cartridge (accounting for the \$49.95 price tag) allows the duplication of virtually every element in the arcade version.

As with the coin-op **Kong**, there are four different game screens. A multi-colored "Mario" must



climb increasingly difficult building sections in order to save his sweetheart from the clutches of Kong. Of course, Kong isn't going to make this task easy.

On the first screen, Kong throws barrels down ramps toward Mario, who must jump over them or suffer the consequences. When certain barrels reach the bottom, they explode into flaming "Firefoxes," which doggedly pursue Mario, and are tough to jump over. Mario's only defense against these threats is in

POLE POSITION
ATARI, Inc.
\$49.95 16K Cartridge

by Lee Pappas

A fine example of what ATARI and its home computers are truly capable of, **Pole Position** combines excellent graphics with good playability — a rare combination these days. The computer version *very*

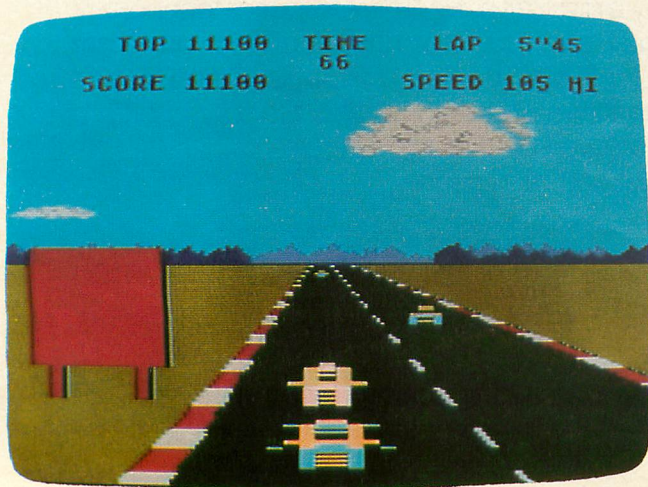
closely reproduces the feel of driving a race car on various tracks, and the thrill of competition that goes with it.

Pole Position starts out by displaying one of the most colorful screen images ever, as you fight the clock on your qualifying lap. Using your joystick, you have 90 seconds of qualifying time, however your car must complete the lap in LESS than 74 seconds to enter the race. Then, depending on how well you did, the computer places your car at the starting line with seven other cars. Whether you start near the front of the pack, or are stuck in the back is dependent on how well you qualified.

Fasten your helmet.

From here you steer your multi-color race car around a twisty track, as you attempt to pass as many other cars as possible to gain bonus points. As you scream past the computer controlled opponents, you'll hear the roar of their engines. Take a corner too fast through, and you'll run off the road and risk hitting one of the cruelly placed billboards (thus turning your expensive race car into a fireball!).

Graphically the game looks identical to the arcade version, but with one disappointing exception. The billboards are single-colored and blank, where as in the coin-op game they are truly graphic ads for **Dig Dug**, **Centipede**, ATARI, and so on. But the multi-shaded clouds, Mt. Fuji, and fast spinning tires over a



the form of large hammers, which he can use to smash the barrels and snuff out firefoxes.

On the second screen, Mario must remove key rivets from a 5-story framework and undermine Kong's perch. Once again, the semi-intelligent firefoxes appear and try to stop Mario. On this screen there are several bonus items which Mario can pick up to receive extra points.

The third screen introduces a new danger: *Mad Springs!* Mario must use all of his climbing and jumping skills to work his way from the left side of the screen to the right. He can use the up and down elevators, but one mistake in judgement will lead to his demise. Timing is very critical here.

The fourth screen brings in another dangerous obstacle: Conveyor belts carrying tubs of sand. Mario can smash these tubs with his hammer, but if he wastes too much time, the firefoxes will descend on him, with predictable results. The conveyor belts change direction from time to time, and seriously affect Mario's speed when running along the belts.

Not a pushover.

For the most part ATARI's **Donkey Kong** plays very true to the arcade version. The fancy animation of Kong grabbing the girl and climbing to the next

level is gone, but I would rather have a good game with acceptable graphics than a pretty graphics demo with no game.

Not surprisingly, the ATARI home version of **Donkey Kong** starts out somewhat easier than the arcade counterpart. This is the rule with most home versions of coin-op games, which don't have to eat quarters to make their money. To date, I have a high score of approximately 80,000 on the home version.

I know, you're probably saying to yourself, "The home version must be a real pushover if this guy can get a high score like that!" Not quite. Once you begin playing the fifth level, things get nasty *fast!* Kong starts throwing barrels like there's no tomorrow, and it takes some quick thinking to get even halfway up the framework. No, this isn't a pushover!

One final note: after playing the home version of **Donkey Kong** for a few days, I went to a local arcade and tested my prowess on a real **Kong**. Remember, up to this point my high score was only 9,950. I'm happy to say that in this most recent attempt I boosted my high score to the 18,000 point mark. I'm convinced my experience on the home version was responsible for the better results, and think this is adequate testimony for any arcade game adaptation. □

rapidly moving road make up for the blank boards. And the accompanying sound effects as you screech around corners and upshift from *Lo* gear to *High* really pull you into the game. Nor did ATARI forget the blimp towing the *Prepare To Qualify* banner and the "thrill of victory, agony of defeat" musical tune, along with the "Christmas Tree" start up lights.

Pole Position lets you choose from several tracks: Indianapolis and Malibu (neither of which represent the real tracks), the ATARI Gran Prix, and a practice course. The game also lets you select up to an eight lap race, however you must complete each lap within a certain time frame to continue on to the next lap. I found this home version of **Pole Position** actually *more* difficult than the arcade game, making it a real challenge and a game I highly recommend. □



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by Sparky Starks

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- R Read new OS, set DS to match
- S Search for ASCII key, drive OD, sector OS to DS
- T Tape to disk
- U Upper case conversion of printer lower case
- V Toggle write verify
- W Write memory buffer to sector DS, drive DD
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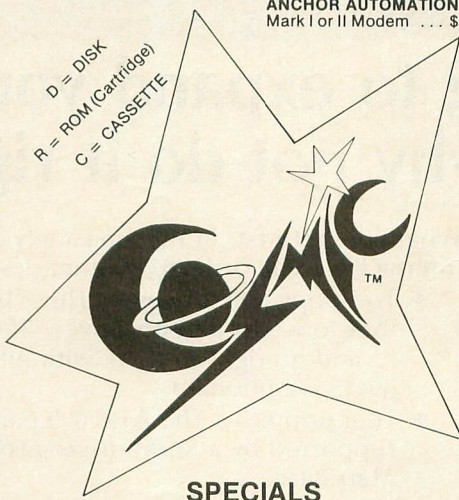
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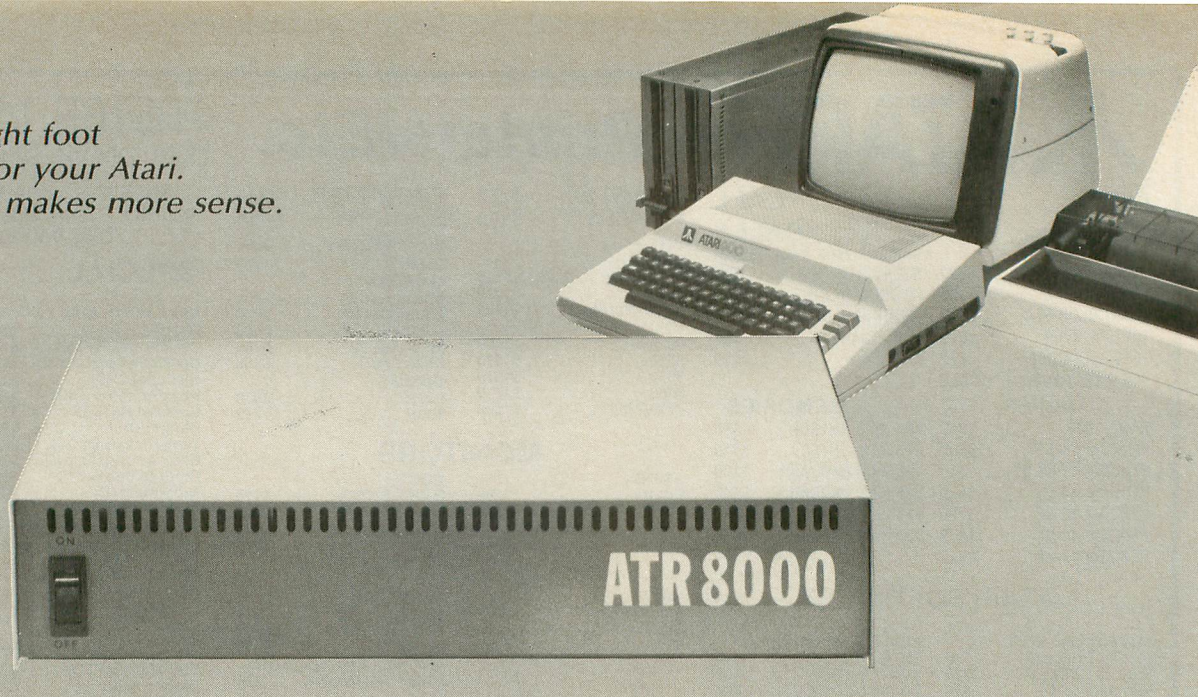
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THE DARK CRYSTAL

by Roberta Williams

ATARI Version by Chris Iden

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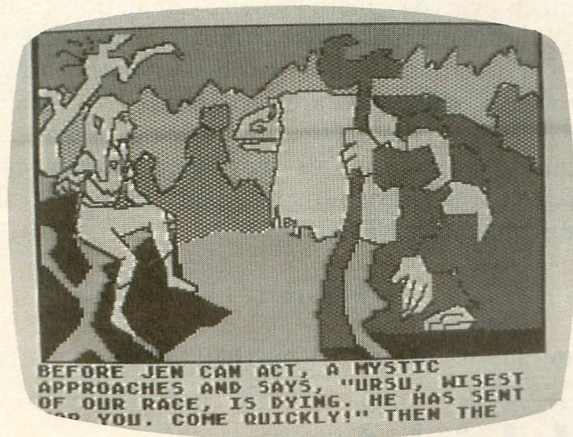
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48K Disk \$39.95

by Brian Moriarty

Dark Crystal is an illustrated adventure based on the Jim Henson movie of the same name. The object is to locate and restore the missing shard of a magic crystal before the "Great Conjunction" of three suns. I haven't seen the film, so I had no prior knowledge of the story's plot or characters. My comments here are based solely on the inherent qualities of the game and not on its value as a souvenir.



The Dark Crystal

The program occupies both sides of three disks. Disk 1, Side A is the main interpreter; the other sides contain picture data for the dozens of color illustrations. On-Line thoughtfully provides a back-up utility that lets you copy the picture disks, which are subject to lots of wear and tear. The interpreter is copy-protected, however.

Game play is similar to On-Line's popular **Wizard and the Princess** and **Mission: Asteroid** adventures. The parser is of the simple two-word, verb-noun variety; multiple commands or complex sentences are not allowed. Each game location has its own hi-res color illustration which must be pulled off the disk. You can "flip away" the picture temporarily to view a listing of your last several commands. Provisions are made for the saving and loading of up to 15 different game positions. The program also lets you format an extra game-save disk during the course of play — a lifesaver if you're in a tough spot with no formatted disks handy.

The illustrations for **Dark Crystal** are supposed to have been digitized from actual movie stills. Detail and coloration are still rather crude — certainly not photographic — but the selection includes a number of dramatic perspective and shading effects you don't often see in games of this type.

I spent the better part of an evening mapping out **Dark Crystal**. I wandered through almost forty different locations and exhausted three of the five picture-disk sides. Aside from a few unavoidable encounters with characters telling you what to look for, *nothing happened*. There were no threatening situations, no puzzles, mazes or unusual objects to pick up, just cute little creatures peeking out from behind trees, and a couple of dead ends. The handsomely printed owner's guide tells you most of what you need to know about your mission; very little is left to the imagination.

Dark Crystal seems to be more concerned with recreating the events and scenery of the movie than with providing a fun game. Despite its fine packaging and professional engineering, I still prefer On-Line's previous Hi-Res Adventures for the ATARI. □

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BOOT CAMP

by Tom Hudson

With this issue, A.N.A.L.O.G. begins a new column. "Boot Camp" will examine assembly language on the ATARI computer systems, while presenting useful subroutines to illustrate the techniques discussed in the column. Readers are invited to send topic suggestions or questions to BOOT CAMP, A.N.A.L.O.G. Computing, P.O. Box 23, Worcester, MA 01603.

The ground rules.

Before starting to learn assembly language, let's lay the ground rules.

First, you should have a good reference guide to assembly language operation codes. I suggest *6502 Assembly Language Programming* by Lance Leventhal (OSBORNE/McGraw-Hill). Of course, there are many such books, and the final choice of what book to use is up to you. Just be sure it covers the 6502 operation codes clearly and completely.

Second, since many program concepts will be shown in BASIC, you should have a working knowledge of BASIC. Assembly language requires a solid background in programming logic, and working in BASIC helps develop this skill. In addition, assembly programming concepts can be grasped more easily if they are first shown in a language the reader is familiar with, such as BASIC. This should not be a problem for most readers, since BASIC is usually the first language learned by personal computer owners. Therefore, from this point on, I will assume that all readers of this column are fluent in BASIC.

Third, you will need an assembler/editor package. All assembly language listings in this column will be compatible with the ATARI *Assembler/Editor* cartridge and OSS's *EASMD* and *MAC/65* assemblers. You can use other assemblers, but some code conversion may be necessary.

Fourth, you should be able to read flowcharts. Flowcharts are a good way to visualize a program's operation before actually writing any code.

Numbering systems.

Everybody is familiar with the DECIMAL numbering system. We all use this numbering system in everyday mathematical calculations. The word "decimal" is derived from the Latin *decem*, or ten. Therefore, this numbering system is known as "base 10," since there are ten digits, 0-9. Let's take a closer look at the decimal numbering system.

Figure 1 shows how a six digit base 10 number can be broken down into individual digits. Each digit can range from 0-9 in value.

Figure 1.

| 10^5 | 10^4 | 10^3 | 10^2 | 10^1 | 10^0 | POSITION VALUE | |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|----------------|-------------------------|
| 2 | 6 | 5 | 0 | 7 | 3 | | |
| | | | | | $3 \times 10^0 =$ | | 3 |
| | | | | $7 \times 10^1 =$ | | | 70 |
| | | | $0 \times 10^2 =$ | | | | 0 |
| | | $5 \times 10^3 =$ | | | | | 5000 |
| | $6 \times 10^4 =$ | | | | | | 60000 |
| $2 \times 10^5 =$ | | | | | | | 200000 |
| | | | | | | | 265073 (BASE 10) |

Above each digit is that digit's POSITION VALUE. The position value is the amount each digit is multiplied by to get the actual value of the digit. You will notice that the position values are shown in powers of ten, since we are working in base 10. The ones position is shown as 10 to the zero power. Any time a number is raised to the zero power, the result is ONE. Therefore, to get the value of the 3 in the last position of the number, we would calculate:

DIGIT X POSITION VALUE=VALUE

In this case the calculation would be:

$$3 \times 1 = 3$$

We would conclude that the last position in the number would have a value of 3.

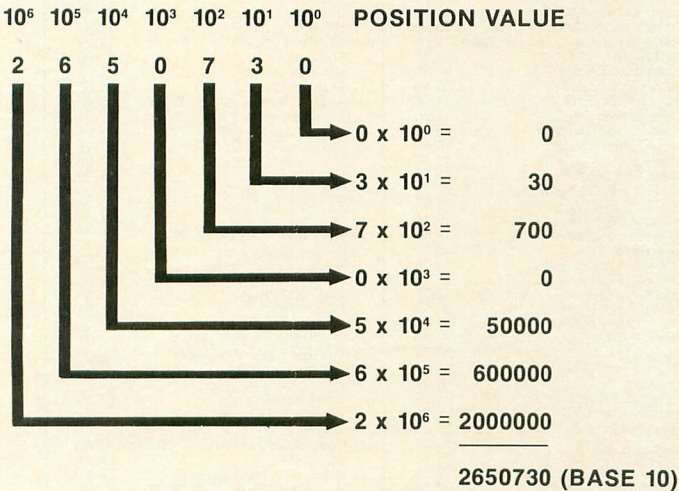
The next position, containing the digit 7, has a position value of 10 to the first power, or 10. The calculation of this digit's value would be:

$$7 \times 10 = 70$$

When we repeat this calculation for each digit in the number and add all the values, we will obtain the value of the number, 265,073 (base 10).

Here's another concept that we may not think about, but is very interesting. What happens to the number if we shift all the digits to the left, as shown in Figure 2?

Figure 2.



By looking at the final results, you can see that the number has effectively been multiplied by 10, with a result of 2,650,730 (base 10)!

Why did this happen? The answer is actually very simple. When each digit is shifted to the left, its position value is increased by a power of ten. The resulting number will be ten times larger than if it were not shifted. Try shifting the number to the right and see what happens.

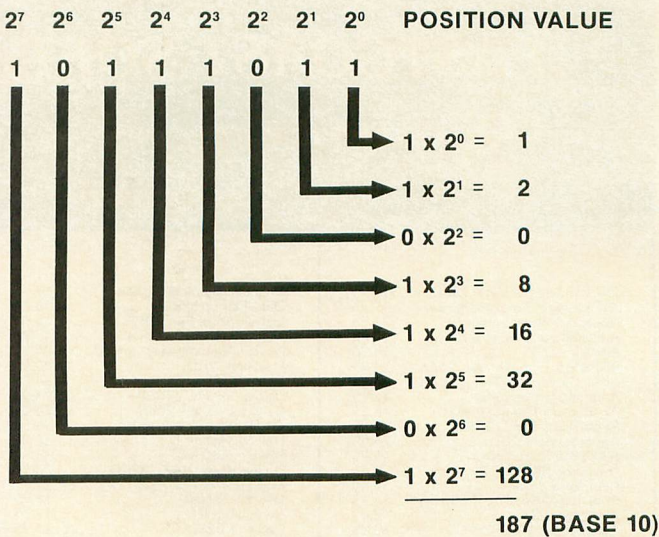
What do we care about all this?

Now that we know exactly how our normal numbering system works, let's apply what we know to a different system, BINARY.

The word "binary" comes from the Latin *bis*, or "double." As you may know, digital computers work with two electrical states, ON and OFF. This situation is perfectly suited for the binary numbering system, or base 2.

The binary numbering system uses only two digits, 0 and 1, but the principle of the numbering system is the same as base 10. Figure 3 shows a number in base 2 and how it can be converted to base 10.

Figure 3.



Once again, the number is shown with the position values above each digit in the number. In base 2, you will notice that the position values are

(continued on next page)

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powers of two. This means that, unlike the decimal progression of 1, 10, 100, etc. the binary system has a progression of 1, 2, 4, 8 and so on. As a result, the number 10111011 (base 2) is 187 in base 10. Figure 4 shows the binary equivalents of the numbers 0-19. Try using the method shown in Figure 3 to convert these numbers to the base 10 equivalents shown.

Figure 4.

| BASE 10 | BASE 2 | BASE 10 | BASE 2 |
|---------|--------|---------|--------|
| 0 | 0 | 10 | 1010 |
| 1 | 1 | 11 | 1011 |
| 2 | 10 | 12 | 1100 |
| 3 | 11 | 13 | 1101 |
| 4 | 100 | 14 | 1110 |
| 5 | 101 | 15 | 1111 |
| 6 | 110 | 16 | 10000 |
| 7 | 111 | 17 | 10001 |
| 8 | 1000 | 18 | 10010 |
| 9 | 1001 | 19 | 10011 |

Remember how a base 10 number multiplied by 10 when we shifted it left one digit? Let's look at how a binary number is affected by such a shift. Figure 5a shows the number 7 in binary before the shift and Figure 5b shows the number after the shift.

Figure 5a.

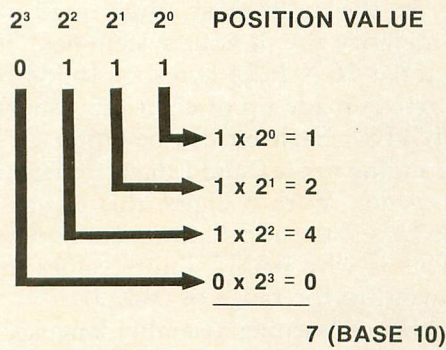
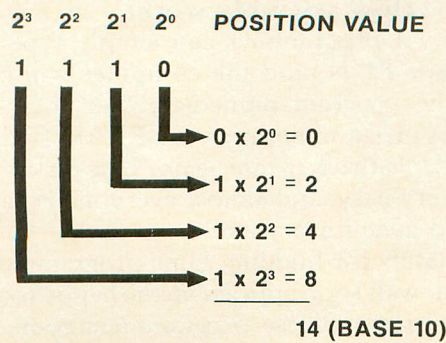


Figure 5b.



The number has been multiplied by 2! By examining this result and the above shift in base 10, we can see that by shifting the digits in a number left or right, we multiply or divide the number by its base number. This concept will come in very handy in later installments of this column, so keep it in mind.

"Funny" numbers.

The mechanics of the binary numbering system are extremely important, but they can cause some problems.

Let's say you want to look at what is in memory location 33011, but don't want to give the number in decimal for some reason. The most logical choice, as far as your computer is concerned, is binary. Unfortunately for us humans, this number comes out as 1000000011110011, and is cumbersome, to say the least. We don't like to handle numbers like this — there are just too many chances to make a mistake.

Fear not! There is yet another numbering system that is compatible with both our friend the computer and our human limitation for handling large numbers. What is this system, you ask? It is called base 16, or HEXADECIMAL.

(continued on next page)

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Most A.N.A.L.O.G. readers are familiar with base 16 through the assembly-language arcade games **Fill 'Er Up** and **Livewire**. Both of the BASIC programs used to create these games contained hundreds of "funny" numbers like F7, 6A, and so on. What's the story behind hexadecimal? Read on!

We have already noted that base 10 uses ten digits, 0-9, and that base 2 uses two digits, 0-1. Naturally, then, it follows that base 16 uses sixteen digits.

But wait a minute! Since we humans normally use only the ten digits from the decimal system, we don't have enough for base 16 — we'll have to come up with six more. Rather than invent six new digit symbols, we'll use the letters A-F, which are already in existence. Figure 6 shows the 16 digits used in hexadecimal and their decimal equivalents.

Figure 6.

| BASE 10 | BASE 16 |
|---------|---------|
| 0 | 0 |
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |
| 5 | 5 |
| 6 | 6 |
| 7 | 7 |
| 8 | 8 |
| 9 | 9 |
| 10 | A |
| 11 | B |
| 12 | C |
| 13 | D |
| 14 | E |
| 15 | F |

Once again, the principle of the hexadecimal (hex) numbering system is the same as the other systems we have examined so far; the only difference is that the letters A-F must be thought of as the numbers 10-15. Figure 7 shows the conversion of the hex number \$F4BE (all hex numbers should be preceded by a "\$") to decimal.

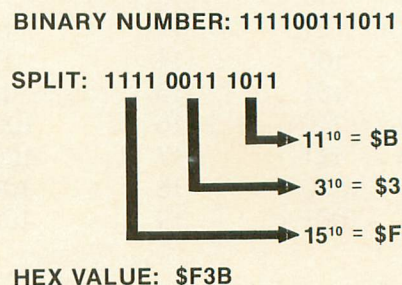
Figure 7.

| | 16^3 | 16^2 | 16^1 | 16^0 | POSITION | VALUE |
|---|--------|--------|--------|--------|--------------------|------------------------|
| F | 4 | B | E | | | |
| | | | | | $14 \times 16^0 =$ | 14 |
| | | | | | $11 \times 16^1 =$ | 176 |
| | | | | | $4 \times 16^2 =$ | 1024 |
| | | | | | $15 \times 16^3 =$ | 61440 |
| | | | | | | 62654 (BASE 10) |

So how does expressing numbers in hex help us avoid binary monstrosities? It's easy. The number 33011 (1000000011110011 in binary) is \$80F3 in hex. Obviously, this is a much easier number to remember than its binary equivalent.

Another interesting fact is that binary numbers are very easy to convert to hex. First the binary number must be divided into groups of four digits, from right to left. Then each group of four digits (ranging in value from 0-15) can easily be converted to the corresponding hex digit 0-F. Figure 8 illustrates this technique.

Figure 8.



Bytes and bits.

All readers who have owned their computers for more than a few days have at least heard of the terms "BYTE" and "BIT." Usually the term pops up when the memory capacity of the computer is being discussed.

The byte is the unit most often used when referring to memory size. If your system has "16K" of memory, it has 16 X 1024 bytes, or 16384 bytes total. Each byte is made up of eight bits (short for BINARY DIGITS). Each bit can be either OFF or ON, corresponding to the 0 and 1 digits in the binary numbering system. With 8 digits, this means that each byte can have 2 to the 8th power (or 256) combinations. This is why BASIC limits values in the POKE command to the range of 0-255.

In the process of learning assembly language, we will learn to manipulate the memory of your computer to do the things we want. Study these concepts carefully as they will be used in almost every assembly language program you write.

How assembly works.

In BASIC, a programmer can simply type in a program, type RUN, and the computer will begin executing the program immediately. If there is a problem, the programmer presses BREAK, finds the error and RUNs the program again. This makes programming very easy, and almost everyone is happy.

Yes, I said *almost* everyone.

Unfortunately for budding game programmers, a kind of brick wall soon appears on the happy road to the ultimate game. These programmers soon find

that BASIC is far too slow to handle the complex graphics and game logic necessary for an arcade-style game. At the very least, assembly-language sub-routines are necessary to speed things up.

Why is BASIC so slow? Inside the computer is a device called a 6502 MICROPROCESSOR. This little chip of silicon is what makes your computer work. It is capable of performing hundreds of thousands of operations per second, and does so every second your computer is powered on!

Sadly, all this computing power is lost as soon as a BASIC cartridge is inserted into your machine. You see, the microprocessor doesn't understand a single word of English, and the BASIC cartridge must act as an interpreter.

All of this interpreting takes time, and instead of doing the work you want, the poor microprocessor winds up spending most of its time translating BASIC into a language it can understand: binary. And this translation doesn't happen just once — it happens every time a BASIC command is executed! What a waste.

Assembly language, on the other hand, uses what is known as an ASSEMBLER to perform this translation just once. The programmer writes a program in a special format. This is known as the SOURCE code. When ready to execute the program, the programmer processes it with an assembler, which translates the source code into OBJECT code, which is the actual binary machine language. This code can be loaded at any time and executed as fast as the computer can go. It only has to be assembled once.

There are a few tradeoffs involved when using assembly language, however.

First, the programmer must re-assemble a program each time a change is made. This can take quite a bit of time when a large program is involved. For this reason, it is a good idea to flowchart each program before writing any code. This helps reduce logic errors.

Second, the programmer must know where the program will be located in memory. Since the computer's operating system has certain needs, the programmer must be aware of what memory locations are available.

Third, errors can be hard to find. When a program is executing at hundreds of thousands of operations per second, an error cannot always be easily traced to a certain instruction. For this reason, a good debugging package is a must.

Fourth, all arithmetic must be handled explicitly by the programmer. Assembly language does not have square root, sine or cosine functions. It cannot multiply or even divide! Unless the programmer specifies otherwise, the addition and subtraction instructions can only produce numbers from -128 to 127. In the course of this column, we will examine the arithmetic functions that are possible in assembly language and how they are coded.

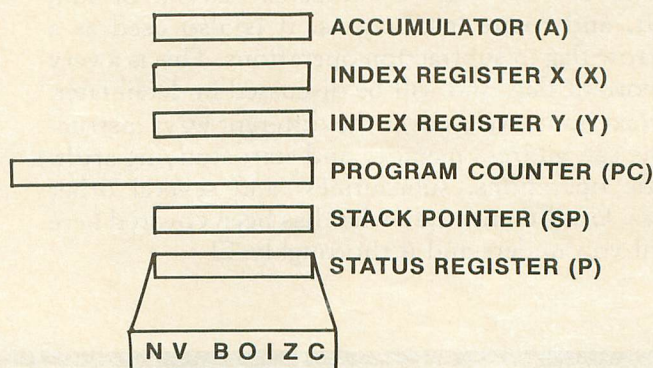
This may sound like a lot of limitations, but the 6502 processor allows the programmer to use the computer's built-in operating system directly, which BASIC has a hard time doing. And, of course, assembly language can be thousands of times faster than BASIC, allowing the programmer to write real-time simulations and arcade-style games.

Now that we've laid the groundwork for assembly-language programming, let's look at the 6502 itself.

Chip off the old block.

The 6502 processor chip has six REGISTERS that we are concerned with. These registers hold specific information and provide work areas for the programmer, and are shown in Figure 9.

Figure 9.



The ACCUMULATOR (A) is the most important register as far as the programmer is concerned. This register is used for all arithmetic operations and most data manipulation. The accumulator is used more than any other.

The INDEX REGISTERS (X and Y) are used to hold memory indexes, counters, or offsets into tables. They can also be used as temporary storage areas.

The PROGRAM COUNTER (PC) is used by the 6502 to keep track of what instruction is being executed. This register is 16 bits long, enabling it to point to any byte in memory (up to 65535, or 64K). Since this register is maintained by the 6502, we will not be referencing it very often.

The STACK POINTER (SP) is used by the 6502 to keep track of a temporary storage region known as the STACK. The stack holds subroutine return addresses and other temporary data. Since this register is maintained by the 6502, we will not be referencing it very often.

The PROCESSOR STATUS REGISTER (P) is made up of 7 individual "flags," or indicators, which inform the programmer of the 6502's current status.

The SIGN flag (N) is ZERO when the result of an operation is positive, and ONE when the result is negative.

The OVERFLOW flag (V) is set to the EXCLUSIVE-OR of bits 6 and 7 of the result of an arithmetic operation. The exclusive-or will be result in a TRUE result if either bit being evaluated is TRUE, but not if both are TRUE. The overflow flag is rarely used, and is not important at this point.

The BREAK flag (B) is set to 1 when a BRK instruction is executed. We will be using the instruction during program testing to stop program execution.

The DECIMAL MODE (D) flag is used to tell the processor to use either binary (0) or binary-coded decimal (1) arithmetic. This flag is important, and the programmer must be aware of its setting at all times.

The INTERRUPT flag (I) enables or disables system interrupts, depending on its setting.

The ZERO flag (Z) is set to 1 when any arithmetic or logical operation produces a zero result. A non-zero result sets the flag to 0.

The CARRY flag (C) holds carries out of add, shift, and rotate instructions. It is also used as a borrow flag in subtraction operations. This is a very important flag, and will be discussed in detail later.

Next issue, we'll cover the different ways instructions can address memory and start studying arithmetic operations, subroutines, and several other areas. Until then, study what has been covered here until you understand it thoroughly. □



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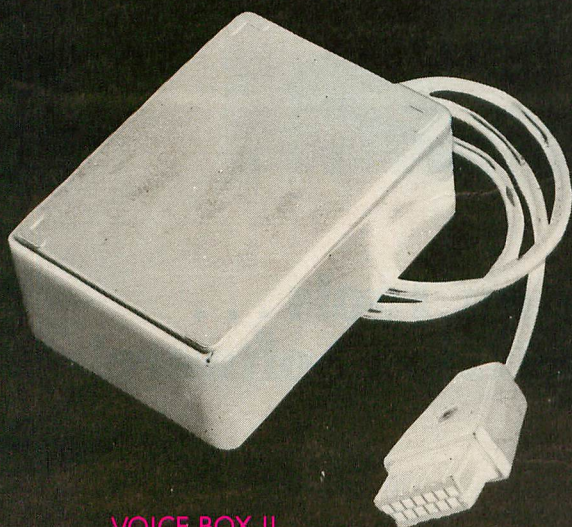
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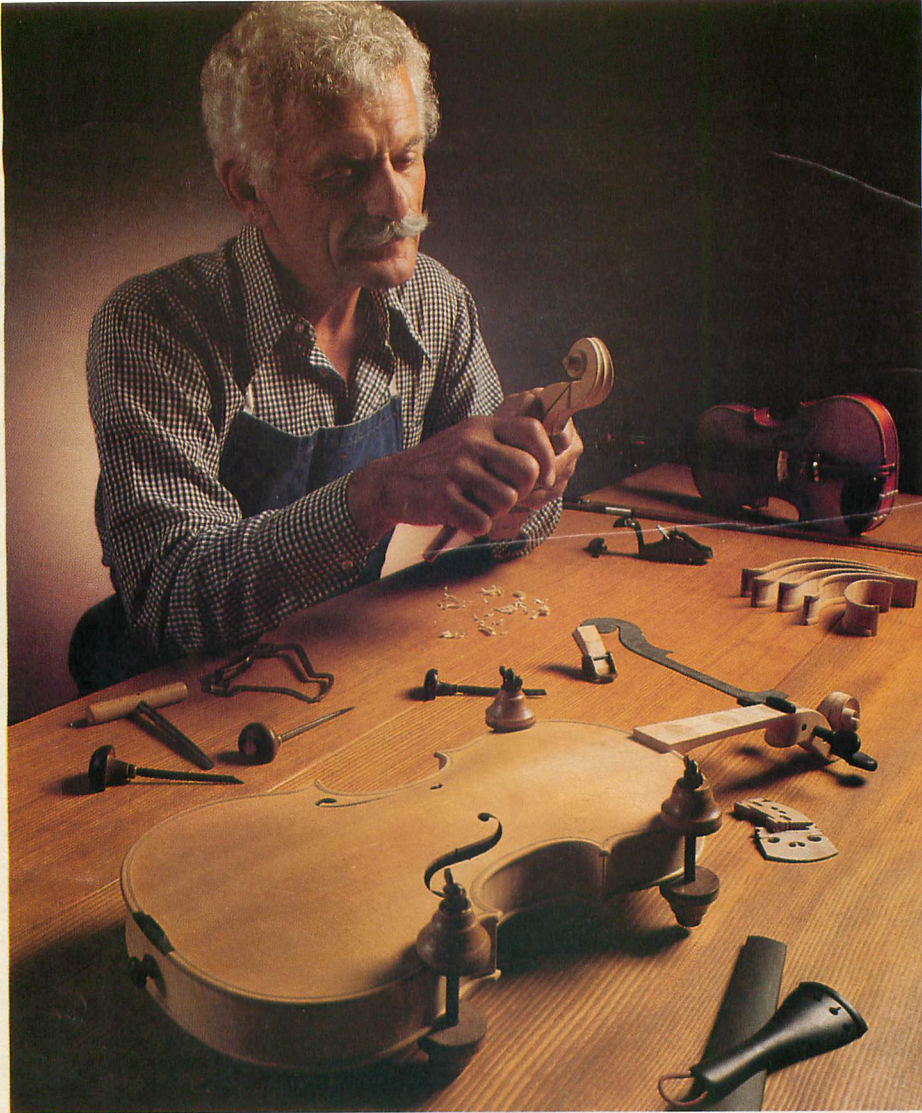
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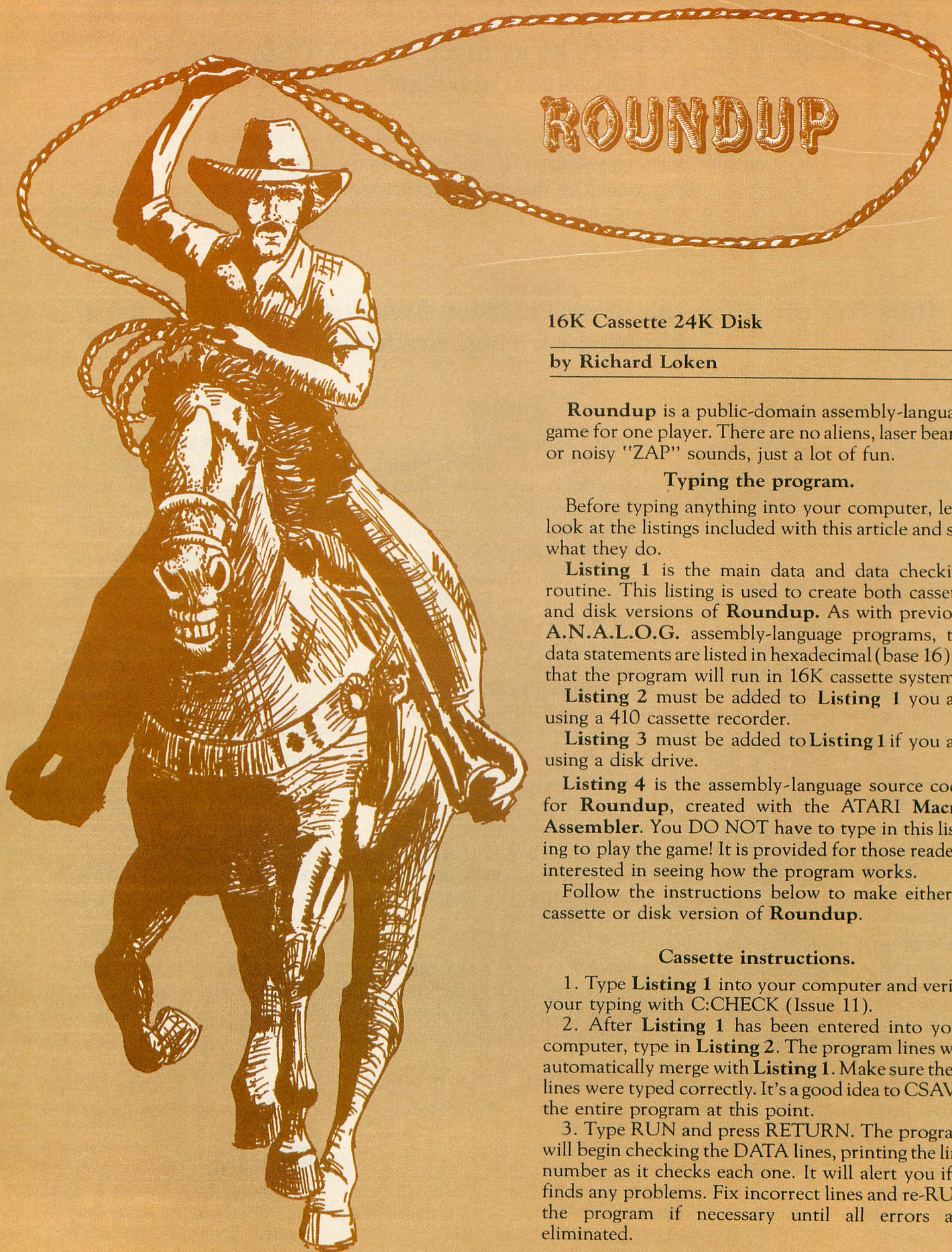
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16K Cassette 24K Disk

by Richard Loken

Roundup is a public-domain assembly-language game for one player. There are no aliens, laser beams or noisy "ZAP" sounds, just a lot of fun.

Typing the program.

Before typing anything into your computer, let's look at the listings included with this article and see what they do.

Listing 1 is the main data and data checking routine. This listing is used to create both cassette and disk versions of **Roundup**. As with previous A.N.A.L.O.G. assembly-language programs, the data statements are listed in hexadecimal (base 16) so that the program will run in 16K cassette systems.

Listing 2 must be added to **Listing 1** if you are using a 410 cassette recorder.

Listing 3 must be added to **Listing 1** if you are using a disk drive.

Listing 4 is the assembly-language source code for **Roundup**, created with the ATARI Macro Assembler. You DO NOT have to type in this listing to play the game! It is provided for those readers interested in seeing how the program works.

Follow the instructions below to make either a cassette or disk version of **Roundup**.

Cassette instructions.

1. Type **Listing 1** into your computer and verify your typing with C:CHECK (Issue 11).

2. After **Listing 1** has been entered into your computer, type in **Listing 2**. The program lines will automatically merge with **Listing 1**. Make sure these lines were typed correctly. It's a good idea to CSAVE the entire program at this point.

3. Type RUN and press RETURN. The program will begin checking the DATA lines, printing the line number as it checks each one. It will alert you if it finds any problems. Fix incorrect lines and re-RUN the program if necessary until all errors are eliminated.

4. When all DATA lines are correct, the program will ask you to "READY CASSETTE AND PRESS RETURN." Place a blank tape in your recorder, press RECORD and PLAY simultaneously and press RETURN. The message "WRITING FILE" will appear and the program will create a boot tape version of **Roundup**, printing each DATA line number as it goes. When the READY prompt appears, you're ready to load and play the game. Make sure your BASIC program has been CSAVED before continuing.

5. From this point on, whenever you want to play **Roundup**, do the following: Rewind the tape created by the BASIC program to the beginning. Turn your computer OFF and remove any cartridges. Press PLAY on your recorder, then turn your computer ON while holding down the START key. The computer will BEEP once. Press RETURN and **Roundup** will load and run automatically.

Disk instructions.

1. Type **Listing 1** into your computer and check it with D:CHECK II (Issue 10) to eliminate any typing errors.

2. After **Listing 1** is correctly typed into your computer, type in **Listing 3**. The lines in this listing will merge with those in **Listing 1**. It's a good idea to SAVE the entire BASIC program at this point.

3. Type RUN and press RETURN. The program will begin verifying the DATA lines, printing the line number of each as it goes. It will alert you if it finds any problems. Fix incorrect lines and re-RUN the program if necessary until all errors are eliminated.

4. When all the DATA lines are correct, the program will ask you to "INSERT DISK WITH DOS, PRESS RETURN." Place a disk with DOS in drive 1 and press RETURN. The message "WRITING FILE" will appear and the program will create an AUTORUN.SYS file, printing each data line number as it goes. When the READY prompt appears, you're ready to play the game. Make sure your BASIC program has been SAVED before continuing.

5. To play **Roundup**, place the disk containing the AUTORUN.SYS file in drive 1. Turn the computer OFF, remove any cartridges and turn the computer ON. **Roundup** will load and run automatically.

Playing the game.

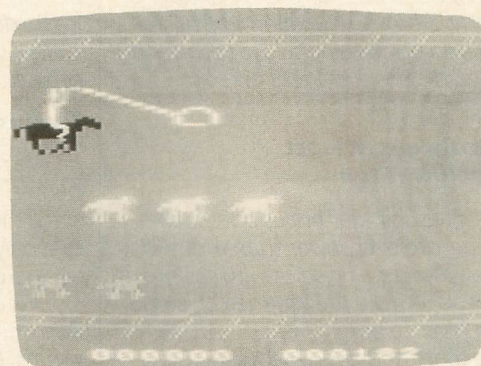
The game of **Roundup** requires you to herd and lasso cattle. Plug your joystick into port 1 and press START to begin or restart the game. When the game begins, you will be seen riding a horse on the left side of the screen, between two fences. You can move up and down by pushing the stick. You cannot go above or below the fences.

You will see that you are pursuing cattle to the right of you. The cattle must not be allowed to get behind you off the screen. If three cattle get behind

you, the game is over. To prevent this you must move your horse into them and, with renewed vigor, the cattle will then sprint ahead. The cattle get tired, however, and repeated herding will not move the cattle as far. Nevertheless, a skillful trail hand should be able to drive them all day.

While you are doing all this herding you may notice that you aren't receiving points. Points can only be scored by lassoing the cattle. Push the joystick button to throw your lasso. You must devote all of your attention to lassoing, so you will not be able to move up or down at this time. If your lassoing is successful, the longhorn will disappear and points will be scored.

There are four kinds of cattle. They vary in color, speed and point value. One steer is particularly stubborn and cannot be herded. He must be lassoed or you will lose other cattle. As an added penalty, when the game ends, any unscored points will be lost. Between games your score and the high score are displayed on the bottom of the screen.



Roundup

This program listing was done with the ATARI **Macro Assembler**, but can be assembled on other assemblers. For those of you with ATARI's **Editor Assembler** cartridge or the OSS EASMD, here are some translation hints.

| MACRO | EDITOR ASSEMBLER |
|-----------------|------------------|
| DB | .BYTE |
| DW | .WORD |
| DS \$100..... | *=*\$100 |
| ORG | *= |
| #HIGH ANG | #ANG/256 |
| #LOW ANG | #ANG&FF |

Extensive use of local labels (:L) has been used to reduce the number of referenced labels. If your assembler does not support local labels, you will have to invent your own unique labels to resolve branches. My equate file is rather long, and not all of the labels are used. You may leave out unused equates to save text buffer RAM.

Roundup should run on any ATARI with a minimum of 16K but will require at least 32K to assemble with the **Macro Assembler**. □

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Listing 1.

```
1 REM *** ROUNDUP ***
10 DATA 0,1,2,3,4,5,6,7,8,9,0,0,0,0,0,
0,0,10,11,12,13,14,15
20 DIM DAT$(91),HEX(22):FOR X=0 TO 22:
READ N:HEX(X)=N:NEXT X:LINE=990:RESTOR
E 1000:TRAP 60:"CHECKING DATA"
25 LINE=LINE+10:"LINE:";LINE:READ DA
T$:IF LEN(DAT$)<90 THEN 110
28 DATLIN=PEEK(183)+PEEK(184)*256:IF D
ATLIN<>LINE THEN ? "LINE ";LINE;" MISS
ING!":END
30 FOR X=1 TO 89 STEP 2:D1=A5C(DAT$(X,
X))-48:D2=A5C(DAT$(X+1,X+1))-48:BYTE=H
EX(D1)*16+HEX(D2)
35 IF PA55=2 THEN PUT #1,BYTE:NEXT X:R
EAD CHKSUM:GOTO 25
40 TOTAL=TOTAL+BYTE:NEXT X:READ CHKSUM
:IF TOTAL=CHKSUM THEN 25
50 GOTO 110
60 IF PEEK(195)<>6 THEN 110
100 ? "WRITING FILE":PA55=2:LINE=990:R
ESTORE 1000:TRAP 60:GOTO 25
110 ? "BAD DATA: LINE ";LINE:END
1000 DATA 488A489848AE9E24BDA124BCAA24
8D0AD48D0AD48C16D0AD07D0F007A9019D5D20
D01CB05428C939F015AD04D0,5284
1010 DATA 0D06D0F00D0B0C24F008A9009DBC
24FE53208D1ED0E8E009D002A2008E9E2468A8
68AA68400300000000000000,9613
1020 DATA 000000000000000000000000A200
BD00E09D0008BD00E19DFF08BD00E29DFF09BD
00E39DFF0AE8D0E5A9088DF4,14092
1030 DATA 02A200BD0E9239D0808E8E010D0F5
A200BDF9239D1808E8E010D0F5A200BD29249D
2808E8E010D0F5A2008A9D00,19575
1040 DATA 039D00049D00059D00069D00079D
00369D00379D00389D0039E8D0E2A9038D1A36
8D1D368D20368D1D378D2037,23041
1050 DATA 8D2038A9048D1B368D1E368D2136
8D1E378D21378D2138A9058D1A39A9068D1B39
20D925A9008D0002A928D001,26542
1060 DATA 02A9C08D0ED4A93F8D2F02A9038D
1DD0A90A8D3002A9228D3102A9118D6F02A9C6
8DC802A9D08D0C1028D0C202A9,31378
1070 DATA 0A8D0C0028D0C3028D0C702A9A88DC4
02A9E48DC502A9168D0C602A9008D08D0A9018D
09D08D0AD0A9018D0BD0A9FF,36715
1080 DATA 8D09D28D0C0D0A9308D02D3A9F88D
00D3A9348D02D3A9008D07D4A93C8D00D0A930
8D01D0A9408D02D0A9448D07,41986
1090 DATA D0A94C8D06D0A9548D05D0A95C8D
04D0A9648D03D0A9648D07F24A9008D08D2A903
8D0FD2A9648D00D2A91E8D02,47237
1100 DATA D2A9C88D06D220C12220312920A6
25A9008D07726AD0BD4C919D0F9A9CF8D2202A9
248D2302A9018DA225AD0A225,52153
1110 DATA D0FBAD7726F0034C923AD2F28D0
03208F2220762720C1224CE72170708060575D
248050570036805057003680,56322
1120 DATA 5057003680505700368050570036
80505700368050575D248050463924410A22A2
00BD4124D08122F004901A00,59914
1130 DATA 05E8E006D0EFA200BD41249D8122
E8E006D0F5A200BD41249D7922E8E006D0F5A9
748D3722A9228D3822600000,65239
1140 DATA 0000001010101010100000101010
10101000000000000000AD00D3C90FF01CA9
00854DAD00D3C90EF012C90D,67749
1150 DATA D00DAD7F24C998F006EE7F24EE7F
2460AD7F24C932F0F8CE7F24CE7F2460CEE823
30034CF622A9048D0E823AEDB,73566
1160 DATA 23BDDC238D1123E8BDDC238D1223
E8BDDC238D1723E8BDDC238D1823E8E00CD002
A2008EDB23AC7F24A200BD23,78816
1170 DATA 23990004C8E8E023D0F4AD7F2418
6911A8A200B0FFFF99005B0FFFF990086C8E8
E01AD0EE600000263632327A,84216
1180 DATA 323222267C787070707070707070
70383E1F03030306C040200000000000000F
1F3F5F5F5F5F5F1F10303030,86597
1190 DATA 50A0204000000000000081C1CFEFE
F6F2F0E0E0E0E0380C040408000000000000
00000000F1F3F5F5F5F9F9F,89981
```

```
1200 DATA 1F18181828282848505000000000
081C1CFEFEF6F2F2E0E0E0E020202020505050
50400000000000000000F1F3F,93255
1210 DATA 5F5F5F5F5F1F18008080808080505
0400000000081C1CFEFEF6F2F0E0E0E0E06060
60A0A0A02040000000004523,97003
1220 DATA 5E2377239023A923C2230000FF03
06FF18306000FF0000FF0000000000F1F2FCC
0A0A0004FEF0F03048080000,100406
1230 DATA 4F3F1F1C6406000CFEF0F0302828
00000F7F8F0C1414000CFEF0F018141020701F
1F0F0B08080000E0F0E8A820,103874
1240 DATA 20000033232F3225001010101010
1000232F373300130000000000000000000000
00000000102010201020102,104441
1250 DATA 0102010201020102010201020102
0102010201020102010200AE9B24E030D0
02A200A000BDF923991808E8,106539
1260 DATA C8C010D0F48E9B24600000000000
00000000000000000000000000000000000C
000602040401020000000101,107861
1270 DATA 0001000100010000000000000000
0000A9008DA225EE9825EE9925EEA325AD7726
F0034C5FE4ADA425F006CEA4,111628
1280 DATA 254CF924208024ADA5258DA425A9
008DA225A200E000F073BDBD24F031100620DD
284C60258D9A25F006DE9A25,116455
1290 DATA 4C60258DA124E90130069DA1244C
5A25A9079DA124FEC724BDB3249D9A254C6025
AD98252901F01FBD0A1246901,121042
1300 DATA C908F00890069DA1244C6025A900
9DA124DEC724BDB3249D9A25E8E007D09F2033
2820EE25208E2520F8282079,125936
1310 DATA 294C5FE4BDA124E902300F9DA124
9DA824BDB3249D9A254C6025A90F9DA1249DA1
244C60250000000000000000,129837
1320 DATA 000000000006A200A9D89DA249D
B124A90A9DB22A8E208628E006D0F860A900AA
A8BDC724990F22BD55289910,134509
1330 DATA 22C8C8C8C8C8E8E008D0EA60A900
AA08B90F229DC724C8C8C8C8E8E008D0F060
A201207826BDC724300AC924,140758
1340 DATA F013E8E007D0EF60A9019D0D24A9
009DC7244CFC25A91E8DFD29A9A88D07D2BD55
28C938F00FC937F019C936F0,146672
1350 DATA 28C939F0034CFC25CE4D24CE5220
F0382086284CFC25CE5220CE4D24CE4D24CE52
203024F0222086284CFC25CE,151500
1360 DATA 5220CE4D24CE4D24CE4D24CE5220
CE5220F00830062086284CFC25A9018D77264C
FC2500BDBD24F00160BD5420,155973
1370 DATA DDC724D005A9019D0D2460000080
000000000000000000000000000000000000
0000000000000000000000,157674
1380 DATA 0000000000000000000000000000
000000000000000000000000000000000000
0000000000000000000000,157994
1390 DATA 0080404020201010000000000000
0000000000000000000000000000004040202010
1008080000000000000000,158714
1400 DATA 0000000000000000000000000000
0000000000000000000000000000004040202010
1008080000000000000000,159466
1410 DATA 0202000000000000000000000000
0000000000000000000000,159852
1420 DATA 0000000000000000000000000000
0000000000000000000000,159852
1430 DATA 3028A8252901F0EEA91A8D3128
AC7F24AE3028BD8C26990003E8C8CE3128D0F3
38E0CEB0048E302860A91AAC,167882
1440 DATA 7F24A200BD5C27990007C8E8E01A
D0F4A9F58D9925A9008D2F2860AD9925F00160
A9408D2F28AC7F24A21BA900,173041
1450 DATA 990007C8CAD0F9A9018D302860AD
98252901F00160AE3028A9FF0ACAD0FC8D3228
AC7F24A21BB900032D322899,177885
1460 DATA 0003C8CAD0F3AD3028601C90AF0
048D302860A9008D2F2860000000FFA2018D5E
20D006E8E008D0F660A9009D,182668
1470 DATA 5E20206628602050A640AD87600
02030400243636363636362400000000000000
0000A9008D9925BD5D286065,184962
1480 DATA 288D6528FE5528BD5528C939F008
C93AF0049D552860BDE828A8B94D289DAA24B9
49289D5D28B951289DB324C0,190116
```


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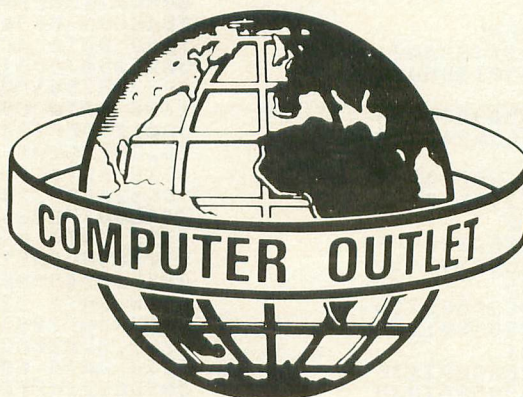
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| Wizard of Wor | (D) \$ 27 (CT) \$ 30 |
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| Gold Rush (D) | \$ 23 |
| Bandits (D) | \$ 23 |
| Way Out (D) | \$ 27 |
| Fast Eddy (CT) | \$ 24 |
| World War (CT) | \$ 24 |
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| Jumbo Jet Pilot (CT) | \$ 34 |
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| Zaxxon (D,C) | \$ 27 |
| Miner 2049er (CT) | \$ 34 |
| Twerps (D) | \$ 23 |
| Flip Out (D) | \$ 20 |
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```

1490 DATA 03F024A9369D5528A9009DC724A9
019DBD24A9009D5420FEE828BD828C904D005
A9009DE82860A9399D5528A9,195231
1500 DATA 009DC724A9FF9DBD24AD0AD28DDC
284CAF2800CEDC28D005A9019DBD2460000101
000200010000010100020001,198851
1510 DATA 00AD6528D00160AD98252903F001
60CE6528A005B94124C919F006690199412460
A9109941248810EB60A9008D,203171
1520 DATA 6528A005A91099412488D0F860A9
088D1FD0AD1FD0C906D0F960203C22203129A9
008D2F288D30288D31282021,207502
1530 DATA 29A9398D3722A9248D3822A9038D
5220A9138D4D24A200BDF0289DE828E8E008D0
F56868684C6620AD7726F00F,212388
1540 DATA A9008D01D28D03D28D05D28D07D2
60ADF829F012AD6528F01EA9008DFB29A9A88D
01D24C8529AD98252902D00A,217592
1550 DATA A9008D01D2A9018DFB29EEFC29AD
FC29C915D005A9008DFC29C900F017C903F01B
C90AF00FC90CF013C90FF007,223087
1560 DATA C911F00B4CEC29A9848D03D24CEC
29A9008D03D2ADFD29F006CEFD294CFA298D07
D26001000000000000000000,227475

```

CHECKSUM DATA

(See p. 20)

```

1 DATA 794,955,686,427,745,192,617,894
,445,496,549,150,147,897,114,8108
1030 DATA 309,165,126,431,436,356,459,
211,970,661,214,683,729,551,419,6720
1180 DATA 758,19,739,979,686,974,842,2
92,43,811,98,76,942,26,109,7394
1330 DATA 427,553,233,59,114,688,771,8
18,764,551,224,176,312,60,471,6221
1480 DATA 256,222,949,841,944,235,287,
395,38,4167

```

```

2 REM *** CASSETTE VERSION ***
65 IF PA55=2 THEN CLOSE #1:END
70 ? "READY CASSETTE AND PRESS RETURN"
:OPEN #1,8,128,"C:":RESTORE 200:FOR X
=1 TO 35:READ N:PUT #1,N:NEXT X
200 DATA 0,21,221,31,255,31,169,60,141
,2,211,169,0,141,231,2,133,14,169,56,1
41,232,2,133,15,169,102
210 DATA 133,10,169,32,133,11,24,96
1570 DATA 0000000000000000000000000000
0000000000000000000000000000000000
000000000000000000000000,227475
1580 DATA 0000000000000000000000000000
0000000000000000000000000000000000
000000000000000000000000,227475

```

```

2 REM *** DISK VERSION ***
65 IF PA55=2 THEN PUT #1,224:PUT #1,2:
PUT #1,225:PUT #1,2:PUT #1,102:PUT #1,
32:CLOSE #1:END
70 ? "INSERT DISK WITH DOS, PRESS RETU
RN":DIM INS(1):INPUT INS:OPEN #1,8,0,
"D:AUTORUN.SYS"
90 PUT #1,255:PUT #1,255:PUT #1,0:PUT
#1,32:PUT #1,4:PUT #1,42

```

Assembly listing.

```

-----
;ROUNDUP by RICHARD LOKEN
;

```

```

; EQUATES FOR "ROUNDUP"

```

```

DMACTL = $22F
CHBASE = $2F4
POKMSK = 16
RTCLC = 18
ATTRACT = 77
VDSLST = 512
CDTMV2 = 538
CDTMA1 = 552
VJBLKI = 546
SDMCTL = 559
SDLSTL = 560
GPRJ0R = 623
STRIG = $284
STRIG0 = 644
PCOLR0 = 704
PCOLR1 = 705
PCOLR2 = 706
PCOLR3 = 707
COLOR0 = 708
COLOR1 = 709
COLOR2 = 710
COLOR3 = 711
COLOR4 = 712
CHBAS = 756
HPOSP0 = $D000
M0PF = $D000
HPOSP1 = $D001
M1PF = $D001
HPOSP2 = $D002
M2PF = $D002
HPOSP3 = $D003
M3PF = $D003
HPOSM0 = $D004
P0PF = $D004
HPOSM1 = $D005
P1PF = $D005
HPOSM2 = $D006
P2PF = $D006
HPOSM3 = $D007
P3PF = $D007
M0PL = $D008
SIZEP0 = $D008
M1PL = $D009
SIZEP1 = $D009
M2PL = $D00A
SIZEP2 = $D00A
M3PL = $D00B
SIZEP3 = $D00B
P0PL = $D00C
SIZEM = $D00C
P1PL = $D00D
P2PL = $D00E
P3PL = $D00F
TRIG0 = $D010
PRIOR = $D01B
GRACTL = $D01D
HITCLR = $D01E
CONSOL = $D01F
AUDF1 = $D200
AUDC1 = $D201
AUDF2 = $D202
AUDC2 = $D203
AUDF3 = $D204
AUDC3 = $D205
AUDF4 = $D206
AUDC4 = $D207
AUDCTL = $D208
STIMER = $D209

```


RANDOM = \$D20A
 PORTA = \$D300
 PACTL = \$D302
 HSCROL = \$D404
 PMBASE = \$D407
 WSYNC = \$D40A
 VCOUNT = \$D40B
 NMEN = \$D40E
 SETVBV = \$E45C
 SYSVBV = \$E45F
 XITVBV = \$E462
 CGREY = \$00
 CGOLD = \$10
 CORANG = \$20
 CREDOR = \$30
 CPINK = \$40
 CPURPL = \$50
 CPURBL = \$60
 CBLUE1 = \$70
 CBLUE2 = \$80
 CLBLUE = \$90
 CTURGO = \$A0
 CGRNBL = \$B0
 CGREEN = \$C0
 CYEGRN = \$D0
 CORGRN = \$E0
 CLORNG = \$F0
 COLBK = \$2C8
 MYPMB = \$0000
 MISSIL = \$0300
 PL0 = \$0400
 PL1 = \$0500
 PL2 = \$0600
 PL3 = \$0700
 CHSET = \$0800

;These memory areas are reserved for
 ;the scrolling cow lines. They are
 ;aligned on 256-byte boundaries for
 ;ease of use.

COW = \$3600 ;3 COWS
 COW.A = \$3700 ;2 COWS
 COW.B = \$3800 ;1 COW
 ANG = \$3900 ;LONE ANGUS

ORG \$2000

;the display list interrupt stuffs
 ;the cow color and fine scrolling
 ;data into the hardware
 ;also checks herding and lasso
 ;collisions - sets flags for
 ;other routines to process

DLI PROC
 PHA ; save all registers

TXA
 PHA
 TYA
 PHA
 LDX LINECT ; get DLI counter
 LDA LNSC1,X ; get fscroll for line
 LDY LNCOL1,X ; get line color
 STA WSYNC
 STA HSCROL ; and stuff them into
 STY \$D016 ; the hardware

; check for hits on cows

LDA P3PF
 BEQ :L3
 LDA #1
 STA HIT-1,X
 BNE :L2

; check for herding

:L3 LDA LMSH1-1,X
 CMP #HIGH ANG
 BEQ :L2
 LDA P0PF ; get the coll. reg.
 ORA P2PF
 BEQ :L2 ; if zero then no coll.
 LDA LFRT-1,X
 BEQ :L2
 LDA #0 ; yes, a coll. ; change
 STA LFRT-1,X ; dir. of prev. ln
 INC NUMHRD-1,X
 :L2 STA HITCLR ; and clear hit

; finish DLI

INX
 CPX #9 ; 8 is too many
 BNE :L
 LDX #0
 :L STX LINECT
 PLA
 TAY
 PLA
 TAX
 PLA
 RTI
 COWLFT DB 3
 DB 0
 NUMHRD DB 0,0,0,0,0,0,0,0
 DB 0,0
 HIT DB 0,0,0,0,0,0,0,0

;program begins and restarts here

START PROC
 LDX #0 ; TRANSFER CHARACTER SET
 :L LDA \$E000,X
 STA CHSET,X

LDA \$E100,X
 STA CHSET+\$FF,X
 LDA \$E200,X
 STA CHSET+\$1FF,X
 LDA \$E300,X
 STA CHSET+\$2FF,X
 INX
 BNE :L
 LDA #HIGH CHSET ;INSTALL CHAR SET
 STA CHBAS
 LDX #0 ; ALTER CHARACTER SET
 :L1 LDA FNCE,X
 STA CHSET+8,X
 INX
 CPX #10
 BNE :L1
 LDX #0
 :L2 LDA COW1,X
 STA CHSET+\$18,X
 INX
 CPX #10
 BNE :L2
 LDX #0
 :L5 LDA ANGUS,X
 STA CHSET+\$28,X
 INX
 CPX #10
 BNE :L5
 LDX #0 ; CLEAR P/M AND COW LINES
 TXA
 :L3 STA MISSIL,X
 STA PL0,X
 STA PL1,X
 STA PL2,X
 STA PL3,X
 STA COW,X
 STA COW.A,X
 STA COW.B,X
 STA ANG,X
 INX
 BNE :L3

;now set up the character bytes in the
 ;cow lines that represent the cows.

LDA #3
 STA COW+26
 STA COW+29
 STA COW+32
 STA COW.A+29
 STA COW.A+32
 STA COW.B+32
 LDA #4
 STA COW+27
 STA COW+30
 STA COW+33
 STA COW.A+30
 STA COW.A+33
 STA COW.B+33


```

LDA #5
STA ANG+26
LDA #6
STA ANG+27
JSR INILMS
LDA #LOW DLI ; install DLI
STA VDSLST
LDA #HIGH DLI
STA VDSLST+1
LDA #C0 ;ENABLE DLI
STA NMIEH
LDA #3F ; EN.SIN RES + WIDE PF
STA SDMCTL
LDA #3 ; ENABLE P/M
STA GRACLT
LDA #LOW DISPL ; install DISPLIST
STA SDLSTL
LDA #HIGH DISPL
STA SDLSTL+1
LDA #11 ; $11 for 5th player
STA GPRIOR
LDA #C6
STA COLOR4
LDA #D0 ; horse is
STA PCOLR1
STA PCOLR2
LDA #A ; rider and lasso
STA PCOLR0
STA PCOLR3
STA COLOR3
LDA #A8
STA COLOR0
LDA #E4
STA COLOR1
LDA #16
STA COLOR2
LDA #0 ; rider is narrow
STA SIZEP0
LDA #1 ; horse is medium
STA SIZEP1
STA SIZEP2
LDA #1 ; lasso is MEDIUM
STA SIZEP3
LDA #FF
STA STIMER
STA SIZEM
LDA #30 ; enable joystick
STA PACTL
LDA #F0
STA PORTA
LDA #34
STA PACTL
LDA #HIGH MYPMB
STA PMBASE
LDA #60
STA HPOSP0
LDA #48
STA HPOSP1
LDA #64

```

```

STA HPOSP2
LDA #68
STA HPOSM3 ; lasso hpos
LDA #76
STA HPOSM2
LDA #84
STA HPOSM1
LDA #92
STA HPOSM0
LDA #100
STA HPOSP3
LDA #100
STA UPOSP0
LDA #0
STA $D208
LDA #3
STA $D20F
LDA #100
STA AUDF1
LDA #30
STA AUDF2
LDA #200
STA AUDF4
JSR CWPKLD
JSR CHEKST
JSR INICOL
LDA #0
STA GAMEND
LDA VCOUNT
CMP #19
BNE :L10
LDA #LOW VBLANK
STA VBLK1
LDA #HIGH VBLANK
STA VBLK1+1

:L10

;most processor time is spent waiting
;for the next VBLANK. mnloop handles
;the stick,lasso, and player image
;lasso in progress will mask the
;stick handler

MNLOOP
PROC
LDA #1
STA VBDONE
:L LDA VBDONE
BNE :L
LDA GAMEND
BEQ :L3
JMP NEWGAM
:L3 LDA LASTAT
BNE :L2
JSR UPDOWN
:L2 JSR ROPEM
JSR CWPKLD
JMP MNLOOP

```

```

;simple display list with lms and
;hscroll enable and dli on each line

```

```

DISPL DB $70,$70,$80,$60,$57
LMS1 DW FENCE
DB $80,$50,$57
CW1 DW COW
DB $80,$50,$57
CW2 DW COW
DB $80,$50,$57
CW3 DW COW
DB $80,$50,$57
CW4 DW COW
DB $80,$50,$57
CW5 DW COW
DB $80,$50,$57
CW6 DW COW
DB $80,$50,$57
FN1 DW FENCE
DB $80,$50,$46
SCRIN DW SCORLN
DB $41
DW DISPL

```

```

;checks for hi score and sets score
;for end of game score line

```

```

CHKHSC PROC
LDX #0
:L LDA SCORE,X
CMP HSCR,X
BEQ :L1
BCC :L2
BCS :L3
:L1 INX
CPX #6
BNE :L
:L3 LDX #0
:L4 LDA SCORE,X
STA HSCR,X
INX
CPX #6
BNE :L4
:L2 LDX #0
:L5 LDA SCORE,X
STA SCR1,X
INX
CPX #6
BNE :L5
LDA #LOW HSCR
STA SCRIN
LDA #HIGH HSCR
STA SCRIN+1
RTS

```

```

HSCR DB 0,0,0,0,0
SCR1 DB $10,$10,$10,$10,$10,$10
DB 0,0
HSCR DB $10,$10,$10,$10,$10,$10

```



```

DB 0,0,0,0,0,0,0,0
;reads stick for up/down and sets
;vposp0 for CWPKLD

```

```

UPDOWN PROC
LDA PORTA
CMP #3F
BEQ :L
LDA #0
STA ATRACT
LDA PORTA
CMP #14      ; GO UP ?
BEQ UP
CMP #13      ; GO DOWN ?
BNE :L
DOWN LDA VPOSP0
CMP #152
BEQ :L
INC VPOSP0
INC VPOSP0
:L RTS
UP LDA VPOSP0
CMP #50
BEQ :L
DEC VPOSP0
DEC VPOSP0
RTS

```

```

;updates horse + cowboy whether it
;needs it or not and animates horse

```

```

CWPKLD PROC
DEC HRSCTR
BMI :L
JMP :L1
:L LDA #4
STA HRSCTR
LDX HRSCTAV
LDA HS,X
STA :L5+1
INX
LDA HS,X
STA :L5+2
INX
LDA HS,X
STA :L6+1
INX
LDA HS,X
STA :L6+2
INX
CPX #12
BNE :L2
LDX #0
STX HRSCTAV
:L1 LDY VPOSP0
LDX #0
:L3 LDA COWBOY,X
STA PL0,Y

```

```

INX
INX
CPX #35
BNE :L3
LDA VPOSP0
CLC
ADC #17
TAY
LDX #0
:L5 LDA $FFFF,X
STA PL1,Y
:L6 LDA $FFFF,X
STA PL2,Y
INX
INX
CPX #26
BNE :L5
RTS
EPROC
;image data for cowboy and horse
COWBOY DB 0,0,$26,$36,$32,$32
DB $7A,$32,$32,$22,$26,$7C
DB $78,$78,$78,$78,$78,$78
DB $70,$70,$70,$70,$38,$3E
DB $1F,$3,$3,$3,$C,$4,$2,$0
H1A DB 0,0,0,0,0,$F,$1F,$3F
DB $5F,$5F,$5F,$5F,$5F,$1F
DB $10,$30,$30,$30,$30,$50,$A0
DB $20,$40,0,0,0
H1B DB 0,0,8,$1C,$1C,$FE,$FE
DB $F6,$F2,$F0,$E0,$E0,$E0
DB $E0,$30,$38,$C,$4,$4,$8
DB 0,0,0,0
H2A DB 0,0,0,0,0,$F,$1F,$3F
DB $5F,$5F,$5F,$9F,$9F,$1F
DB $18,$18,$18,$28,$28,$28
DB $48,$50,$50,0,0
H2B DB 0,0,8,$1C,$1C,$FE,$FE
DB $F6,$F2,$F2,$E0,$E0,$E0
DB $E0,$20,$20,$20,$20,$50
DB $50,$50,$50,$40,0,0
H3A DB 0,0,0,0,0,$F,$1F,$3F,$5F
DB $5F,$5F,$5F,$5F,$1F,$18,0
DB 8,8,8,8,5,4,0,0
H3B DB 0,0,8,$1C,$1C,$FE,$FE
DB $F6,$F2,$F0,$E0,$E0,$E0
DB $E0,$60,$60,$60,$A0,$A0
DB $A0,$20,$40,0,0,0
HRSCTAV DB 0
HS DW H1A
DW H1B
DW H2A
DW H2B
DW H3A
DW H3B
HRSCTR DB 0
FNCE DB 0,$FF,$3,$6,$FF,$18,$30,$60

```

```

DB 0,$FF,0,0,$FF,0,0,0
COW1 DB 0,0,$F,$1F,$2F,$CC,$A,$A
DB 0,4,$FE,$F0,$F0,$30,$48,8
COW2 DB 0,$80,$4F,$3F,$1F,$1C,$64,6
DB 0,$C,$FE,$F0,$F0,$30,$28,$28
COW3 DB 0,0,$F,$7F,$8F,$C,$14,$14
DB 0,$C,$FE,$F0,$F0,$18,$14,$10
ANGUS DB $20,$70,$1F,$1F,$F,$B,8,8
DB 0,0,$E0,$F0,$E8,$A8,$20,$20
SCORLN DB 0,0,51,35,47,50,37,0
SCORE DB 16,16,16,16,16,16,0
DB 35,47,55,51,0
COWLEFT DB 19,0,0,0
DB 0,0,0,0,0,0,0,0,0,0,0
FENCE DB 1,2,1,2,1,2,1,2,1,2
DB 1,2,1,2,1,2,1,2,1,2
DB 1,2,1,2,1,2,1,2,1,2
VPOSP0 DB 0

```

```

;animates cows in character set

```

```

ANIMATE PROC
LDX CHINDX
CPX #30
BNE :L
LDX #0
:L LDY #0
:L1 LDA COW1,X
STA CHSET+$18,Y
INX
INX
CPY #10
BNE :L1
STX CHINDX
RTS
CHINDX DB 0,0,0
LINECT DB 0,0,0
LNSCI DB 0,0,0,0,0,0,0,0,0
LNCOL1 DB 0,0,0,0,0,0,0,0,$C
LNISP DB 0,6,2,4,4,1,2,0,0,0
LFRT DB 1,1,0,1,0,1,0,1,0,0
SLMS1 DB 0,0,0,0,0,0,0,0

```

```

;controls speed of character anima-
;tion and processes fine and coarse
;scrolling
;updates three clocks which are used
;by other routines

```

```

VBLANK PROC
LDA #0
STA VBDONE
INC VBCTR
INC VBCTR1
INC VBCTR2
LDA GAMEND
BEQ :L14
JMP SYSUBV
:L14 LDA SSPEED      ; time to animate?

```



```

BEQ :L          ; yes
DEC SSPEED      ; no just count
JMP :L1
;L JSR ANIMATE   ; the fence never coarse scrolls
LDA SPEED        ; reset counter
STA SSPEED       ;16 fine scrolls = two characters
;L1 LDA #0       ; handshake with main
STA VBDONE
LDX #0           ; start scrolling sequence
;L7 CPX #0
BEQ MVFENC
;L11 LDA LFRT,X
BEQ GOLEFT
BPL GORIT
JSR COUNTD
JMP NXLN
GORIT LDA SLNISP,X
BEQ :L2
DEC SLNISP,X
JMP NXLN
;L2 LDA LNSC1,X
SBC #1
BMI :L4
STA LNSC1,X
JMP :L8
;L4 LDA #7
STA LNSC1,X
INC SLMS1,X
LDA LNISP,X
STA SLNISP,X
JMP NXLN
GOLEFT LDA VBCTR
AND #1
BEQ NXLN
LDA LNSC1,X
ADC #1
CMP #8
BEQ :L6
BCC :L6
STA LNSC1,X
JMP NXLN
;L6 LDA #0
STA LNSC1,X
DEC SLMS1,X
;L8 LDA LNISP,X
STA SLNISP,X
NXLN INX
CPX #7
BNE :L11

;resolve hardware collisions, check
;scrolling for events and effect
;the lms's so the fence and cows
;move

JSR CHKHIT
JSR LMSCK      ; check for excess
JSR LMSLD
JSR SETSCO

JSR SOUND
JMP SYSUBV

;takes display list lms from ori-
;ginal load and shadows them in
;the SLMS1 array

INILMS PROC
LDA #0
TAX
TAY
;L LDA LMS1,Y
STA SLMS1,X
INY
INY
INY
INY
INY
INX
CPX #8
BNE :L
RTS

;critical routine which prevents
;scrolling from going beyond limits
;calculates missed cows,brings
;herded cows back and checks for
;end of game

LMSCK PROC      ; check lms for excess
LDX #1
;L JSR HERD
LDA SLMS1,X
BMI :L1
CMP #LOW COW+36
BEQ :L2
;L3 INX
CPX #7
BNE :L
RTS
;L1 LDA #1
STA LFRT,X
LDA #0
STA SLMS1,X
JMP :L3
;L2 LDA #30
STA MISCOW
LDA #A8
STA AUDC4
LDA LMSH1,X
CMP #HIGH COW+2
BEQ :L4
CMP #HIGH COW+1
BEQ :L5
CMP #HIGH COW
BEQ :L6

```



```

CMP #HIGH ANG
BEQ :L4
JMP :L3
:L4 DEC COWLEFT
DEC COWLEFT
BEQ :L7
JSR NEWCOW
JMP :L3
:L5 DEC COWLEFT
DEC COWLEFT
DEC COWLEFT
BMI :L7
BEQ :L7
JSR NEWCOW
JMP :L3
:L6 DEC COWLEFT
DEC COWLEFT
DEC COWLEFT
DEC COWLEFT
DEC COWLEFT
BEQ :L7
BMI :L7
JSR NEWCOW
JMP :L3
:L7 LDA #1
STA GAMEND
JMP :L3
GAMEND DB 0

;calculates time to return cows
;after being herded. The number
;of times the line has been
;herded shortens the return time

HERD PROC
LDA LFRT,X
BEQ :L1
RTS
:L1 LDA NUMHRD,X
CMP SLMS1,X
BNE :L2
LDA #1
STA LFRT,X
:L2 RTS
LASS01 DB 0,0,$80,$40,$40,$20,$20,$10,$10
DB 0,0,0,0,0,0,0,0,0,0
DB 0,0,0,0

; second image

DB 0,0,$80,$40,$40,$20,$20,$10,$10
DB 0,0,0,0,0,0,0,0,0,0
DB 0,0,0,0,0,0

; third image

DB 0,0,$80,$40,$40,$20,$20,$10,$10
DB 0,0,0,0,0,0,0,0,0,0
DB 0,0,0,0,0,0,0,0,0,0

DB 0,0,0,0,0,0,0,0,0,0
DB 0,0,0,0,0,0,0,0,0,0
DB 0,0,0,0,0,0,0,0,0,0

; fourth image

DB 0,0,$80,$40,$40,$20,$20,$10,$10
DB 0,0,0,0,0,0,0,0,0,0
DB 0,0,0,0,0,0,0,0,0,0

; fifth image

DB 0,0,$80,$40,$40,$20,$20,$10,$10
DB 0,0,0,0,0,0,0,0,0,0
DB 0,0,0,0,0,0,0,0,0,0

; sixth image

DB 0,0,$80,$40,$40,$20,$20,$10,$10
DB 0,0,4,4,0,0,0,0,0,0
DB 0,0,0,0,0,0,0,0,0,0

; seventh image

DB 0,0,$80,$40,$40,$20,$20,$10,$10
DB 0,0,4,4,2,2,0,0,0,0
DB 0,0,0,0,0,0,0,0,0,0

; eighth image

DB 0,0,$80,$40,$40,$20,$20,$10,$10
DB 0,0,4,4,2,2,1,1,0,0,0
DB 0,0,0,0,0,0,0,0,0,0
LASS02 DB 0,0,0,0,0,0,0,0,0,0
DB 0,0,0,0,0,0,0,$1C,$22,$22,$C1,$81
DB $41,$41,$41,$41,$3C,0,0,0,0,0

;throws the lasso,sets flag which
;disables the stick while lasso is
;on screen

ROPEM PROC
LDA #1
BIT LASTAT
BMI :L
BVS :L1
BNE :L2
LDA STRIG0
BEQ :L3
:L4 RTS
LDA #1
STA LASTAT
LDX #0
STX LSCTR
LDA VBCTR
AND #1
BEQ :L4
LDA #26
STA LSCTR1
LDY UPOSP0
; test for appropriate
; sequence
; initial recall
; continue recall
; continue shoot
; none of above so
; check for trigger
; not puched so return
; he wants to fire so
; set status for cont.sht
; initial index for image

; don't execute every
; time
; not yet so return
; initialize counter for
; 26 bytes
; initialize index to ms

LTX LSCTR
LDA LASS01,X
STA MISSIL,Y
INX
INY
DEC LSCTR1
BNE :L5
SEC
CPX #206
BCS :L6
STX LSCTR
RTS
LDA #26
LDY UPOSP0
LDX #0
LDA LASS02,X
STA PL3,Y
INY
INX
CPX #26
BNE :L7
LDA #245
STA VBCTR1
LDA #80
STA LASTAT
RTS
LDA VBCTR1
BEQ :L8
RTS
LDA #340
STA LASTAT
LDY UPOSP0
LDX #27
LDA #0
STA PL3,Y
INY
DEX
BNE :L9
LDA #1
STA LSCTR
RTS
LDA VBCTR
AND #1
BEQ :L14
RTS
LDX LSCTR
LDA #3FF
:L11 ASL A
DEX
BNE :L11
STA MSMASK
LDY UPOSP0
LDX #27
LDA MISSIL,Y
AND MSMASK
STA MISSIL,Y
INY
DEX
BNE :L12

```



```

LDA LSCTR
ADC #1
CMP #10
BEQ :L13
STA LSCTR
RTS
:L13 LDA #0
      STA LASTAT
      RTS
LASTAT DB 0
LSCTR DB 0
LSCTR1 DB 0
MSMASK DB $FF

```

;checks HIT array (set by DLI) for
;lasso hits and jumps to a routine
;which removes the cow so to speak

```

CHKHIT PROC
LDX #1
:L   LDA HIT,X
      BNE :L3
      INX
      CPX #8
      BNE :L
      RTS
:L3   LDA #0
      STA HIT,X
      JSR CLCOW
      RTS
COWRTH DB 2,5,10,100
COWCOL DB CGREY+10
      DB CYEGRN+8
      DB CBLUE1+6
      DB 0
COWSP DB 2,3,4,0
LMSHI DB HIGH FENCE
      DB HIGH COW
      DB HIGH COW
      DB HIGH COW
      DB HIGH COW
      DB HIGH COW
      DB HIGH COW
      DB HIGH FENCE
COWVAL DB 0,0,0,0,0,0,0
NEWSCO DB 0

```

;sets points to be scored by VBLANK
;and advances cow sequence

```

CLCOW PROC
LDA #0
STA VBCTR1
LDA COWVAL,X
ADC NEWSCO
STA NEWSCO
INC LMSHI,X
LDA LMSHI,X
CMP #HIGH ANG

```

```

BEQ NEWCOW
CMP #HIGH ANG+1
BEQ NEWCOW
STA LMSHI,X
RTS

```

;initializes various cow tables and
;advances sequence of cows

```

NEWCOW PROC
LDA WHICHC,X
TAY
LDA COWCOL,Y
STA LNCOL1,X
LDA COWRTH,Y
STA COWVAL,X
LDA COWSP,Y
STA LNISP,X
CPY #3
BEQ :L1
LDA #HIGH COW
STA LMSHI,X
LDA #0
STA SLMS1,X
LDA #1
STA LFRT,X
:L2   LDA #0
      STA NUMHRD,X
      INC WHICHC,X
      LDA WHICHC,X
      CMP #4
      BNE :L
      LDA #0
      STA WHICHC,X
      RTS
:L1   LDA #HIGH ANG
      STA LMSHI,X
      LDA #0
      STA SLMS1,X
      LDA #255
      STA LFRT,X
      LDA RANDOM
      STA ANGCONT
      JMP :L2
ANGCONT DB 0

```

;kills time waiting to put angus on
;the screen - angcont set by random
;number for a delay of 0 to 3 sec.

```

COUNTD PROC
DEC ANGCONT
BNE :L
LDA #1
STA LFRT,X
:L   RTS
WHICHC DB 0,1,1,0,2,0,1,0
TWHICH DB 0,1,1,0,2,0,1,0

```

;called from VBLANK. scores the
;points accumulated in NEWSCO

```

SETSCO PROC
LDA NEWSCO
BNE :L
RTS
:L   LDA VBCTR
      AND #3
      BEQ :L3
      RTS
:L3   DEC NEWSCO
      LDY #5
      LDA SCORE,Y
      CMP #19
      BEQ :L1
      ADC #1
      STA SCORE,Y
      RTS
:L1   LDA #10
      STA SCORE,Y
      DEY
      BPL :L2
      RTS

```

;zeroes the score at game start

```

CLSCOR PROC
LDA #0
STA NEWSCO
LDY #5
:L   LDA #10
      STA SCORE,Y
      DEY
      BNE :L
      RTS

```

;freezes execution until START
;key is pressed

```

CHEKST PROC
LDA #8
STA CONSOL
:L   LDA CONSOL
      CMP #6
      BNE :L
      RTS

```

;the game is over so look for a new
;high score and show the score - high
;score line
;upon START key reset some arrays

```

NEWGAM PROC
JSR CHKHSC
JSR CHEKST
LDA #0
STA LASTAT
STA LSCTR

```



```

BEQ :L6
CMP #3
BEQ :L7
CMP #10
BEQ :L6
CMP #12
BEQ :L7
CMP #15
BEQ :L6
CMP #17
BEQ :L7
JMP :L8
LDA #84
STA AUDC2
JMP :L8
LDA #8
STA AUDC2
LDA MISCOM
BEQ :L9
DEC MISCOM
JMP :L10
STA AUDC4
RTS
PTFLAG DB 1
CLIPCT DB 0
MISCOM DB 0
END START

```



```

STA LSCTR1
JSR CLSCOR
LDA #LOW SCORLN
STA SCRLN
LDA #HIGH SCORLN
STA SCRLN+1
LDA #3
LDA COMLFT
LDA #19
STA CALFT
LDA #0
LDA WHICH,X
STA WHICHC,X
INX
CPX #8
BNE :L
PLA
PLA
PLA
JMP START

```

;AUDF1 is point sound
 ;AUDF2 is clippity clop
 ;AUDF4 is missed cow sound
 ;clippity clop is shaped by a
 ;counter which toggles AUDC2

```

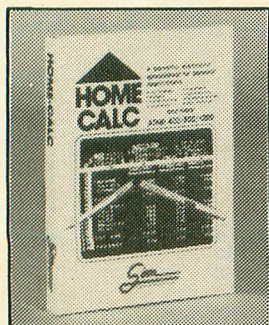
SOUND PROC
LDA GAMEND
BEQ :L
LDA #0
STA AUDC1
STA AUDC2
STA AUDC3
STA AUDC4
RTS
LDA PTFLAG
BEQ :L1
LDA NEWSO
BEQ :L4
LDA #0
STA PTFLAG
LDA #8
STA AUDC1
STA AUDC1
JMP :L4
LDA VBCIR
AND #2
BNE :L4
LDA #0
STA AUDC1
LDA #1
STA PTFLAG
INC CLIPCT
LDA CLIPCT
CMP #21
BNE :L5
LDA #0
STA CLIPCT
CMP #0

```

•

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Ask Sally Forth

by Sally Forth

Editor's Note:

We'd like to welcome Sally Forth to the pages of A.N.A.L.O.G. Computing. Her new FORTH column will help to familiarize our readers with the power and versatility of this popular programming language.

This column assumes some prior familiarity with FORTH. For a general introduction, visit your local library or computer bookstore and get a copy of *Starting FORTH* by Leo Brodie (published by Prentice-Hall) and/or *Discover FORTH* by Thom Hogan (McGraw-Hill).

Sally welcomes your questions about FORTH and will publish the most interesting letters in future issues. Write to her in care of A.N.A.L.O.G. Computing Magazine, 565 Main Street, Cherry Valley, MA 01611

Dear Sally:

I'd like to write some games on my ATARI, but BASIC is just too slow. My friends tell me that FORTH is almost as fast as machine language, and a lot easier to write, too. What's the scoop?

Speed Freak

Good question, Freak. Although FORTH is indeed a very fast programming language, it's hard to make broad generalizations about its speed compared to other languages. Let's try a few experiments to see how ATARI BASIC, FORTH and machine language really stack up.

Listing 1 is an ATARI BASIC program that uses nested FOR/NEXT loops and direct POKES to fill a GRAPHICS 24 hi-res screen with color. The inner "J" loop (lines 240-260) fills up 6 scan lines or 240 bytes at a time. The outer "I" loop executes the "J" loop 32 times; 32 times 240 is 7680, the number of bytes in a GRAPHICS 24 screen.

The system timers at locations 19 and 20 decimal are used to clock the execution of the fill-loop in 60ths of a second or "jiffies." The operating system increments location 20 once every jiffy; after 256 jiffies (4.23 seconds), location 20 is reset to zero and location 19 is incremented. Our BASIC program resets both counters by POKEing them with zeros before it begins filling the screen. After the fill is complete, PEEK(19) is multiplied by 256 and added to PEEK(20) to obtain the execution time.

Listing 1.

```

100 REM *****
110 REM * ATARI/FORTH/ML BENCHMARK *
120 REM * BY SALLY FORTH *
130 REM *****
140 GRAPHICS 24
150 REM
160 REM * ZERO SYSTEM JIFFY TIMERS
170 POKE 19,0:POKE 20,0
180 REM
190 REM * FIND ADDRESS OF SCREEN
200 SCREEN=PEEK(88)+256*PEEK(89)
210 REM
220 REM * SCREEN-FILL LOOP
230 FOR I=1 TO 32
240 FOR J=0 TO 239
250 POKE SCREEN+J,255
260 NEXT J
270 SCREEN=SCREEN+240
280 NEXT I
290 REM
300 REM * DETERMINE FILL TIME
310 JIFFIES=PEEK(20)+256*PEEK(19)
320 REM
330 REM * DISPLAY FILL TIME
340 GRAPHICS 0
350 PRINT JIFFIES;" JIFFIES":END

```

Notice that the GRAPHICS statements on lines 140 and 340 are executed outside the timed loop. This was done because GRAPHICS calls are performed by the CIO (Central Input/Output) utility in the OS, not by the BASIC cartridge. Any

language environment that uses CIO to access the screen will require the same amount of execution time, so it's fairer to leave GRAPHICS calls out of our benchmark test.

Listing 2A is a BASIC program that uses a machine-language subroutine to fill a GRAPHICS 24 screen. The 45 bytes of machine-language code in DATA lines 330-340 are converted into a string (ML\$); after setting up GRAPHICS 24, the routine is activated by the USR call in line 260. Listing 2B is the source code for the DATA statements, created with the MAC/65 Macro Assembler. I structured the machine code to work in a manner similar to the pure BASIC version.

Listing 2A.

```

100 REM *****
110 REM * BASIC/ML/FORTH BENCHMARK *
120 REM * ASSEMBLY DEMO FROM BASIC *
130 REM * BY SALLY FORTH *
140 REM *****
150 REM
160 REM * READ ML DATA INTO ML$
170 DIM ML$(45)
180 FOR I=1 TO 45
190 READ BYTE:ML$(I)=CHR$(BYTE)
200 NEXT I
210 REM
220 REM * SET UP GRAPHICS MODE
230 GRAPHICS 24
240 REM
250 REM * FILL SCREEN, GET TIMING
260 JIFFIES=USR(ADR(ML$))
270 REM
280 REM * DISPLAY TIMER READING
290 GRAPHICS 0
300 PRINT JIFFIES;" JIFFIES":END
310 REM
320 REM * DATA FOR ML ROUTINE
330 DATA 104,169,0,133,19,133,20,162,3
340 DATA 2,160,0,169,255,145,88,200,192,240,208
350 DATA 249,24,165,88,105
360 DATA 240,133,88,165,89,105,0,133,8
370 DATA 9,202,208,229,165,19,133,213,165,20,13
380 DATA 3,212,96

```

Listing 2B.

```

0100 ; *****
0110 ; * BASIC/FORTH/ML BENCHMARK *
0120 ; * ASSEMBLY VERSION *
0130 ; * BY SALLY FORTH *
0140 ; *****
0150 ;
0160 ; System equates
0170 ;
0180 SAVMSC = $58 ; Addr of screen
0190 BASRET = $D4 ; BASIC return
0200 RTCLOCK = $13 ; System timer
0210 ;
0220 ; For simplicity, we'll let
0230 ; BASIC set up GRAPHICS 24.
0240 ;
0250 ; PLA ; # args; ignore
0260 ;
0270 ; Zero the system timers
0280 ;
0290 LDA #0
0300 STA RTCLOCK
0310 STA RTCLOCK+1
0320 ;
0330 ; This is the screen-fill loop
0340 ;

```

```

0350 LDX #32 ; Loop 32 times
0360 NEXTI
0370 LDY #0 ; Init J-loop
0380 LDA #255 ; Fill byte
0390 NEXTJ
0400 STA (SAVMSC),Y ; Poke it!
0410 INY
0420 CPY #240 ; 240 pokes yet?
0430 BNE NEXTJ ; No; do another
0440 CLC
0450 LDA SAVMSC ; Add 240 to
0460 ADC #240 ; screen addr
0470 STA SAVMSC
0480 LDA SAVMSC+1 ; This is a
0490 ADC #0 ; 16-bit add
0500 STA SAVMSC+1
0510 DEX ; 32 loops yet?
0520 BNE NEXTI ; No; do another
0530 ;
0540 ; Screen is now filled, so pass
0550 ; the timer readings to BASIC
0560 ;
0570 LDA RTCLOCK
0580 STA BASRET+1
0590 LDA RTCLOCK+1
0600 STA BASRET+2
0610 RTS ; Back to BASIC!

```

Listing 3.

```

Scr # 1
0 ( BASIC/ML/FORTH BENCHMARK )
1 ( FORTH VERSION BY SALLY FORTH )
2
3 0 VARIABLE READING
4
5 88 CONSTANT SCREEN
6
7 : SCREENFILL ( THE FILL LOOP )
8 32 0 DO
9 240 0 DO
10 255 I SCREEN @ + C!
11 LOOP
12 240 SCREEN @ + SCREEN !
13 LOOP ;
14
15 -->

```

```

Scr # 2
0 ( BENCHMARK CONTINUED )
1
2 : BENCHMARK
3 24 GR.
4 0 19 ! ( ZERO TIMERS )
5 SCREENFILL
6 256 19 C@ * 20 C@ +
7 READING ! ( SAVE READING )
8 0 GR.
9 READING @ . ( SHOW READING )
10 ." JIFFIES" CR ;
11
12
13
14
15

```


Listing 3 shows one way to implement the screen-fill routine in FORTH. Again, the program is deliberately organized to work like the BASIC program.

I ran the BASIC, machine-language and FORTH benchmarks on my 48K 800 system and obtained the results shown in **Listing 4**. BASIC is painfully slow, requiring well over a minute to POKE the screen full of bytes. The FORTH code runs in just under four seconds, an encouraging 18-times speed increase over BASIC. But the machine language code flies past in just five jiffies! This is 47 times faster than the FORTH demo, and over 863 times faster than the BASIC cartridge! Machine language is the clear winner in this example.

Listing 4. Speed test results.

| RUN-TIME | JIFFIES | SECONDS |
|--------------|---------|---------|
| ATARI BASIC | 4316 | 71.9 |
| valFORTH 1.1 | 236 | 3.9 |
| Machine code | 5 | 0.1 |

Not the last word.

The above demonstration should not be taken as the definitive comparison of BASIC, FORTH and machine code. Before you pawn your FORTH system to buy a macro assembler, consider the next paragraphs.

The BASIC program in **Listing 1** is a very inefficient way to fill a GRAPHICS 24 screen. Those nested FOR/NEXT loops make the speed comparison more revealing, but they really put a strain on the poor old cartridge. By replacing the double loop with a single mega-loop, and combining many statements into a single line, we can realize a small but useful speed improvement. Want proof? Type in and RUN the program in **Listing 5**. You should obtain an execution time of 3243 jiffies or about 54 seconds. It's still pretty sluggish, but anything is better than **Listing 1**.

Listing 5.

```
100 GRAPHICS 24
110 POKE 19,0:POKE 20,0:SCREEN=PEEK(88)
    +256*PEEK(89)
120 FOR I=SCREEN TO SCREEN+7680:POKE I
    ,255:NEXT I:JIFFIES=PEEK(20)+256*PEEK(
    19)
130 GRAPHICS 0
140 PRINT JIFFIES;" JIFFIES":END
```

Now for some real eye-popping magic. Type and RUN the program in **Listing 6**, and watch ATARI BASIC fill an entire GRAPHICS 24 screen in only 12 jiffies — *without using the USR function!* The secret is in line 120, where we DIMension a string

(\$\$) equal to the size of the screen. Next, we go POKEing around inside BASIC's variable table, fooling the cartridge into thinking that the string occupies the same memory area as the screen. Finally, we use BASIC string manipulations in lines 200-220 to rapidly fill the screen/string with bytes.

Listing 6.

```
100 GRAPHICS 24
110 POKE 19,0:POKE 20,0
120 DIM $$ (7680)
130 STRING=PEEK(140)+256*PEEK(141)
140 SCREEN=PEEK(88)+256*PEEK(89)
150 TABLE=PEEK(134)+256*PEEK(135)
160 OFFSET=SCREEN-STRING
170 HI=INT(OFFSET/256)
180 LO=OFFSET-(HI*256)
190 POKE TABLE+2,LO:POKE TABLE+3,HI
200 $$ (1,1)=CHR$(255)
210 $$ (7680,7680)=CHR$(255)
220 $$ (2)=$$
230 JIFFIES=PEEK(20)+256*PEEK(19)
240 GRAPHICS 0
250 PRINT JIFFIES;" JIFFIES":END
```

(continued on next page)

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FORTH fanatics may be looking at **Listing 6** with dismay. But fear not, stackers, FORTH can still show ATARI BASIC a thing or two! Instead of using the clumsy DO loops in **Listing 3**, we can use the standard FORTH word FILL to cover a GRAPHICS 24 screen with lightning speed. Compile **Listing 7** into your FORTH system, and enjoy a very respectable execution time of only 7 jiffies — again, without any direct calls to machine language.

Conclusions.

By studying the material presented here, we can infer the following points about BASIC, FORTH and programming in general:

1. No high-level language can match the speed of pure machine code.

2. Both BASIC and FORTH have built-in machine-language functions which can be harnessed to speed up your programs.

3. It's harder to coax high speed out of BASIC than it is with FORTH.

Speed isn't the only thing that determines the performance of a computer language. Another parameter, *code efficiency*, will be covered in my next installment. □

Listing 7.

```
Scr # 3
0 ( FAST VERSION OF BENCHMARK )
1 ( BY SALLY FORTH )
2
3 0 VARIABLE READING
4
5 88 CONSTANT SCREEN
6
7 : BENCHMARK-2
8 24 GR.
9 0 19 !
10 SCREEN @ 7680 255 FILL
11 256 19 C@ * 20 C@ +
12 READING !
13 0 GR.
14 READING @ .
15 ." JIFFIES" CR ;
```

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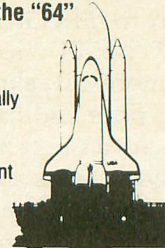
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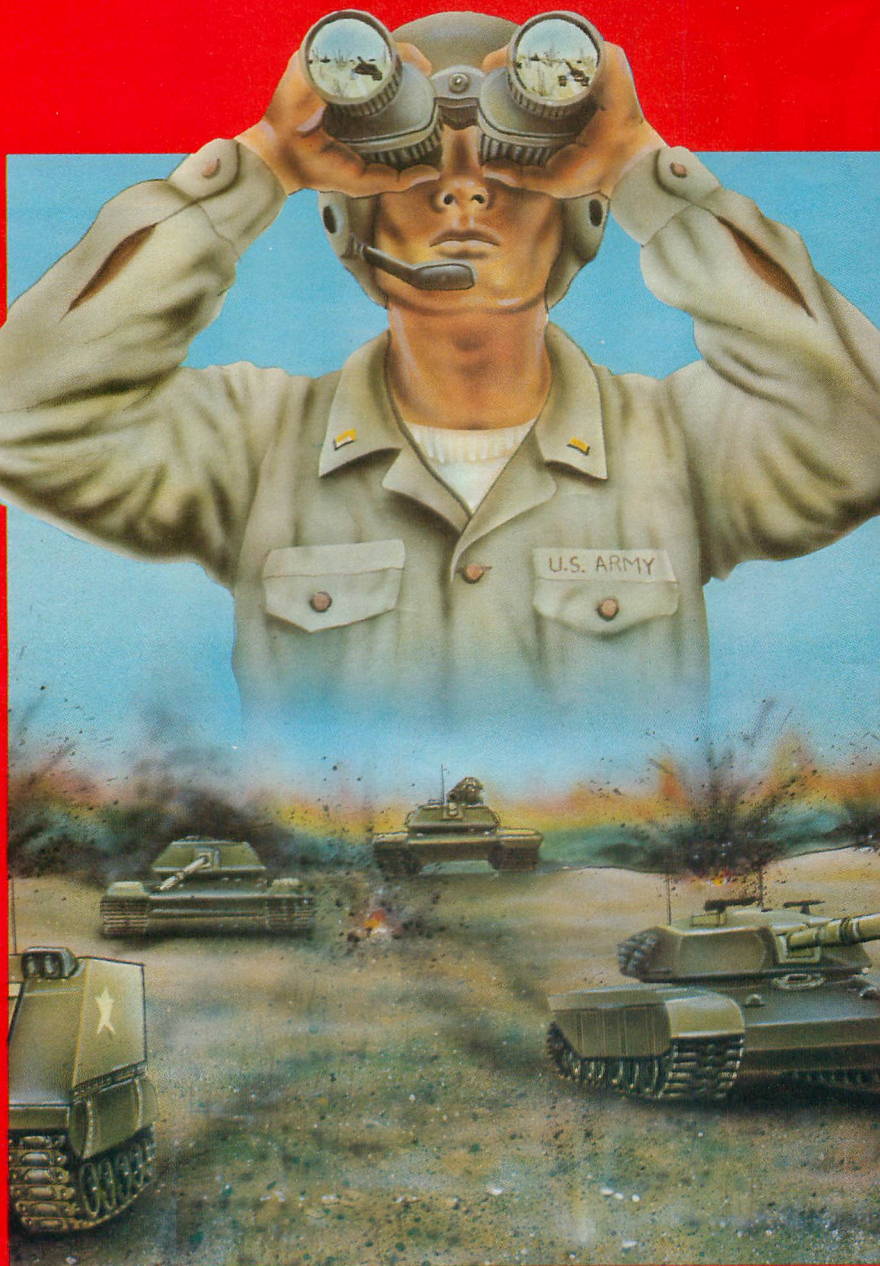
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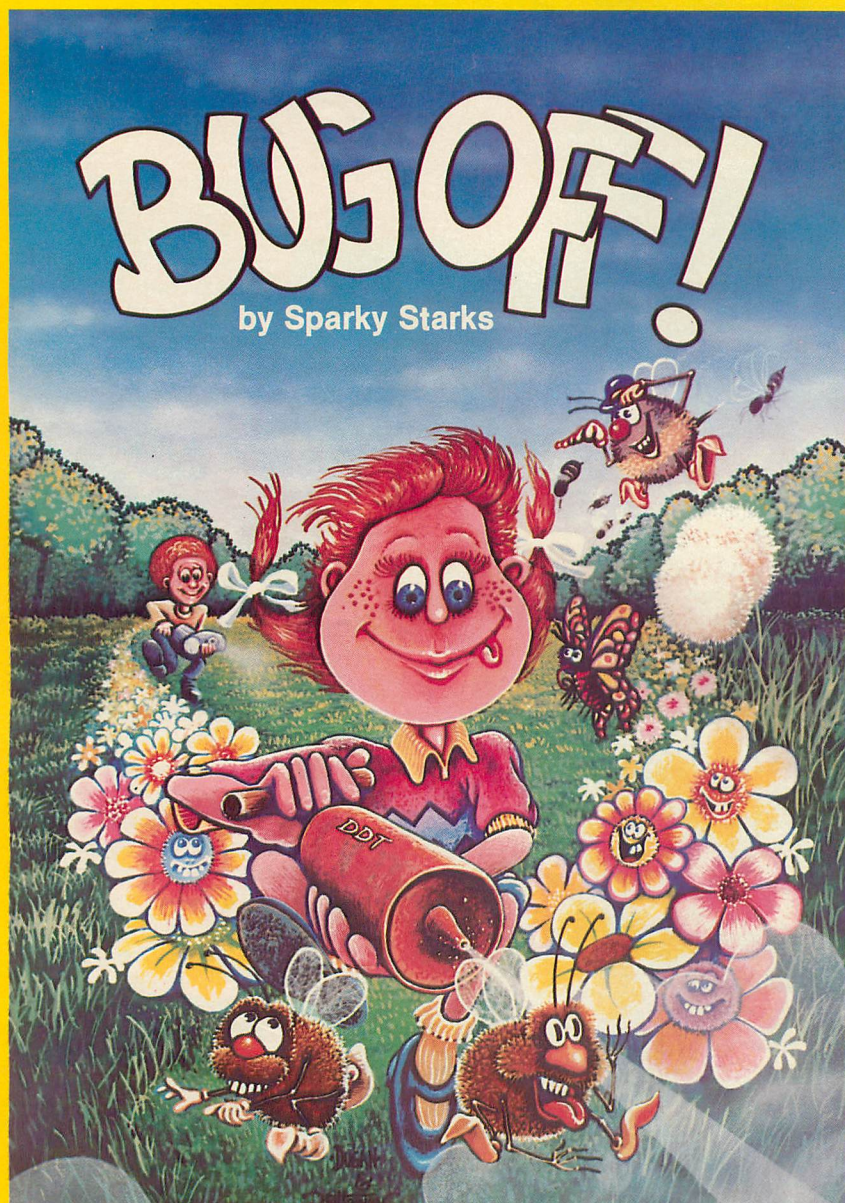
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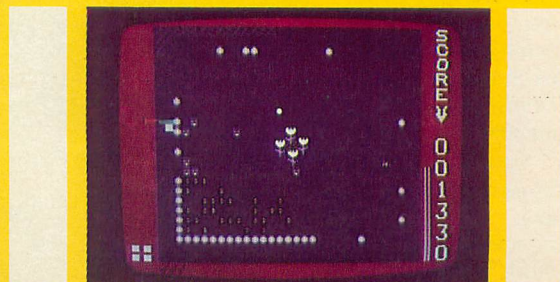
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A computer is no better than the software available for it. The ATARI computer has had an important link, namely ATARI BASIC, strengthened by the arrival of three new programming packages. **BASIC Commander** and **BASIC Debugger** are from MMG Micro Software, and **Monkey Wrench II** is from Eastern House Software. Both manufacturers refer to these packages as "programming aids." In my mind this is an understatement. All three programs offer commands expected only on much larger machines.

In order to make a comparison, **Monkey Wrench II** will be put up against both of MMG's packages. The first difference you will notice is that **Monkey Wrench II** is hardware (it's a cartridge that fits in the right hand slot of the ATARI 800), while MMG's products are on diskettes. Having the package on cartridge is advantageous since there is no need to load the program from diskette. This also allows the use of autoloading diskettes along with the **Monkey Wrench II** program. For example, the **APX Screen Dump Utility** does work along with **Monkey Wrench II**. However, depending on the program, this may not always be the case. The omission of the right hand slot in the ATARI 400 and 1200 eliminates the possibility of using **Monkey Wrench II**.

MMG's utilities are available either together or on separate diskettes as autoloading programs. With both programs on one disk, you can use any function

of either at any time. The disadvantage is that more memory is required if both are loaded. This could be crucial on larger programs (which, of course, are normally harder to debug). In addition to the utility itself, **BASIC Commander** also has a help file which displays all functions, and **BASIC Debugger** has a DEMO program to use as a learning aid.

BASIC Commander has 10 commands, 7 programmed keys, and 3 programmable keys. **BASIC Debugger** has 5 commands plus a TRACE command with 9 options. **Monkey Wrench II** has 18 commands plus a machine language monitor, giving you 16 more commands for use with the 6502 microprocessor. All three have commands that are unique to each. First, I will review the similar functions.

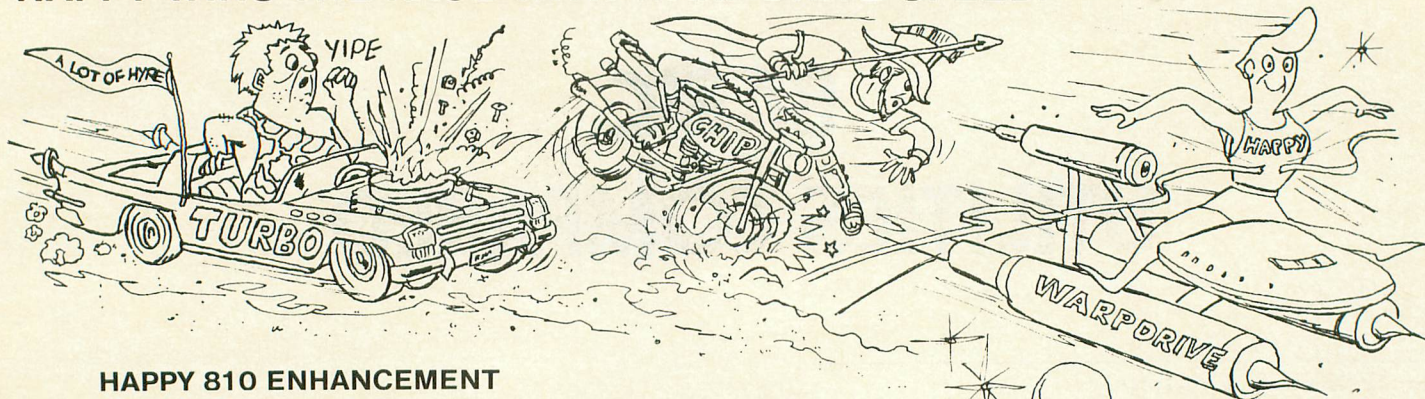
Auto line numbering is available on both **Monkey Wrench II** and **BASIC Commander**. MMG claims that this function alone speeds input 25 to 75%. With **BASIC Commander**, pressing START will cause a prompt of "Increment,Start." You can enter your choice, or let the default values of 10,10 be implemented by just hitting RETURN (if lines already exist, numbering starts 10 after the last line by default). The program stops you from overwriting existing lines except for the line you specify as start. If you enter a line with incorrect syntax, the program exits the auto mode.

Monkey Wrench II works in a similar manner with some exceptions. First, you won't be prompted for parameters. It is also possible to write over existing lines. One advantage is that, unlike **BASIC Commander**, **Monkey Wrench II** allows you to use ATARI's screen editing without exiting from the auto mode.

Renumbering functions are available on **Monkey Wrench II** and **BASIC Commander**. I consider this a necessity for most programmers. All lines as well as all line references (GOTO, GOSUB, etc.) are renumbered. The implementation for **BASIC Commander** is superior since it lists the line numbers of indirect references (GOTO A) and references to non-existent lines to the screen.

Both of these packages contain block delete functions that facilitate deleting a series of lines. **BASIC**

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Commander has gotten around the ATARI BASIC bug of computer "lock up" with deletion. **Monkey Wrench II** is still prone to this, however.

All three packages have variable list functions. **BASIC Commander** will give you a list of names and the total number of variables. **Monkey Wrench II** gives you the choice of screen or printer listing, and will list all scalar and string variables, the current value, and the total number of variables. Array variables will only be listed by name, along with the DIM value(s).

BASIC Debugger has the most complex variable listing. It will list to printer or screen all variables and line numbers they occur on. See also the following discussion of the TRACE function.

Monkey Wrench II and **BASIC Commander** allow you to get a listing of the disk directory without having to boot DOS. No more worrying about saving a program "on top of" another program with the same name!

The ability to scroll your program on the screen is extremely useful. With **Monkey Wrench II**, this is enabled automatically and is always available unless you toggle it off. This implementation is very easy to use. In contrast, the use of scrolling with **BASIC Debugger** is very awkward. You must access it with a

3-key combination, and it will then be disabled whenever you hit any key other than the up or down arrow.

Monkey Wrench II and **BASIC Debugger** both have a useful string search function. Both allow you to search a specific block of lines or the whole program (default). Ever want to change a variable name throughout a program? **Monkey Wrench II** allows you to do this easily. It also allows the use of "%" as a "wild card character" in string searching. For example, "b%g" would find occurrences of big, bag, beg, etc.

Now, I'll examine functions unique to each utility. The author of **BASIC Commander** was a lazy typist (like me!). **BASIC Commander** has three programmable keys which can hold up to 36 characters each. I have found this feature extremely useful. After entering the desired line, this line will appear on the screen whenever you hit the CTRL-key combination. There are also preprogrammed keys that will put SAVE"D:, ENTER"D:, LIST"D:, ? #6;,, LOAD"D:, and RUN"D: on the screen as if you typed them.

BASIC Commander also allows the use of several DOS functions without having to boot DOS. These include locking, unlocking, renaming, and de-



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leting files. You can also format a new diskette very easily. This format function is safeguarded well, since three separate inputs are needed from the user. However, the delete file command can take effect in one fell swoop!

BASIC Commander has concise, easy-to-read documentation. The manual is only 7 pages, which reflects the fact that the program is very user friendly and gives good prompts. Commands are implemented by either pressing the function keys or CTRL-key combinations. By hitting CTRL-0, all **BASIC Commander** commands are disabled. This allows you to use these keys in the normal manner (special graphics characters). Forgetting to toggle (when running programs that use the START key, for example) can cause problems, especially in different graphics modes. I also found that **BASIC Commander** was disabled after using the CTRL-R combination and had to be re-enabled by hitting CTRL-0.

To use DOS, you must hit SYSTEM RESET which erases **BASIC Commander** from memory. (A new version is now available that corrects this.) Overall, **BASIC Commander** is an extremely well written and easy to use utility, that I heartily recommend.

BASIC Debugger offers some functions standard on some powerful (and expensive) micros. The most important of these is the TRACE function. This is an indispensable debugging tool, which allows you to trace program execution line by line. Several options are available with this command. Lines executed can be listed to an auxiliary screen (see below), output can be listed to a printer, and conditions (>, <, <>, =) can be imposed that stop tracing when the condition is no longer true. Step tracing can be done, which will execute one line on hitting the space bar. The values of up to 5 variables can be listed as each line is executed. MMG claims scalars, arrays, and string variables can be checked; however, I had problems tracing array element values.

BASIC Debugger has an auxiliary screen that can be toggled to and from. It serves as a useful workspace, and is where output from the trace function gets displayed. The editing of two related sections of a program is simplified by the fact that the screen can be split into two parts, each of which can be scrolled independently. An annoying problem is that the cursor can go off the screen, unlike the normal mode.

Although **BASIC Debugger** looks good on paper, I found some troublesome features. Some functions require hitting three keys simultaneously. Documentation could be better. The user should read the manual carefully, as this is a complex package. Major points are often not brought to the reader's attention.

MMG's manual warns that toggling between the regular and auxiliary screen while BASIC is writing

to the screen may crash the computer. I have had additional problems with the system crashing for no apparent reason. Intermittent occurrences of keyboard malfunction may also take place (hitting "A" gives a "P", etc.). Also, although hitting SYSTEM RESET is supposed to leave **BASIC Debugger** enabled, my system frequently crashes when I try to use **BASIC Debugger** after hitting SYSTEM RESET. MMG states they have not received other complaints of this type in the 5 months **BASIC Debugger** has been on the market.

In addition to the previously discussed features, **Monkey Wrench II** has other unique functions. Sections of a program can be either copied or moved (original lines deleted) to a new part of a program. Line references like GOTO must be changed by the user. Caution should be used, since you may copy over existing lines. Output to screen or printer can be formatted so that multiple BASIC commands (separated by colons) are left justified and the whole program is paginated.

On turning on your computer, the lower case key is disabled, and the cursor keys function without holding down the CTRL-key. (You must hold down CTRL for +, -, =, and *.) The former stops annoying occurrences of hitting the lower case key. The latter takes getting used to, especially if you do a lot of equation type programming. Both can be disabled by toggle commands.

Other miscellaneous **Monkey Wrench II** commands include a simple-to-use hexadecimal to decimal and dec to hex conversion, the ability to change screen margins, and a memory test that checks all combinations of bit patterns in a memory range. This outputs the address of any errors (hopefully none!). As the manual says, though, "be prepared to wait!"

Documentation is good for **Monkey Wrench II**, considering the complexity of the package. Hitting SYSTEM RESET or using DOS functions causes no problems (another advantage of the cartridge). All commands start with the > sign, rather than using CTRL-key combinations.

One complaint is that there aren't uniform toggle commands to disable **Monkey Wrench II** functions. Prompts are also not included for the input of parameters. Thus, you will have to remember things like "was that line number (space) increment or increment (space) line number?" This will probably come easily with frequent use. All in all, I feel **Monkey Wrench II** offers a diverse number of useful functions for serious programmers.

In deciding which of these utilities may be for you, I recommend writing down things that bug you about programming. Next, see if these sore spots are covered by one or more of the above utilities. If so, don't hesitate in getting it. I think you will find your programming life will be made a lot easier! □

Necromancer

A large, purple, spectral face with glowing red eyes dominates the background, set against a dark forest scene. The face appears to be part of a massive tree or a giant entity. The title 'Necromancer' is written in a large, stylized, orange font with a lightning bolt-like underline. A copyright notice '©1982 TIM BOXELL' is visible in the upper right corner of the illustration.

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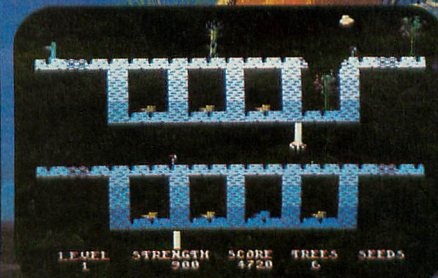
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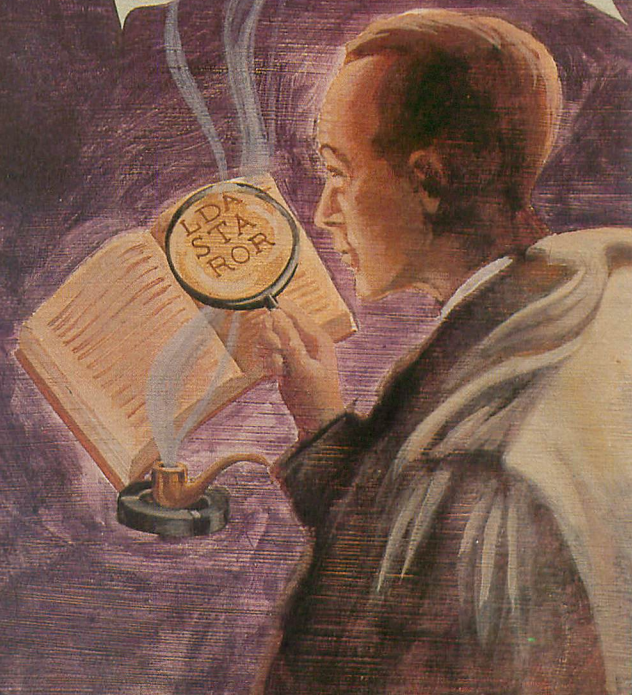
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SPEED UP YOUR PROGRAMS WITH CIO

16K Cassette or Disk

by Richard Groszkiewicz

For those of you who are not familiar with the Central Input/Output (CIO) utility of the ATARI, it's time you get acquainted.

CIO is a machine language routine in the ATARI operating system that is accessible from BASIC. This routine transfers data between memory and a storage device (disk or cassette) at a high rate of speed.

Anything that can be done by PUT or GET statements in BASIC can be done by CIO. You can load data files just as fast as the ATARI operating system loads BASIC programs which have been SAVED to disk or cassette.

| | | 500 BYTES | | 2000 BYTES | |
|-----|-------|-----------|------|------------|------|
| | | CASS | DISK | CASS | DISK |
| PUT | BASIC | 32.5 | 9.3 | 114.0 | 33.0 |
| | CIO | 12.5 | 2.9 | 41.8 | 6.9 |
| GET | BASIC | 38.9 | 8.2 | 121.0 | 33.0 |
| | CIO | 17.8 | 0.7 | 51.3 | 2.2 |

The table above shows that CIO is between two and ten times faster than BASIC for doing byte-oriented I/O. For cassette users, the range is between two and three times faster. Note that the table seems to indicate that it takes longer for the BASIC cassette routine to GET bytes than it takes to PUT them onto the cassette! This is not really the case; when the cassette is opened to GET the data, control is returned to the program after only half of the leader has been read. Thus, the times shown for GET via cassette are overstated by at least five seconds. The same thing happens when using PUT with the cassette.

How to use CIO.

Listing 1 is the program that produced the results

shown above for transferring 500 bytes. It illustrates the steps necessary to access CIO from BASIC:

1. Calculate the starting address from which you will either read or store data.
2. Calculate the number of bytes to transfer.
3. Determine which Input/Output channel you will use, and OPEN the file. For example:
 - a. GET with cassette — IO=1:OPEN #IO,4,128,"C:"
 - b. PUT with cassette — IO=1:OPEN #IO,8,128,"C:"
 - c. GET with disk — IO=1:OPEN #IO,4,0,"D:FILENAME. EXT"
 - d. PUT with disk — IO=1:OPEN #IO,8,0,"D:FILENAME. EXT"

Note that the auxiliary byte is 128 for cassette; this specifies short inter-record gaps, which speeds up the read/write process.

4. Do a GOSUB 6000 for CIO PUT, or GOSUB 7000 for CIO GET. The CIO subroutines do the rest of the work for you by using the previously defined variables IO, ADDRESS, and NUMBER:

A. Set up the I/O Control block by defining IO=16*IO, and then define IOCB=832+IO. In addition, set a TRAP statement for the possibility that we go beyond the correct file length (using CIO GET).

B. For GETting data from a file, you must POKE IOCB+2,7. To PUT data to a file, use POKE IOCB+2,11.

C. POKE the address locations into the correct IOCB locations. Break the ADDRESS into low and high bytes. Then POKE IOCB+4,ADRLO and POKE IOCB+5, ADRHI.

D. POKE the number of bytes into the correct IOCB locations. Break the NUMBER into low and high bytes. Then POKE IOCB+8, NUMLO and POKE IOCB+9,NUMHI.

Note: if you are using CIO to get bytes from a file, you can let NUMLO and NUMHI be 255, and the routine will stop when it reaches the end of the file.

This is accomplished with the TRAP statement at line 7010.

E. The call to the CIO routine has been set up by the prior POKES. The most general way to call the routine is **I=USR (ADR ("HHHLLV"),IO)**. The string in the quotes above is three lower case H's, followed by an inverse asterisk, upper case L, upper case V, and lower case inverse D.

Program Analysis.

| | |
|-----------|---|
| 110-175 | Timer subroutine |
| 180-200 | Initialization: define name of test file |
| 210-260 | Determine if a disk drive is accessible, and define the auxiliary byte for the CIO routine accordingly. |
| 270-300 | Locate the beginning of free user memory. |
| 310-320 | Define the NUMBER of bytes to transfer. |
| 370-430 | Use BASIC to PUT 500 bytes to disk or cassette. |
| 440-500 | Use BASIC to GET 500 bytes from disk or cassette. |
| 510-550 | Use CIO to PUT 500 bytes to disk or cassette. |
| 560-600 | Use CIO to GET 500 bytes from disk or cassette. |
| 6000-6110 | The CIO PUT subroutine |
| 7000-7110 | The CIO GET subroutine |

There is one caveat regarding use of the CIO routines: you cannot save data from the ROM area of memory, such as the character set, or from the BASIC cartridge. This is because of the way CIO works. It actually writes certain disk file data to the area being saved from, and then rewrites the correct information back. Since the writes into ROM have no effect, the data written to disk is incorrect. Specifically, the file sector links will be wrong. You would need to repair the sector links before the disk would be safe to use.

If you are a bit uneasy about the USR call, a short explanation will help calm your fears. The string is contained within the USR call because the short machine language routine it holds is written in a completely relocatable fashion. Here is the character by character translation of the routine:

| Character | ATASCH | OP CODE | EXPLANATION |
|-----------|--------|---------|--|
| * h | 104 | PLA | Get number of arguments (should be 1) |
| * h | 104 | PLA | Get high byte of first argument |
| * h | 104 | PLA | Get low byte of first argument |
| * * | 170 | TAX | Place low byte in the X register |
| * L | 76 | JMP | Immediate jump to address that follows |
| * V | 86 | \$56 | Low byte of address of CIO routine |
| * d | 228 | \$E4 | High byte of address of CIO routine |

All that the short USR call does is to transfer control of the program to the CIO routine, which

resides at location \$E456 (hexadecimal) in memory. A prerequisite of the CIO routine is that the X register must contain the proper index for the input/output control block (or IOCB for short). The CIO routine is THE routine that is typically used in machine language programs to perform disk and cassette input/output operations. Since it is itself a machine language routine, we get a great speed increase by using it.

Applications

Any time that you need to transfer large amounts of data from disk or cassette into memory, you should consider using the CIO utility. The routines shown in the first program can be used to load character sets, data tables, or even entire graphics screens. It can also be used to load and execute machine language files. The remainder of this article will illustrate alternative uses for the CIO utility through specific examples. Your typing can be diminished by LISTing the CIO GET and CIO PUT routines from lines 6000-6110 and 7000-7110 of **Listing 1** to disk or cassette. All of my examples use these same routines.

Listing 1.

```

100 GO TO 190
110 REM TIME SUBROUTINE
120 OLDTIME=TIME:ODD=ODD+1
130 TIME=PEEK(20)+256*(PEEK(19)+256*PEEK(18))
140 TIME=INT(1000*TIME/60)/1000
150 ELAPSE=TIME-OLDTIME
160 PRINT "TIME=";TIME,
170 IF ODD=2*INT(ODD/2) THEN ? " ELAPSE=";ELAPSE
175 ? :RETURN
180 REM INITIALIZATION
190 TIMER=120
200 DIM FILES(14):FILES$="D:TESTDATA"
210 REM CHECK FILES
220 TRAP 250:AUX=0
230 OPEN #1,6,0,"D:*.*)"
240 GOTO 260
250 FILES$="C":AUX=128
260 TRAP 34567:CLOSE #1
270 REM AREA TO PLAY WITH
280 REM WARNING-DON'T USE
290 REM O.S. OR BASIC ROMS
300 ADDRESS5=PEEK(144)+256*PEEK(145)+256
310 REM WILL TRANSFER 500 BYTES
320 NUMBER=500
370 OPEN #1,8,0,FILES$
380 ? "PUT VIA BASIC"
390 GOSUB TIMER
400 FOR I=1 TO NUMBER
410 PUT #1,PEEK(ADDRESS5+I-1)
420 NEXT I:CLOSE #1
430 GOSUB TIMER: ?
440 OPEN #1,4,0,FILES$
450 ? "GET VIA BASIC"
460 GOSUB TIMER
470 FOR I=1 TO NUMBER
480 GET #1,A:POKE ADDRESS5+I-1,A
490 NEXT I:CLOSE #1
500 GOSUB TIMER: ?
510 IO=1:OPEN #10,8,AUX,FILES$
520 ? "PUT VIA CIO"
530 GOSUB TIMER
540 GOSUB 6000
550 GOSUB TIMER: ?
560 IO=1:OPEN #10,4,AUX,FILES$

```



```

570 ? "GET VIA CIO"
580 GOSUB TIMER
590 GOSUB 7000
600 GOSUB TIMER:?
610 END
6000 REM CIO TO PUT BYTES
6010 IO=16*IO
6020 IOCB=832+IO:POKE IOCB+2,11
6030 ADRHI=INT(ADDRESS/256)
6040 ADRLO=ADDRESS-ADRHI*256
6050 POKE IOCB+4,ADRLO:POKE IOCB+5,ADRHI
6060 NUMHI=INT(NUMBER/256)
6070 NUMLO=NUMBER-256*NUMHI
6080 POKE IOCB+8,NUMLO:POKE IOCB+9,NUMHI
6090 I=USR(ADR("hhh:lv"),IO)
6100 CLOSE #IO/16
6110 RETURN
7000 REM CIO TO GET BYTES
7010 IO=16*IO:TRAP 7100
7020 IOCB=832+IO:POKE IOCB+2,7
7030 ADRHI=INT(ADDRESS/256)
7040 ADRLO=ADDRESS-ADRHI*256
7050 POKE IOCB+4,ADRLO:POKE IOCB+5,ADRHI
7060 NUMHI=INT(NUMBER/256)
7070 NUMLO=NUMBER-256*NUMHI
7080 POKE IOCB+8,NUMLO:POKE IOCB+9,NUMHI
7090 I=USR(ADR("hhh:lv"),IO)
7100 CLOSE #IO/16
7110 RETURN

```

CHECKSUM DATA (See p. 20)

```

100 DATA 870,160,630,341,48,336,26,370
,944,916,29,596,487,518,522,6793
240 DATA 717,756,970,127,66,227,801,15
6,899,729,276,306,939,846,820,8635
430 DATA 627,714,226,299,960,184,841,6
20,794,486,292,822,635,801,458,8759
580 DATA 307,840,622,39,747,886,80,696
,983,494,491,838,577,696,148,8444
6110 DATA 793,706,793,835,698,985,496,
493,840,579,698,150,795,8861

```

Saving graphics screens.

Sheldon Leemon, the author of *Instedit*, published articles in the M.A.C.E. newsletter last year on how to use CIO. The example application that follows is an extension of the technique used in those articles.

I assume that you have had the experience of keying in a short GTIA demonstration program, only to discover that it takes 10 minutes to finish! I will show you how to save the entire display list as well as the color registers and the graphics screen on cassette or diskette. Then the screen can be loaded back into memory very quickly.

The first program that does this for you is shown in **Listing 2**. It is called Screen Save, and it should be LISTed to disk or cassette after you have keyed it in. The program should be ENTERed after loading in a graphics demonstration program, such as the short one shown at the end of the LISP article in A.N.A.L.O.G. Number 10.

The first thing that must be done is to eliminate any "holding" loop that exists at the end of the graphics demo program. The lines from 5000 to 5100 must be executed in order to save the screen. After doing that, then you can RUN the program. The subroutine at lines 8000-8350 test whether a disk or cassette is accessible. For disk users, a file name will be requested, and the program will make sure that the file can be OPENed on the disk.

Then the graphics program will execute and produce a fancy display. Next, if you changed the program correctly, the lines starting at 5000 will be executed. Here is a short line-by-line analysis:

- 5020-5030 The file is OPENed for a write
- 5035-5040 The graphics mode is obtained and written to the file
- 5045-5050 The color registers are all written to the file
- 5060-5070 The beginning of the area to save from is the display list, and the end of the area is the top of memory. The values of these addresses are stored in memory locations 560, 561, and 106 (high byte only).
- 5080-5090 The starting address and number of bytes are defined.
- 5100 The CIO routine has been prepared by the preceding lines, and now the CIO PUT routine is called. The program stops execution after the CIO routine is done.

If the program does not successfully save the screen to disk, the usual problem is a disk full error. Each GRAPHICS 8,9,10 or 11 screen takes up 8K of memory, or 66 disk sectors! It's easy to fill up a disk at that rate.

Listing 2.

```

0 GOSUB 8000
1 REM GRAPHICS DEMO PROGRAM GOES HERE
5000 REM
5010 REM SETUP FOR CIO PUT ROUTINE
5020 REM
5030 IO=1:OPEN #IO,8,AUX,FILES$
5035 REM SAVE GRAPHICS MODE
5040 GR=PEEK(87):PUT #IO,GR
5045 REM SAVE ALL COLOR REGISTERS
5050 FOR I=0 TO 8:PUT #IO,PEEK(704+I):
NEXT I
5060 RAMTOP=PEEK(106)*256
5070 DLIST=PEEK(560)+256*PEEK(561)
5080 ADDRESS=DLIST
5090 NUMBER=RAMTOP-DLIST+1
5100 GOSUB 6000:END
6000 REM CIO TO PUT BYTES
6010 IO=16*IO
6020 IOCB=832+IO:POKE IOCB+2,11
6030 ADRHI=INT(ADDRESS/256)
6040 ADRLO=ADDRESS-ADRHI*256
6050 POKE IOCB+4,ADRLO:POKE IOCB+5,ADRHI
6060 NUMHI=INT(NUMBER/256)
6070 NUMLO=NUMBER-256*NUMHI
6080 POKE IOCB+8,NUMLO:POKE IOCB+9,NUMHI

```



```

6090 I=USR(ADR("hhhLV"),IO)
6100 CLOSE #10/16
6110 RETURN
8000 REM
8010 REM INITIALIZATION
8020 REM
8040 DIM FILE$(14)
8050 TRAP 8100:OPEN #1,6,0,"D:*.*)"
8060 AUX=0:GOTO 8110
8100 FILE$="C":AUX=128
8110 TRAP 34567:CLOSE #1
8300 IF FILE$="C" THEN RETURN
8310 ? "Please Enter File Name"
8320 TRAP 8310:INPUT FILE$
8330 IF FILE$="" THEN 8310
8340 CLOSE #1:OPEN #1,8,0,FILE$
8350 TRAP 34567:CLOSE #1:RETURN

```

CHECKSUM DATA (See p. 20)

```

0 DATA 637,403,283,412,285,10,295,566,
870,451,396,398,646,647,414,6713
6000 DATA 747,886,80,696,983,494,491,8
38,577,696,148,793,289,60,291,8069
8040 DATA 303,44,570,964,12,886,754,36
3,976,909,55,5836

```

The companion program, SCREEN FETCH, is shown in Listing 3. This program is almost identical to Screen Save except that it does everything in reverse.

The first thing that is done is to GOSUB 8000. This sets things up to restore a screen file. Line 8340 has been changed to allow the file to be OPENed for read access rather than write.

Next, the subroutine at line 5000 is executed. In line 5030, we OPEN the file for read access. Line 5040 GETs the GRAPHICS mode. Lines 5041 and 5042 are also different. It is presumed that the original graphics screen was a full screen display, rather than a split screen display with a text window. The test in line 5041 checks for GRAPHICS modes 0,9,10, and 11, which typically do not have a text window. Line 5042 executes the GRAPHICS call.

Line 5050 retrieves the color registers from the file and POKEs them into memory locations 704-712. The lines from 5060 to 5090 are identical to the Screen Save routine. Line 5100 has been changed to call the CIO GET routine.

After executing these subroutines, the graphics screen should be displayed in all its glory. I've included a simple color rotation subroutine (lines 170-230) to give the appearance of motion on the screen. This routine was also included in the GRAPHICS mode 10 demonstration program that was mentioned earlier.

Screen Fetch should be SAVED to disk or cassette so that it can be RUN. You can create entire cassettes or disks full of nifty demonstration screens to impress your friends.

Listing 3.

```

0 GOSUB 8000
10 GOSUB 5000
170 REM ROTATE COLOR REGISTERS
180 CHOLD=PEEK(705)
190 X=705
200 POKE X,PEEK(X+1)
210 X=X+1:IF X<712 THEN 200
220 POKE 712,CHOLD
230 GOTO 180
5000 REM
5010 REM SETUP FOR CIO GET
5020 REM
5030 IO=1:OPEN #10,4,AUX,FILE$
5035 REM GET GRAPHICS MODE
5040 GET #10,GR
5041 IF GR>0 AND GR<9 THEN GR=GR+16
5042 GRAPHICS GR
5045 REM GET ALL COLOR REGISTERS
5050 FOR I=0 TO 8:GET #10,A:POKE (704+
I),A:NEXT I
5060 RAMTOP=PEEK(106)*256
5070 DLIST=PEEK(560)+256*PEEK(561)
5080 ADDRESS=DLIST
5090 NUMBER=RAMTOP-DLIST+1
5100 GOSUB 7000:RETURN
7000 REM CIO TO GET BYTES
7010 IO=16*IO:TRAP 7100
7020 IOCB=832+IO:POKE IOCB+2,7
7030 ADRI=INT(ADDRESS/256)
7040 ADRL=ADDRESS-ADRI*256
7050 POKE IOCB+4,ADRL:POKE IOCB+5,ADRI
7060 NUMHI=INT(NUMBER/256)
7070 NUMLO=NUMBER-256*NUMHI
7080 POKE IOCB+8,NUMLO:POKE IOCB+9,NUMHI
7090 I=USR(ADR("hhhLV"),IO)
7100 CLOSE #10/16
7110 RETURN
8000 REM
8010 REM INITIALIZATION
8020 REM
8040 DIM FILE$(14)
8050 TRAP 8100:OPEN #1,6,0,"D:*.*)"
8060 AUX=0:GOTO 8110
8100 FILE$="C":AUX=128
8110 TRAP 34567:CLOSE #1
8300 IF FILE$="C" THEN RETURN
8310 ? "Please Enter File Name"
8320 TRAP 8310:INPUT FILE$
8330 IF FILE$="" THEN 8310
8340 CLOSE #1:OPEN #1,4,0,FILE$
8350 TRAP 34567:CLOSE #1:RETURN

```

CHECKSUM DATA (See p. 20)

```

0 DATA 637,995,989,793,323,635,532,502
,718,283,20,285,998,2,48,7760
5041 DATA 402,400,372,285,396,398,646,
647,970,706,793,835,698,985,496,9029
7060 DATA 493,840,579,698,150,795,289,
60,291,303,44,570,964,12,886,6974
8310 DATA 754,363,976,897,55,3045

```

Loading machine language programs.

In general, everyone has a favorite usage for the AUTORUN.SYS file on disks. I prefer to use it to boot a generalized menu program that is written in BASIC. If I want to play a machine language game, I must hit the BREAK key and go to DOS to load the game.

There is a way to write a program in BASIC that can load most machine language games. For some others, which are written to overlap the region occupied by the Disk Operating System, a different method must be used. I will discuss both types of programs in the following examples.

The **Harvey Wallbanger** game that appeared in **A.N.A.L.O.G.** Number 9 created an AUTORUN.SYS file on a diskette. The first thing that you should do is to change the filename using DOS option "E." My example will assume that the file is named HARVEY.OBJ.

In order to load a binary program and execute it, there are several things you need to know: (a) what is the address where we should load the machine language, (b) how many bytes of code should we load, and (c) what is the memory address where the code should begin executing after it is loaded? Thanks to numerous articles which have appeared in the past, we know how to find the answers to these questions. The structure of a machine language program is as follows:

A. The first two bytes should both contain 255. This is the standard "header" the system expects for a machine language file.

B. The next two bytes contain the beginning load address for the file, in low byte/high byte format.

C. The next two bytes contain the ending load address for the file.

D. The remainder of the file contains the machine language program.

E. Assuming that we have a single large machine language file, the next thing we will find is a second very short file which contains the address to begin execution. Depending on how the program is created, the second file may or may not have the two header bytes of 255. In addition, the execution address may be loaded into locations 736 and 737, or 738 and 739.

The program shown in **Listing 4** should handle most single-stage machine language files that have been saved with an execution address. The program consists of three sections:

1. Lines 4000-4080 constitute the main program.
2. Lines 5000-5110 pull the address bytes and calculate the number of bytes to transfer.
3. Lines 7000-7110 are the CIO GET routine, with one change, which is the REM statement at line 7100.

The first section is the only one that needs an explanation. The file is OPENed at line 4000. Line 4020 calls the address checker at line 5000. Then that routine calls the CIO GET routine to load the main machine language program. Line 4040 calls the address checker again; note that we had to define IO=1 again because line 7050 of the CIO GET routine changed it. On the second call, we are

expecting only two bytes, which will contain the execution address. If this is not the case, then the program STOPS at line 4050. If there are precisely two bytes transferred, then we transfer control to the machine language program via the USR call in line 4070. You can usually return to BASIC directly by hitting SYSTEM RESET after using this load routine.

The program in **Listing 4** won't work with programs which are not loaded from a binary disk file. One example is **Fill 'Er Up!** (**A.N.A.L.O.G.** Issue 10), which used a BASIC program to read data statements into a string variable called PROG\$. The machine-language program in PROG\$ was then executed with a USR call.

Listing 4.

```

4000 IO=1:OPEN #IO,4,0,"D:HARVEY.OBJ"
4010 REM GET MAIN LOAD FILE
4020 IO=1:GOSUB 5000
4030 REM GET EXECUTION ADDRESS
4040 IO=1:GOSUB 5000:CLOSE #IO/16
4050 IF NUMBER<>2 THEN PRINT "DOGS - "
;NUMBER;" BYTES INSTEAD OF 2!" :STOP
4060 REM JUMP TO EXECUTION ADDRESS
4070 I=USR(PEEK(START)+256*PEEK(FINIS)
)
4080 END
5000 REM 1ST 2 BYTES 5/B 255 HEADERS
5010 REM LOAD ADDRESS TO START
5020 GET #IO,ADRLO:GET #IO,ADRHI
5030 IF ADRLO=255 AND ADRHI=255 THEN G
OTO 5020
5040 START=ADRLO+256*ADRHI
5050 REM LOAD ADDRESS TO STOP
5060 GET #IO,LO:GET #IO,HI
5070 FINIS=LO+256*HI
5080 REM CALCULATE NUMBER OF BYTES
5090 ADDRESS=START
5100 NUMBER=FINIS+1-START
5110 GOSUB 7000:RETURN
7000 REM CIO TO GET BYTES
7010 IO=16*IO:TRAP 7100
7020 IOCB=832+IO:POKE IOCB+2,7
7030 ADRHI=INT(ADDRESS/256)
7040 ADRLO=ADDRESS-ADRHI*256
7050 POKE IOCB+4,ADRLO:POKE IOCB+5,ADR
HI
7060 NUMHI=INT(NUMBER/256)
7070 NUMLO=NUMBER-256*NUMHI
7080 POKE IOCB+8,NUMLO:POKE IOCB+9,NUM
HI
7090 I=USR(ADR("hhh%LU8"),IO)
7100 REM DO NOT CLOSE FILE!!
7110 RETURN

```

CHECKSUM DATA (See p. 20)

```

4000 DATA 964,254,514,551,238,129,376,
125,267,556,555,233,919,477,529,6687
5060 DATA 394,610,277,681,752,971,706,
793,835,698,985,496,493,840,579,10110
7090 DATA 698,813,795,2306

```

Fill 'Er Up is really great to play, but it got tiresome to wait two minutes before the game could be played. I decided to use the CIO PUT routine to

save everything in PROG\$ to disk, and then use the CIO GET routine to quickly pull the data back into the string.

The program in Listing 5 consists of a few familiar-looking lines of code, plus the CIO PUT routine. These lines should be keyed in and LISTed to disk or cassette. Cassette users should change line 210 to

210 IO=1:OPEN #IO,8,0,"C:".

The Fill 'Er Up program should be loaded in exactly as it appeared in the magazine. Then ENTER the new program lines, and RUN the program. After going through the checksum calculations, it will GOSUB to our new code at line 210 and save the checked data in PROG\$. Then it will come back and ask you if you want to play.

Listing 5.

```
65 GOSUB 210
210 IO=1:OPEN #1,8,0,"D:FILLERUP.DAT"
220 ADDRESS=ADR(PROG$)
230 NUMBER=3240
240 GOSUB 6000:RETURN
6000 REM CIO TO PUT BYTES
6010 IO=16*IO
6020 IOCB=832+IO:POKE IOCB+2,11
6030 ADRI=INT(ADDRESS/256)
6040 ADRL=ADDRESS-ADRI*256
6050 POKE IOCB+4,ADRL:POKE IOCB+5,ADRI
6060 NUMHI=INT(NUMBER/256)
6070 NUMLO=NUMBER-256*NUMHI
6080 POKE IOCB+8,NUMLO:POKE IOCB+9,NUMHI
6090 I=USR(ADR("hhhLUV"),IO)
6100 CLOSE #IO/16
6110 RETURN
```

CHECKSUM DATA (See p. 20)

```
65 DATA 766,910,324,117,197,747,886,80
696,983,494,491,838,577,696,8802
6100 DATA 148,793,941
```

Instead of playing, you should type NEW, and ENTER those lines of code again. Listing 6 contains the new Fill 'Er Up program that you will now type in. Change lines 6000-6110 to be the CIO GET routine at lines 7000-7110. Change line 65 too, or else BASIC will not think that PROG\$ is really 3240 bytes long. Change line 210 to say 210 IO=1:OPEN #IO,4,0,"D:FILLERUP.DAT" (or "C:" for cassette). Line 240 should be changed to 240 GOSUB 7000, and line 250 should be added. For disk users, the game now loads in about 10 seconds instead of taking over two minutes!! Cassette users can also realize a time savings of about two minutes.

Listing 6.

```
65 DIM PROG$(3240):PROG$(1)="" : PROG$(
3240)="" : PROG$(2)=PROG$
210 IO=1:OPEN #1,4,0,"D:FILLERUP.DAT"
220 ADDRESS=ADR(PROG$)
230 NUMBER=3240
240 GOSUB 7000
250 A=USR(ADR(PROG$),ADR(PROG$))
7000 REM CIO TO GET BYTES
7010 IO=16*IO:TRAP 7100
7020 IOCB=832+IO:POKE IOCB+2,7
7030 ADRI=INT(ADDRESS/256)
7040 ADRL=ADDRESS-ADRI*256
7050 POKE IOCB+4,ADRL:POKE IOCB+5,ADRI
7060 NUMHI=INT(NUMBER/256)
7070 NUMLO=NUMBER-256*NUMHI
7080 POKE IOCB+8,NUMLO:POKE IOCB+9,NUMHI
7090 I=USR(ADR("hhhLUV"),IO)
7100 CLOSE #IO/16
7110 RETURN
```

CHECKSUM DATA (See p. 20)

```
65 DATA 326,906,324,117,819,131,706,79
3,835,698,985,496,493,840,579,9048
7090 DATA 698,150,795,1643
```

Speeding up execution.

For this last example of how CIO can make your life easier, I have chosen the Disk Tool utility from issues 9 and 10 of A.N.A.L.O.G. First, I have to applaud Tony Messina for this very useful program. I recently used it to repair a disk that had somehow developed 25 bad sectors!

Disk Tool was set up with a special AUTORUN.SYS file that moved the LOMEM pointer from 7420 to 9000. Then you ran the first part of the program, which read numerous DATA statements and POKes them into the reserved area of memory. This was a bit complicated and took some time before the program was up and running. A friend of mine challenged me to eliminate the AUTORUN.SYS file so that the program could be run through a standard BASIC program. Well, the AUTORUN.SYS file is just another machine language program, and all those DATA statements are just the thing for CIO.

First of all, I changed the name of the AUTORUN.SYS file to DSKTOOL1.OBJ. There was a problem here, since my BASIC program would be "wiped out" when the LOMEM pointer was changed. I wanted the BASIC program to load and execute the machine language file, and RUN another BASIC program.

Listing 7 is the initial loader program. This boots in the machine language file "D:DSKTOOL1.

OBJ" that relocated the LOMEM pointer. Close inspection of the program reveals that it is nearly identical to the HARVEY.BAS loader program in **Listing 4**. This is reasonable since our object in both cases is the same: to load and execute a machine language program.

You should key in the program in **Listing 7** carefully and SAVE it before testing it. The reason is that it will wipe itself out if it works as planned! Line 4000 should be changed so that it loads the correct file. Additional changes are on lines 4060 to 4160. Lines 4070 to 4090 clear the screen and make the cursor invisible. The REM statement in line 4090 allows you to see what is happening. If you remove the REM, the POKE will make the text invisible on the screen.

Lines 4100 to 4120 print RUN"D:DSKTOOL.PT1 on the screen, and then the cursor is repositioned at the beginning of the line. The tricky part is the POKE in line 4130. Memory locations 764 holds the last keyboard character pressed. The POKE of a 12 to that location makes the computer think that the RETURN key has been pressed while the program was running! Now, when the machine language routine is run at line 4150, the BASIC program is wiped out. However, the RUN line is still on the screen, and the computer "executes" the RETURN next. In this way, the DSKTOOL.PT1 program is RUN with no program left in memory.

Listing 7.

```

4000 IO=1:OPEN #IO,4,0,"D:DSKTOOL1.OBJ
"
4010 REM GET MAIN LOAD FILE
4020 IO=1:GOSUB 5000
4030 REM GET EXECUTION ADDRESS
4040 IO=1:GOSUB 5000:CLOSE #IO/16
4050 IF NUMBER<>2 THEN PRINT "OOPS - "
;NUMBER;" BYTES INSTEAD OF 21":STOP
4060 REM SET UP CHAIN TO NEXT PROGRAM
4070 GRAPHICS 0
4080 POKE 752,1:
4090 REM REM POKE 709,148
4100 POSITION 2,5
4110 ? "RUN";CHR$(34);"D:DSKTOOL.PT1"
4120 POSITION 2,3
4130 POKE 764,12
4140 REM JUMP TO EXECUTION ADDRESS
4150 I=USR(PEEK(START)+256*PEEK(FINIS))
)
4160 END
5000 REM 1ST 2 BYTES S/B 255 HEADERS
5010 REM LOAD ADDRESS TO START
5020 GET #IO,ADRLO:GET #IO,ADRHI
5030 IF ADRLO=255 AND ADRHI=255 THEN G
OTO 5020
5040 START=ADRLO+256*ADRHI
5050 REM LOAD ADDRESS TO STOP
5060 GET #IO,LO:GET #IO,HI
5070 FINIS=LO+256*HI
5080 REM CALCULATE NUMBER OF BYTES
5090 ADDRESS=START
5100 NUMBER=FINIS+1-START
5110 GOSUB 7000:RETURN
7000 REM CIO TO GET BYTES
7010 IO=16*IO:TRAP 7100
7020 IOCB=832+IO:POKE IOCB+2,7
7030 ADRHI=INT(ADDRESS/256)
7040 ADRLO=ADDRESS-ADRHI*256

```

```

7050 POKE IOCB+4,ADRLO:POKE IOCB+5,ADR
HI
7060 NUMHI=INT(NUMBER/256)
7070 NUMLO=NUMBER-256*NUMHI
7080 POKE IOCB+8,NUMLO:POKE IOCB+9,NUM
HI
7090 I=USR(ADR("hhhLUV"),IO)
7100 REM DO NOT CLOSE FILE!!!
7110 RETURN

```

CHECKSUM DATA

(See p. 20)

```

4000 DATA 43,254,514,551,238,129,544,5
5,238,554,221,841,217,159,377,4935
4150 DATA 126,268,556,555,233,919,477,
529,394,610,277,681,752,971,706,8054
7010 DATA 793,835,698,985,496,493,840,
579,698,813,795,8025

```

So far we've eliminated the AUTORUN.SYS file, and the first program (which I called DISKTOOL) chains to the second program. The second program does a lengthy series of READs and POKEs, and then chains to the main program. Next, I altered the second program so that it takes all of the data POKed to memory and creates a file on disk using the CIO PUT routine. **Listing 8** shows the few PUT is called at line 4030. The lines in **Listing 8** line 125 branches to the routine that sets up the address and calculates the number of bytes. CIO PUT is called at line 4030. The lines in **Listing 8** should be keyed in and ENTERed into OLDTOOL.PT1. Next, the program should be RUN, which will create the machine language file.

Listing 8.

```

125 GOSUB 4000:END
4000 IO=1:OPEN #IO,8,0,"D:DSKTOOL2.OBJ
"
4010 ADDRESS=7420
4020 NUMBER=9000-7420
4030 GOSUB 6000
4040 RETURN
6000 REM CIO TO PUT BYTES
6010 IO=16*IO
6020 IOCB=832+IO:POKE IOCB+2,11
6030 ADRHI=INT(ADDRESS/256)
6040 ADRLO=ADDRESS-ADRHI*256
6050 POKE IOCB+4,ADRLO:POKE IOCB+5,ADR
HI
6060 NUMHI=INT(NUMBER/256)
6070 NUMLO=NUMBER-256*NUMHI
6080 POKE IOCB+8,NUMLO:POKE IOCB+9,NUM
HI
6090 I=USR(ADR("hhhLUV"),IO)
6100 CLOSE #IO/16
6110 RETURN

```

CHECKSUM DATA

(See p. 20)

```

125 DATA 679,57,184,684,934,789,747,88
6,80,696,983,494,491,838,577,9119
6090 DATA 696,148,793,1637

```


The final step is to change the DSKTOOL.PT1 file so that it loads in the machine language file that we created. Listing 9 shows the new version of the program. At line 100, the program branches to the same code we used before to OPEN the file and calculate the address and the number of bytes. The OPEN statement in line 4000 has been changed to OPEN#IO,4,0,"D:DSKTOOL2.OBJ," and line 4070 now has a GOSUB 7000. When RUN, this program loads the machine language file. Then the program chains to the DSKTOOL.PT2. program. The entire process takes only a few seconds, compared to more than a minute before!

Listing 9.

```

5 GRAPHICS 2+16:POKE 712,14:POKE 709,1
02:POKE 708,202
10 ? #6;"*****"
20 ? #6;"ANALOG 400/800"
30 ? #6;"presents"
40 ? #6;"utility #3"
50 ? #6;"DSK TOOL"
60 ? #6;"*****"
70 ? #6;"by"
80 ? #6;"TONY MESSINA"
90 ? #6;"reading ml program"
100 GOSUB 4000
110 ? #6;"loading dsktool.ut1"
120 RUN "D:DSKTOOL.PT2"
130 END
4000 IO=1:OPEN #IO,4,0,"D:DSKTOOL2.OBJ"
"
4010 ADDRESS=7420
4020 NUMBER=9000-7420
4030 GOSUB 7000
4040 RETURN
7000 REM CIO TO GET BYTES
7010 IO=16*IO:TRAP 7100
7020 IOCB=832+IO:POKE IOCB+2,7
7030 ADRHI=INT(ADDRESS/256)
7040 ADRLO=ADDRESS-ADRHI*256
7050 POKE IOCB+4,ADRLO:POKE IOCB+5,ADRHI
7060 NUMHI=INT(NUMBER/256)
7070 NUMLO=NUMBER-256*NUMHI
7080 POKE IOCB+8,NUMLO:POKE IOCB+9,NUMHI
7090 I=USR(ADR("hhhLUV"),IO)
7100 CLOSE #IO/16
7110 RETURN

```

CHECKSUM DATA (See p. 20)

```

5 DATA 355,844,577,160,882,404,854,341
,200,512,736,364,74,35,45,6443
4010 DATA 184,684,935,789,706,793,835,
698,985,496,493,840,579,698,150,9865
7110 DATA 795,795

```

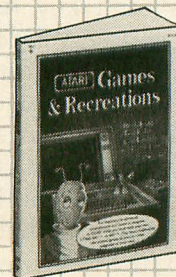
Summary

Everyone should get in the habit of using CIO to transfer large blocks of data. As shown above, even cassette users can benefit, due to the increased speed obtained by using short inter-record gaps. CIO will help your programs avoid embarrassing delays while a character set loads in (for example). An added advantage is that your programs can be shorter and take up less memory. □

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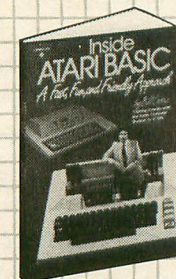
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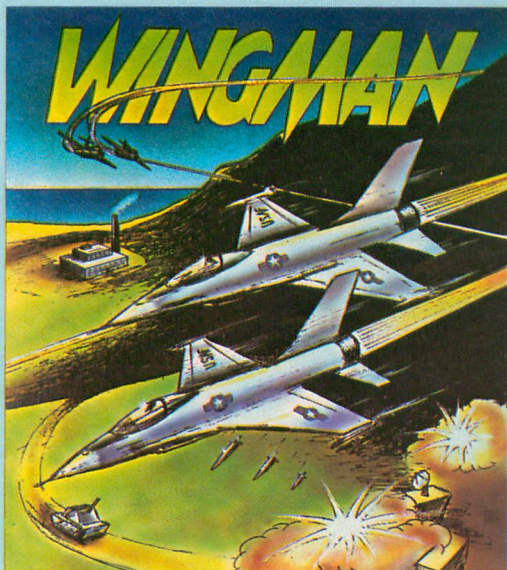
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FINE SCROLLING

PART ONE

16K Cassette or Disk

by Kyle Peacock

Many readers have been asking for an explanation of the fine scrolling capabilities of the ATARI home computers. Personally, I feel it's time to let the cat out of the bag. I intend to go a step beyond those demonstration "try this" programs and reveal how **Caverns of Mars**, **Defender**, and **Eastern Front** run amok with memory and turn a simplistic display into a window on another world. So put away the groceries, turn off the TV, sit back, and pay attention!

Due to the amount of material being covered under fine scrolling, this article will appear in four parts. Part one will cover display lists. Parts two, three and four will cover horizontal, vertical and combinational scrolling respectively.

The ATARI is a unique machine in that it has its own display microprocessor. That is to say, along with the 8-bit 6502 microprocessor lurking under all that plastic, is a processor known as ANTIC. This chip is responsible for the activation and upkeep of the screen, *whatever* the graphics mode.

Like all computer processors, ANTIC has its own set of instructions. For example, the following table lists several computer languages and their associated syntaxes:

Table 1.

| Language | Typical Statement |
|----------|--|
| BASIC | PRINT "THE MASTER PROGRAMMER" |
| 'C' | PRINTF("UNIX OPERATING SYSTEM"); |
| FORTH | ." WHO IS SALLY FORTH?!" |
| ANTIC | 02 -- DISPLAY ONE GR.0 LINE • OF TEXT |

As you see, the ANTIC language isn't very straightforward. Instead of having "PRINT," all we have is a (seemingly) meaningless number. Unfortunately, ANTIC can't understand any other language except digits ranging from 0 to 255. Not to worry, because the mysteries of ANTIC and display lists are about to be revealed!

A DISPLAY LIST (DL) is an ordered list of instructions that tells ANTIC exactly how the screen is to be displayed. BASIC doesn't allow for easy manipulation of the display list. However, through a series of PEEKs and POKEs, we can set up an almost infinite number of mixed graphics modes to create whatever display we choose. In order to do this, we'll have to know exactly how each display list instruction works. The following table gives a brief description of the basic DL instructions. Each instruction requires just one byte of memory.

Table 2.

| DL Instruction | Explanation |
|----------------|--|
| Decimal (Hex) | |
| 00 (\$00) | Display 1 Blank Scan Line |
| 16 (\$10) | Display 2 Blank Scan Lines |
| 32 (\$20) | Display 3 Blank Scan Lines |
| 48 (\$30) | Display 4 Blank Scan Lines |
| 64 (\$40) | Display 5 Blank Scan Lines |
| 80 (\$50) | Display 6 Blank Scan Lines |
| 96 (\$60) | Display 7 Blank Scan Lines |
| 112 (\$70) | Display 8 Blank Scan Lines |
| 02 (\$02) | Display graphics mode 0 line (S) |
| 03 (\$03) | Display modified graphics mode 0 line |
| 04 (\$04) | Display Multi-color character line (S) |
| 05 (\$05) | Display Multi-color character line (T) |
| 06 (\$06) | Display graphics mode 1 line |
| 07 (\$07) | Display graphics mode 2 line |
| 08 (\$08) | Display graphics mode 3 line |
| 09 (\$09) | Display graphics mode 4 line |
| 10 (\$0A) | Display graphics mode 5 line |
| 11 (\$0B) | Display graphics mode 6 line |
| 12 (\$0C) | Display graphics mode 6+ line |
| 13 (\$0D) | Display graphics mode 7 line |
| 14 (\$0E) | Display graphics mode 7+ line |
| 15 (\$0F) | Display graphics mode 8 line |

(S) — Standard height characters.

(T) — Twice standard height characters.

A "blank scan line" is simply a horizontal line going across the screen. Its height is the same as one graphics mode 8 line, and it requires no RAM for the display area. Consequently, it is not possible to place any characters or graphics on a blank scan line. (Hence the term "BLANK.") All other DL instructions require RAM to be used for the display area. The following table lists graphics modes and their associated bytes per line.

Table 3.

| Graphics Mode | Bytes Per Line |
|---------------|----------------|
| 0 | 40 |
| 1 | 20 |
| 2 | 20 |
| 3 | 10 |
| 4 | 10 |
| 5 | 20 |
| 6 | 20 |
| 7 | 40 |
| 8 | 40 |

Besides being told how to display the screen RAM, ANTIC must also be told exactly where the screen RAM is. BASIC usually tells ANTIC that the screen RAM is located somewhere near the top of available memory. The exact location will differ according to the amount of RAM in your machine.

Fortunately, we can tell ANTIC to display any part of RAM we choose. For example, a 16K machine has RAM ranging from 00 to 16,384 (hex: \$00 to \$4000). We can tell ANTIC to "fetch" its display memory something like:

Table 4.

ATARI 400/800 w/16K

| Memory Arrangement | |
|--------------------|-----------------------------------|
| decimal | (hex) ← |
| 000 | \$0000 |
| : | : |
| : | : |
| : | ← Display 4 GR.2 lines from here. |
| : | : |
| 4096 | \$1000 |
| : | : |
| : | : |
| : | ← Display 6 GR.2 lines from here. |
| : | : |
| 8192 | \$2000 |
| : | : |
| : | : |
| : | ← Display 2 GR.7 lines from here. |
| : | : |
| 12288 | \$3000 |
| : | : |
| : | : |
| : | ← Display 9 GR.8 lines from here. |
| : | : |
| 16384 | \$4000 |

In order to tell ANTIC where it will get its display memory, we need another set of DL instructions known as LMS (Load Memory Scan) instructions. These instructions occupy 3 bytes of memory each. The first byte, known as the OPCODE, is followed by two additional bytes, known as the OPERAND. The operand points to the address of the first byte of memory to be displayed. By adding 64 (HEX: \$40) to the display opcodes of Table 2 (Mind you, I said *display* opcodes, not *blank scan line* opcodes), and tacking on a 2-byte address in LO byte/HI byte order, we can inform ANTIC where we want it to "fetch" the display memory for that particular line. Admittedly, this sounds a bit confusing so let's look at an example:

Table 5.

ANTIC Instruction Explanation

| Decimal | (Hex) | |
|---------|-------|--|
| 02 | \$02 | Display GR.0 line |
| +64 | +\$40 | Add on for specifying where the display memory is. |
| 66 | \$42 | NEW OPCODE |
| 00 | \$00 | OPERAND (LO-BYTE) |
| 06 | \$06 | OPERAND (HI-BYTE) |

These three bytes will tell ANTIC to display a graphics mode 0 line using 40 bytes of memory (standard screen width), starting at location \$0600 hex, which is Page 6 of RAM.

To top off our discussion of display lists, I need to mention two more vital concepts. Once we have created a display list, we must tell ANTIC where it can find its new set of instructions. This is accomplished by storing in memory locations 560 and 561 (Hex: \$230 & \$231) the LO and HI bytes, respectively, of where our display list resides. After we set these two locations, ANTIC will "fetch" the first instruction, execute it, increment its internal pointers, and repeat the process. This occurs much the same way a BASIC program executes line 10, then line 20, 30, 40, etc.

A display list can be thought of as an infinite loop. After reaching the bottom of the list, ANTIC needs to reset its internal pointers to jump back to the top. This is accomplished with a special instruction called JVB (Jump on Vertical Blank) that is similar to the three-byte LMS instruction mentioned above. The instruction for jumping back to the beginning of the display list is as follows:

Table 6.

ANTIC Instruction Explanation

| Decimal | (Hex) | |
|---------|-------|--|
| 65 | \$41 | Jump back to the start of the DISPLAY LIST |
| xx | \$XX | OPERAND (LO-BYTE) |
| yy | \$YY | OPERAND (HI-BYTE) |

The 2-byte operand of this instruction consists of the LO and HI bytes, respectively, of the display list's address.

Now that you've gotten all the technical mumbo-jumbo down, let's go through a sample Display List step by (painstaking) step.

Explanation of the Program.

Lines 555 to 665 contain the data for our new display list. Let's give these lines a closer look:

Line 555 — Because some TVs have what is known as 'overscan,' it's always a good idea to start our display list with 24 blank scan lines.

Line 560 — Display one GR.1 line of text using RAM from 14848 ($58 \times 256 + 0$) to 14867 (20 bytes for GR.1).

Line 565 — Blank 8 scan lines.

Line 570 — Display one GR.1 line using RAM from 14868 (where ANTIC last left off) to 14887.

Line 575 — Blank 3 scan lines.

Line 580 — Display one GR.0 line using RAM from 14888 ($58 \times 256 + 40$) to 14927 (40 bytes for GR.0).

Line 585 — Blank 8 scan lines.

Line 590 — Display one GR.1 line using RAM from 14928 ($58 \times 256 + 80$) to 14947.

Line 595 — Blank 3 scan lines.

Line 600 — Display two GR.1 lines using RAM from 14948 (where ANTIC last left off) to 14987 (20 bytes for GR.1 times 2 lines).

Line 605 — Blank 8 scan lines.

Line 610 — Display one GR.1 line using RAM from 14988 ($256 \times 58 + 140$) to 15007 (20 bytes for GR.1).

Line 665 — Tell ANTIC to reset itself to location 1536 ($6 \times 256 + 0$) and begin again.

Next issue, we'll take an even more in-depth look at display lists. By rearranging the way RAM is displayed, we can utilize the ATARI's fine scrolling capabilities. Then all we do is ...well, that's next time. See you in sixty days. □

```

100 REM *****
105 REM * DISPLAY LIST DEMO PROGRAM *
110 REM * BY KYLE PEACOCK *
115 REM *
120 REM * A.N.A.L.O.G. COMPUTING *
125 REM * ISSUE #13 *
130 REM *****
135 REM
140 REM -- PRESS 'START' TO EXIT.
145 REM -- DO NOT PRESS 'BREAK'!!
150 REM
155 PRINT "K"
160 DIM STRING$(50)
165 REM
170 REM -- CLEAR OUT MESSAGE SPACE
175 REM
180 FOR X=14848 TO 15148:POKE X,0:NEXT
X
185 REM
190 REM -- READ WHERE IN MEMORY
195 REM -- MESSAGE GOES, ADD ON
200 REM -- FOR CHARACTER COLOR,

```

```

205 REM -- & MESSAGE STRING.
210 REM -- THEN INSTALL IN MEMORY.
215 REM
220 FOR X=1 TO 14
225 READ WHERE,PLUS,STRING$
230 POSITION 1,5
235 PRINT "LOCATION: ";WHERE
240 POSITION 1,10:PRINT "Q"
245 POSITION 1,10
250 FOR Y=2 TO LEN(STRING$)-1
255 POKE WHERE+2+Y,ASC(STRING$(Y,Y))-3
2+PLUS
260 PRINT STRING$(Y,Y);
265 NEXT Y:FOR Z=0 TO 250:NEXT Z
270 NEXT X
275 REM
280 REM -- NOW READ DISPLAY LIST
285 REM -- DATA & INSTALL INTO PAGE 6
290 REM
295 TRAP 335
300 READ DLIST:POKE 1536+ADD,DLIST
305 ADD=ADD+1
310 GOTO 300
315 REM
320 REM -- TELL ANTIC WHERE OUR NEW
325 REM -- DISPLAY LIST IS
330 REM
335 POKE 560,0
340 POKE 561,6
345 REM
350 REM -- WAIT FOR CONSOLE KEY
355 REM
360 IF PEEK(53279)=7 THEN 360
365 REM
370 REM -- BACK TO NORMAL DISPLAY
375 REM
380 GRAPHICS 0:END
385 REM
390 REM -- MESSAGE STRINGS
395 REM
400 DATA 14848,64
405 DATA " DISPLAY LIST DEMO "
410 DATA 14868,128
415 DATA " (1) GR.0 LINE"
420 DATA 14888,0
425 DATA " I AM A GR.0 LINE OF
TEXT!"
430 DATA 14928,128
435 DATA " (2) GR.1 LINES"
440 DATA 14948,192
445 DATA " I AM A GR.1 LINE"
450 DATA 14968,192
455 DATA " AND SO AM I!"
460 DATA 14988,128
465 DATA " (3) GR.2 LINES"
470 DATA 15008,192
475 DATA " I'M BIGGER THAN"
480 DATA 15028,192
485 DATA " ALL THE REST"
490 DATA 15048,192
495 DATA " !!!!!!!!!!"
500 DATA 15068,128
505 DATA " (3) GR.7 LINES"
510 DATA 15088,128
515 DATA " (4) GR.8 LINES"
520 DATA 15108,192
525 DATA "KDUEKF8KENE9GLHMTYFBD9BAGALE
MTUFBKDI3LF0HDNDEOTD76"
530 DATA 15148,64
535 DATA "838MD7ND93LFUR9MFGD63KG8NDMA
GAK39TLFA51PDYA45YTR83"
540 REM
545 REM -- DISPLAY LIST DATA
550 REM
555 DATA 112,112,112
560 DATA 70,0,58
565 DATA 112
570 DATA 6
575 DATA 32
580 DATA 66,40,58
585 DATA 112
590 DATA 70,80,58
595 DATA 32
600 DATA 6,6
605 DATA 112
610 DATA 70,140,58
615 DATA 32

```


620 DATA 7,7,7
 625 DATA 112
 630 DATA 70,220,58
 635 DATA 32
 640 DATA 77,4,59,77,44,59,77,4,59
 645 DATA 112
 650 DATA 70,240,58
 655 DATA 32
 660 DATA 79,44,59,79,4,59,79,44,59,79,
 4,59
 665 DATA 65,0,6

CHECKSUM DATA (See p. 20)

100 DATA 778,233,353,246,734,766,787,8
 8,851,33,89,984,708,97,673,7420
 175 DATA 100,329,103,351,187,324,928,8
 24,84,146,978,440,18,971,274,6057
 250 DATA 744,874,121,396,781,102,290,9
 39,103,742,792,956,694,86,605,8225
 325 DATA 509,87,783,800,95,300,98,554,
 101,416,104,784,107,544,110,5392
 400 DATA 69,238,271,365,225,204,270,41
 2,292,333,299,274,291,423,287,4253
 475 DATA 592,294,480,301,361,265,412,2
 72,417,275,641,76,517,94,979,5976
 550 DATA 97,309,200,654,620,459,85,660
 ,80,465,632,638,244,443,739,6325
 625 DATA 644,246,449,741,650,258,455,7
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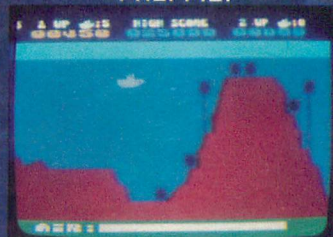
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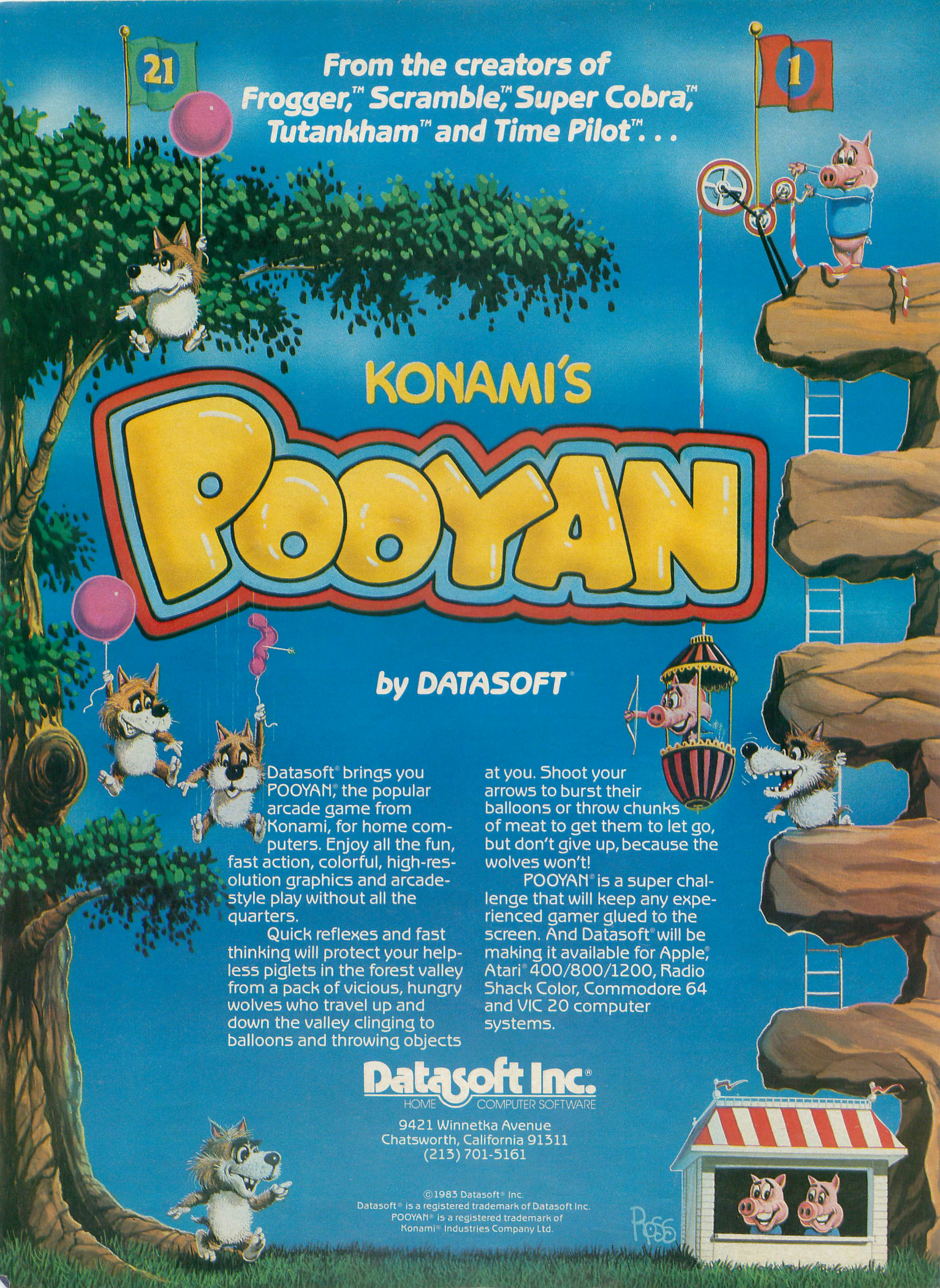
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Poss





SPACE ASSAULT

24K Cassette 32K Disk

by Mike Walters

It is the year 2114. The population of the Earth has become so great that mankind is now occupying five planets of our solar system.

With the population explosion also came the Great Famine. In order to find much-needed food, NASA sent probes out across the entire Milky Way galaxy.

Soon, the answer to Earth's problem was found. A small planet on the outer reaches of the Orion Arm of the galaxy, the planet Kala, was discovered, lush with vegetation. NASA then set up Vegetation Processing Plants (VPPs) to prepare the food and send it back to Earth.

But aliens from Clovis IV, a nearby planet, had fallen under the same fate, and, in the year 2131, war broke out for the vegetation of Kala. The Earth fought off the alien invasion, and the Earth's source of food was secured.

Now the Clovis aliens have returned, and you, as Chief Gunnery Post Officer, must protect the VPPs from them with your Fission Gun Tower.

To play, you must position your sight over the alien craft and press the red button to fire. To destroy a ship, both the sight and the Fission Beam must touch the ship.

This program was written using Tom Hudson's player movement subroutine from **A.N.A.L.O.G. Computing** No. 10. I found it very useful and easy to use.

So, man your Fission Gun! The fate of the Earth is in your hands. □

Space Assault! variables.

XSHIP,YSHIP — X and Y position of enemy
DIR — Direction enemy is travelling

SHIP — Number or type of enemy craft.

A — USR variable

PMB — Player missile memory base for USR command

PMO,PM1,PM2,PM3 — Addresses of player shape data

MOVE — Address of player movement subroutine

TARGET — X position of VPP to hit

BUILDING(N) — Array of X positions for TARGET

X,Y — X and Y position of sight

EXP — Explosion subroutine flag

SD — Value for sound of explosion

SC — Score

HSC — High score

XPOS(N), YPOS(N) — Arrays of joystick movement values

PMMOV\$ — Player movement subroutine

PO\$, P1\$,P2\$,P3\$ — Player shape data in string form

HITS — Number of VPPs destroyed

PMBASE — Player/missile memory base

ST — Joystick variable

SCR — Screen address for VPP explosion

B — Original value of SCR before changing

DL — Address of screen for modified display list

X\$,A\$,C\$ — Used for moving end message

AD — Value to add to drawing coordinates in title screen

DX,DY — X and Y values for DRAWTO statements

TPS — Top of screen memory for modified display list

DUR — Duration of musical note

TONE — Sound value for musical note

NUM — Number of points to draw of title screen

I,N — Loop variables


```

1000 REM *****
1010 REM *   SPACE ASSAULT   *
1020 REM *   Version 2.9     *
1030 REM *   Mike Walters 1983 *
1040 REM *****
1050 REM
1060 GOSUB 2330:REM * Title Screen *
1070 GOSUB 2070:REM * Draw Playfield *
1080 GOTO 1500
1090 REM * Move Enemy Ships *
1100 ON INT(RND(0)*3)+1 GOTO 1110,1120
,1130
1110 YSHIP=YSHIP+3:GOTO 1130
1120 YSHIP=YSHIP-3
1130 IF YSHIP<15 THEN YSHIP=15
1140 IF YSHIP>50 THEN YSHIP=50
1150 IF DIR=1 THEN XSHIP=XSHIP+3
1160 IF DIR=2 THEN XSHIP=XSHIP-3
1170 IF SHIP=1 THEN A=USR(MOVE,1,PMB,P
M1,XSHIP,YSHIP,7)
1180 IF SHIP=2 THEN A=USR(MOVE,2,PMB,P
M2,XSHIP,YSHIP,9)
1190 IF SHIP=3 THEN A=USR(MOVE,3,PMB,P
M3,XSHIP,YSHIP,8)
1200 IF XSHIP<20 OR XSHIP>210 THEN GOS
UB 1280
1210 IF XSHIP>TARGET+38 AND XSHIP<TARG
ET+44 THEN GOSUB 1820
1220 RETURN
1230 REM * Get Random Target *
1240 NUM=INT(RND(0)*7)+1:TARGET=BUILDI
NG(NUM)
1250 IF TARGET=999 THEN 1240
1260 RETURN
1270 REM * Random Ship, Direction *
1280 SHIP=INT(RND(0)*3)+1
1290 DIR=INT(RND(0)*2)+1
1300 YSHIP=INT(RND(0)*35)+15
1310 IF DIR=1 THEN XSHIP=20
1320 IF DIR=2 THEN XSHIP=210
1330 IF SHIP=1 THEN SOUND 2,0,16,3
1340 IF SHIP=2 THEN SOUND 2,255,12,3
1350 IF SHIP=3 THEN SOUND 2,92,12,3
1360 GOSUB 1240:RETURN
1370 REM * Shoot Tower Gun *
1380 POKE 53278,0
1390 COLOR 2:PLOT 150,63:DRAWTO X-44,Y
-12:FOR N=1 TO 10:SOUND 0,N,12,8:NEXT
N:SOUND 0,0,0,0
1400 COLOR 0:PLOT 150,63:DRAWTO X-44,Y
-12
1410 IF SHIP=1 THEN IF PEEK(53253)<>0
AND PEEK(53261)<>0 THEN EXP=1:SD=40:SC
=5C+500:POKE 53249,0:GOSUB 1280
1420 IF SHIP=2 THEN IF PEEK(53254)<>0
AND PEEK(53262)<>0 THEN EXP=1:SD=40:SC
=5C+100:POKE 53250,0:GOSUB 1280
1430 IF SHIP=3 THEN IF PEEK(53255)<>0
AND PEEK(53263)<>0 THEN EXP=1:SD=40:SC
=5C+300:POKE 53251,0:GOSUB 1280
1440 RETURN
1450 REM * Explosion Routine *
1460 SD=SD+5:IF SD>100 THEN SOUND 1,0,
0,0:EXP=0:RETURN
1470 SETCOLOR 4,0,14:SETCOLOR 4,0,0
1480 SOUND 1,SD,8,8:RETURN
1490 REM Initialize & P/M Setup *
1500 TRAP 1510:DIM BUILDING(7),XPOS(15
),YPOS(15),PMMOV(100),POS(7),P1$(7),P
2$(7),P3$(8)
1510 X=125:Y=70:SC=0:HITS=0:MOVE=ADR(P
MMOV):PM0=ADR(POS):PM1=ADR(P1$):PM2=ADR
(P2$):PM3=ADR(P3$)
1520 RESTORE 1530:FOR N=1 TO 7:READ A:
BUILDING(N)=A:NEXT N
1530 DATA 15,35,55,75,95,115,135
1540 RESTORE 1550:FOR N=1 TO 15:READ A
:XPOS(N)=A:READ A:YPOS(N)=A:NEXT N
1550 DATA 0,0,0,0,0,0,0,3,3,3,-3,3,0
,0,0,-3,3,-3,-3,0,0,0,0,3,0,-3,0,0
1560 RESTORE 1570:FOR N=1 TO 100:READ
A:PMMOV(N)=CHR$(A):NEXT N
1570 DATA 216,104,104,104,133,213,104,
24,105,2,133,206,104,133,205,104,133,2
04,104,133,203,104,104,133,208
1580 DATA 104,104,133,209,104,104,24,1
01,209,133,207,166,213,240,16,165,205,

```

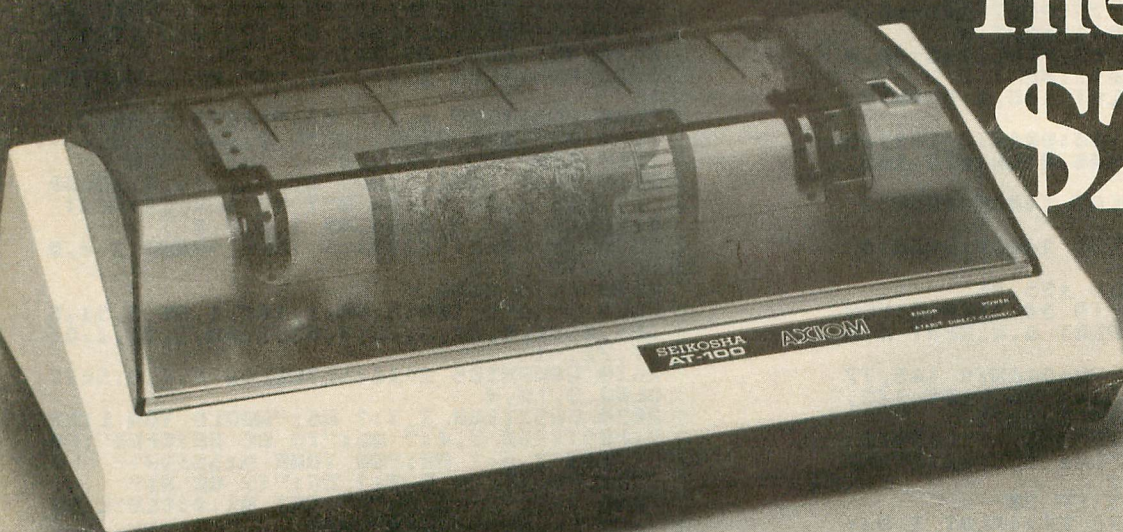
```

24,105,128,133,205,165,206,105
1590 DATA 0,133,206,202,208,240,160,0,
162,0,196,209,144,19,196,207,176,15,13
2,212,138,168,177,203,164
1600 DATA 212,145,205,232,169,0,240,4,
169,0,145,205,200,192,128,208,224,166,
213,165,208,157,0,208,96
1610 RESTORE 1650:FOR N=1 TO 7:READ A:
POS(N)=CHR$(A):NEXT N
1620 FOR N=1 TO 7:READ A:P1$(N)=CHR$(A
):NEXT N
1630 FOR N=1 TO 9:READ A:P2$(N)=CHR$(A
):NEXT N
1640 FOR N=1 TO 8:READ A:P3$(N)=CHR$(A
):NEXT N
1650 DATA 102,66,129,195,129,66,102,60
,126,255,213,255,126,60,129,66,36
1660 DATA 60,36,60,36,66,129,255,102,6
0,24,24,60,102,255
1670 PMBASE=INT((PEEK(145)+3)/4)*4:POK
E 54279,PMBASE:PMB=PMBASE*256
1680 POKE 704,10:POKE 705,149:POKE 706
,40:POKE 707,102
1690 POKE 623,1:POKE 53257,1:POKE 5325
8,1:POKE 53259,1:POKE 559,46:POKE 5327
7,3:GOSUB 1280
1700 REM * Main Loop *
1710 ST=STICK(0)
1720 X=X+XPOS(5T):Y=Y+YPOS(5T)
1730 IF X<48 THEN X=48
1740 IF X>198 THEN X=198
1750 IF Y<12 THEN Y=12
1760 IF Y>50 THEN Y=50
1770 A=USR(MOVE,0,PMB,PMB0,X,Y,7)
1780 IF STRIG(0)=0 THEN GOSUB 1380
1790 GOSUB 1100:IF EXP=1 THEN GOSUB 14
60
1800 GOTO 1710
1810 REM * Destroy Upp *
1820 COLOR 2:PLOT TARGET,YSHIP-10:DRAW
TO TARGET,85
1830 FOR N=1 TO 5:FOR A=9 TO 50 STEP 3
:SOUND 0,A,10,8:NEXT A:NEXT N
1840 COLOR 0:PLOT TARGET,YSHIP-10:DRAW
TO TARGET,85
1850 SCR=PEEK(560)+PEEK(561)*256:B=PEE
K(5CR+4)
1860 FOR N=1 TO 50:POKE 5CR+4,B+PEEK(5
3770)/200:SOUND 0,N,0,8:NEXT N
1870 FOR N=TARGET-5 TO TARGET+5:COLOR
0:PLOT N,80:DRAWTO N,91-RND(0)*5:SOUND
0,N,0,8:NEXT N
1880 FOR N=1 TO 50:SETCOLOR 4,0,14:SOU
ND 0,N,0,8:SETCOLOR 4,0,0:NEXT N
1890 SOUND 0,0,0,0:POKE 5CR+4,B
1900 HITS=HITS+1
1910 IF HITS=7 THEN SOUND 2,0,0,0:FOR
N=1 TO 200:NEXT N:FOR N=53248 TO 53251
:POKE N,0:NEXT N:GOTO 1950
1920 BUILDING(NUM)=999:GOSUB 1240
1930 RETURN
1940 REM * Game Over Routine *
1950 GRAPHICS 1+16:DL=PEEK(560)+PEEK(5
61)*256+4:POKE DL+1,71:POKE DL+2,7
1960 POKE DL+3,7:POKE DL+4,7:POKE DL+1
1,7:POKE DL+12,7:POKE DL+13,7:POKE DL+
14,7
1970 POKE DL+15,65:POKE DL+16,PEEK(560
):POKE DL+17,PEEK(561)
1980 SETCOLOR 0,4,4:SETCOLOR 1,0,10:SE
TCOLOR 2,6,6:SETCOLOR 3,2,6:TRAP 2030:
IF 5C>H5C THEN H5C=5C
1990 POKE 87,2:POSITION 5,1:? #6;"GAME
OVER":POKE 87,1:POSITION 3,7:? #6;"SC
ORE - ";5C
2000 POSITION 1,9:? #6;"HIGH SCORE - "
;H5C:POSITION 7,11:? #6;"Press":POSITI
ON 5,13:? #6;"START"
2010 DIM X$(60):X$="...all vpps destro
yed...Mission terminated...alien takeo
ver"
2020 DIM A$(LEN(X$)),C$(LEN(X$)):A$=X$
2030 POSITION 0,4:? #6;A$(1,20):C$=A$(
2):C$(LEN(C$)+1)=A$:A$=C$
2040 FOR I=1 TO 30:NEXT I:SOUND RND(0)
*3,RND(0)*255,10,RND(0)*8:IF PEEK(5327
9)<>6 THEN 2030

```


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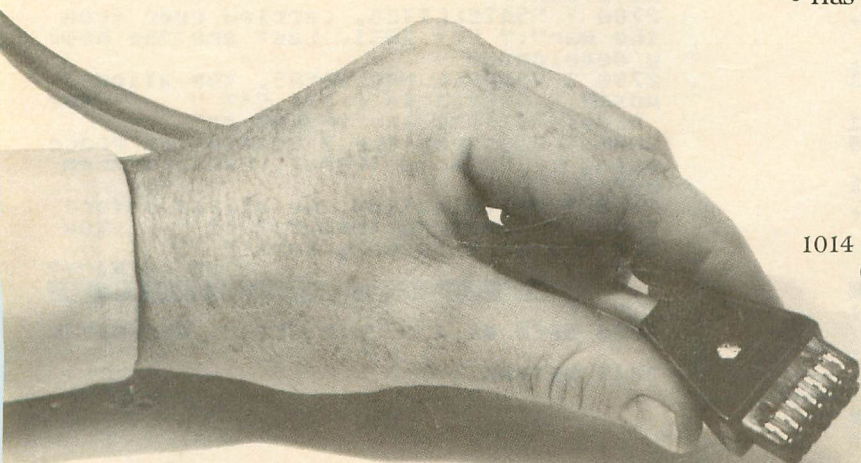


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- Allows minimum system of Atari 400, cassette and AT-100 printer
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- HI-RES screen dump software included
- Two-year user warranty
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```

2050 FOR N=0 TO 3: SOUND N,0,0,0:NEXT N
:GOTO 1060
2060 REM * Draw Playfield Routine *
2070 GRAPHICS 7+16:SETCOLOR 0,0,8:SETC
OLOR 1,4,4:SETCOLOR 2,12,4
2080 COLOR 2:FOR N=1 TO 50:PLOT RND(0)
*159,RND(0)*55+40:NEXT N
2090 COLOR 1:PLOT 150,64:FOR N=66 TO 6
8:PLOT 147,N:DRAWTO 153,N:NEXT N
2100 AD=0:FOR N=72 TO 75:PLOT 145+AD,N
:DRAWTO 155-AD,N:AD=AD+1:NEXT N
2110 AD=0:FOR N=80 TO 83:PLOT 148-AD,N
:DRAWTO 152+AD,N:AD=AD+1:NEXT N
2120 FOR N=88 TO 94:PLOT 145,N:DRAWTO
155,N:NEXT N
2130 COLOR 2:PLOT 149,65:DRAWTO 151,65
:FOR N=69 TO 71:PLOT 145,N:DRAWTO 155,
N:NEXT N
2140 FOR N=76 TO 79:PLOT 148,N:DRAWTO
152,N:NEXT N
2150 FOR N=84 TO 87:PLOT 145,N:DRAWTO
155,N:NEXT N
2160 PLOT 145,95:DRAWTO 155,95
2170 COLOR 0:FOR N=89 TO 94 STEP 2:FOR
A=146 TO 154 STEP 2:PLOT A,N:NEXT A:N
EXT N
2180 COLOR 1:PLOT 147,77:DRAWTO 145,77
:DRAWTO 145,75:DRAWTO 144,75:PLOT 145,
77:DRAWTO 145,79:DRAWTO 144,79
2190 PLOT 153,77:DRAWTO 155,77:DRAWTO
155,75:DRAWTO 156,75:PLOT 155,77:DRAWTO
155,79:DRAWTO 156,79
2200 FOR N=10 TO 140 STEP 20
2210 COLOR 1:FOR I=N TO N+2:PLOT I,84:
DRAWTO I,95:NEXT I
2220 FOR I=N+4 TO N+9:PLOT I,88:DRAWTO
I,95:NEXT I
2230 COLOR 0:FOR I=85 TO 94 STEP 2:PLO
T N+1,I:NEXT I
2240 COLOR 2:FOR I=80 TO 83:PLOT N,I:D
RAWTO N+2,I:NEXT I
2250 PLOT N+4,86:DRAWTO N+9,86:PLOT N+
4,87:DRAWTO N+9,87
2260 PLOT N+5,89:DRAWTO N+8,89
2270 COLOR 0:FOR I=N+5 TO N+8 STEP 2:P
LOT I,91:NEXT I
2280 COLOR 1:PLOT N+5,85:DRAWTO N+7,85
:PLOT N+6,84
2290 NEXT N
2300 COLOR 3:FOR N=0 TO 159:PLOT N,95:
DRAWTO N,95-(2*RND(0)):NEXT N
2310 RETURN
2320 REM * Title Screen *
2330 GRAPHICS 7+16:SETCOLOR 0,4,4:SETC
OLOR 1,9,4:SETCOLOR 2,15,6
2340 DL=PEEK(560)+PEEK(561)*256+4
2350 POKE DL+89,6:POKE DL+90,6:POKE DL
+91,65:POKE DL+92,PEEK(560):POKE DL+93
,PEEK(561)
2360 COLOR 3:FOR N=1 TO 25:PLOT RND(0)
*159,RND(0)*80:NEXT N
2370 RESTORE 2390:COLOR 1:FOR N=1 TO 8
:READ DX,DY:PLOT DX,DY:READ NUM:FOR A=
1 TO NUM:READ DX,DY:DRAWTO DX,DY
2380 NEXT A:NEXT N:PLOT 70,60:PLOT 71,
60
2390 DATA 7,20,5,7,8,14,8,14,20,14,12,
7,12,21,15,5,16,15,16,20,22,20,22,25,1
6,25
2400 DATA 30,20,5,25,20,25,25,31,25,31
,30,25,30,34,36,5,34,25,40,25,40,36,40
,30,34,30
2410 DATA 43,33,3,43,42,49,42,49,33,52
,37,2,52,49,58,49,60,44,3,65,44,63,44,
63,55
2420 DATA 70,46,3,70,57,71,57,71,46
2430 COLOR 2:AD=0:FOR N=10 TO 20:PLOT
95-AD,N:DRAWTO 125+AD,N:AD=AD+1:NEXT N
2440 AD=0:FOR N=20 TO 30:PLOT 80-AD,N:
DRAWTO 140+AD,N:AD=AD+1:NEXT N
2450 AD=0:FOR N=30 TO 35:PLOT 75+AD,N:
DRAWTO 145-AD,N:AD=AD+3:NEXT N
2460 COLOR 3:AD=0:FOR N=12 TO 17:PLOT
98-AD,N:DRAWTO 122+AD,N:AD=AD+1:NEXT N
2470 COLOR 0:PLOT 85,19:DRAWTO 135,19:
PLOT 75,31:DRAWTO 145,31:PLOT 98,12
2480 DRAWTO 122,12:DRAWTO 127,17:DRAMT

```

```

0 93,17:DRAWTO 98,12
2490 PLOT 112,12:DRAWTO 116,17:PLOT 10
7,12:DRAWTO 105,17
2500 COLOR 3:AD=0:FOR N=36 TO 78:PLOT
95+AD,N:DRAWTO 125-AD,N:AD=AD+0.35:NEX
T N
2510 COLOR 1:AD=0:FOR N=36 TO 55:PLOT
103+AD,N:DRAWTO 117-AD,N:AD=AD+0.35:NE
XT N
2520 TP5=PEEK(88)+PEEK(89)*256:POKE 87
,1:TP5=TP5+3521:POKE 88,TP5-(INT(TP5/2
56)*256):POKE 89,INT(TP5/256)
2530 POSITION 2,0:? #6;"BY MIKE WALTER
5"
2540 POSITION 4,1:? #6;"PRESS START"
2550 RESTORE 2600:SOUND 2,144,10,8
2560 READ DUR:IF DUR=-1 THEN 2550
2570 READ TONE:SOUND 0,TONE,10,8:SOUND
1,TONE-1,10,8:FOR N=1 TO DUR*12:NEXT
N:SOUND 0,0,0,0:SOUND 1,0,0,0
2580 IF PEEK(53279)=6 THEN SOUND 2,0,0
,0:GOTO 2610
2590 GOTO 2560
2600 DATA 5,108,5,96,1,108,1,96,5,91,5
,81,1,91,1,81,3,72,3,53,3,60,1,91,1,81
,7,72,-1
2610 GRAPHICS 2+16:SETCOLOR 4,4,0:SETC
OLOR 0,15,4
2620 POSITION 3,3:? #6;"WOULD YOU LIKE
":POSITION 3,4:? #6;"TO BE BRIEFED":PO
SITION 2,5:? #6;"ON YOUR MISSION?"
2630 POSITION 6,7:? #6;"(Y OR N)"
2640 OPEN #1,4,0,"K":GET #1,A:CLOSE #1
2650 IF A=89 THEN 2680
2660 IF A=78 THEN RETURN
2670 GOTO 2640
2680 GRAPHICS 0:SETCOLOR 2,9,0:POKE 75
2,1
2690 POSITION 8,3:? #6;"- OFFICIAL BRIEF
ING -":? :?
2700 ? " You are the Chief Gunner
y Post":? "Officer on the jungle plane
t of KALA,"
2710 ? "the planet Earth's only source
of":? "vegetation after the Great Faw
ine."
2720 ? " The Earth needs this sou
rce of":? "vegetation, but unfortunate
ly so do"
2730 ? "the aliens from CLOVIS IV, who
have":? "fallen into the same situati
on that"
2740 ? "the Earth has.":? " Becau
se of this, the aliens are":? "now fie
rcely attacking the planet."
2750 ? :? :? "Press Any Key To Contin
ue Briefing":OPEN #1,4,0,"K":GET #1,
A:CLOSE #1
2760 ? "K":? :? :? " The Clovis A
liens have 3 types":? "of attacking cr
aft. The first are the"
2770 ? "COMBAT SAUCERS, piloted by the
Royal":? "Strike Force. Next, the DEV
ASTATION"
2780 ? "SATELLITES, carried over from
the War":? "of 2031. Last are the newl
y developed"
2790 ? "PURPLE MARAUDERS, the aliens'
most":? "advanced craft.":? " The
Clovis Aliens are trying to"
2800 ? "destroy the 7 Vegetation Proce
ssing":? "Plants (VPPs). Protect them
by"
2810 ? "eliminating the aliens before
they":? "destroy them.":? :? " You
are the Earth's only hope!"
2820 ? :? :? "GOOD LUCK!":? :?
: "Press Any Key To Begin Your Missi
on"
2830 OPEN #1,4,0,"K":GET #1,A:CLOSE #
1
2840 RETURN

```

(continued on next page)

CHECKSUM DATA

(See p. 20)

1000 DATA 94,641,814,344,98,280,145,53
 2,789,362,99,959,574,934,942,7527
 1150 DATA 187,194,348,359,367,645,693,
 787,745,13,779,791,594,303,18,6823
 1300 DATA 751,513,768,338,366,189,984,
 528,13,425,134,632,618,629,795,7683
 1450 DATA 92,82,417,645,223,555,87,733
 478,270,453,289,875,962,231,6392
 1600 DATA 403,232,60,68,67,343,830,486
 338,731,404,340,334,15,977,5628
 1750 DATA 990,5,122,535,321,729,593,79
 0,514,790,889,341,992,143,77,7831
 1900 DATA 496,625,349,809,785,718,643,
 471,547,502,414,346,407,63,152,7327
 2050 DATA 116,604,292,462,164,612,610,
 239,664,241,239,767,350,398,955,6713
 2200 DATA 597,284,520,864,136,30,887,6
 54,217,516,672,791,43,324,896,7431
 2350 DATA 177,195,537,288,142,842,443,
 824,768,581,614,794,213,422,766,7606
 2500 DATA 118,36,140,338,867,424,180,1
 57,970,742,632,418,863,162,318,6365
 2650 DATA 899,495,740,198,372,190,327,
 719,505,642,8,269,426,279,416,6485
 2800 DATA 460,25,972,550,809,2816

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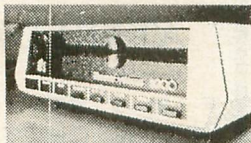
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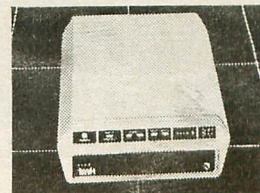
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by Kyle Peacock

While rummaging through the office mail one morning, editor Lee Pappas happened upon **Starbowl Football** by Gamestar. "Ugh!" he smirked, "Another sports game. Okay, who's going to review this one for Issue 13?" All was quiet; not even the sound of ATARI keyboards happily "clicking" away broke the silence. I realized that Lee and I were suddenly the only ones in the office. "What the heck," I said, "I like football anyway."

As in real football, the object of **Starbowl** is to outscore your opponents with touchdowns, field goals and safeties. The game allows for two-player action, with each player controlling or "programming" opposing teams. You can also play against the computer if you're home alone and still want a little gridiron action, although I advise against this option for anyone except an expert. I've been playing solo for two weeks now, and I haven't scored yet.

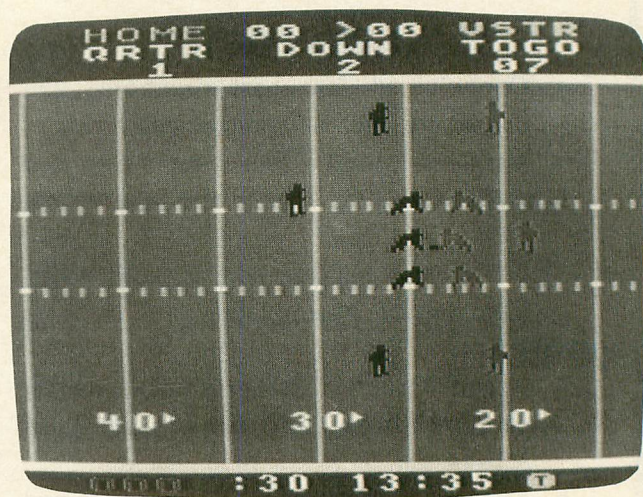
At the start of the game, the opposing teams line up on the fifty yard line and stand at attention to the last few notes of the national anthem. Then they line up for the opening kickoff. Each team consists of six players. On the offense: a top and bottom receiver, four offensive linemen and the quarterback. On defense: a top and bottom cornerback, four defensive linemen and the free safety.

Unlike many games on the market today, **Starbowl Football** combines both exceptional graphics with good playability. The game manages to display all the necessary information on the screen during the huddle (team scores, ball possession, quarter, down and yards to go) without unsightly cluttering during the execution of a play. Through the use of the joystick, it is possible to program one of the offensive receivers (top or bottom) for one of four possible pass patterns. Programming the offensive line for one of four possible blocking assignments is accomplished in a similar manner. The defensive cornerbacks and defensive line can also be put into motion following one of four rushing assignments. According to the user's manual, this allows for up to 196 play possibilities.

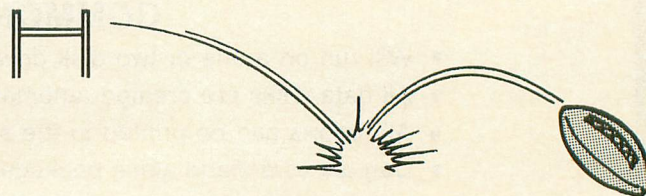
The defensive safety and the quarterback are independently controlled by each player. Little or no yardage will be gained if the defense strategy follows the offense. Such is usually the case when I play

against the computer. It has a nasty habit of consistently selecting its defense to counter my offense. Typical scores read: ATARI: 63, KYLE: 00.

One of the nicer features of **Starbowl Football** is the way the players move up and down the field. The running motions of the receivers and cornerbacks and the apparent "clashing" of the offensive and defensive lines truly add to the game realism. Tackling the ball carrier results in what appears to be the victim of a mugging; upon scoring a touchdown, the player jumps about in triumphant glory. The playfield is wider than the television screen, so the program smooth scrolls the field back and forth to follow the action. The effect resembles that of a panning television camera hanging over the stadium (perhaps from a blimp).



Starbowl Football



One shortcoming I feel I should mention about **Starbowl Football** is the way a receiver catches a pass. In order to catch the oncoming ball, the offensive coach (that's you) must press the joystick button precisely when the ball collides with your receiver. If your timing is off, or your receiver is closely covered by one of the cornerbacks, FORGET IT! To add to the frustration, the computer catches passes about 80% of the time and intercepts the ball about 15%. Perhaps Dan Urgin and Scott Orr made the ATARI play a little too well (or am I that bad?).

The most important requirements for becoming a **Starbowl All-Star** are patience and practice. Unlike most "shoot 'em up" games, **Starbowl Football** can enhance your mental strategies as well as your reflexes. So, next time the N.F.L. goes on strike, you can still enjoy football on T.V.! □

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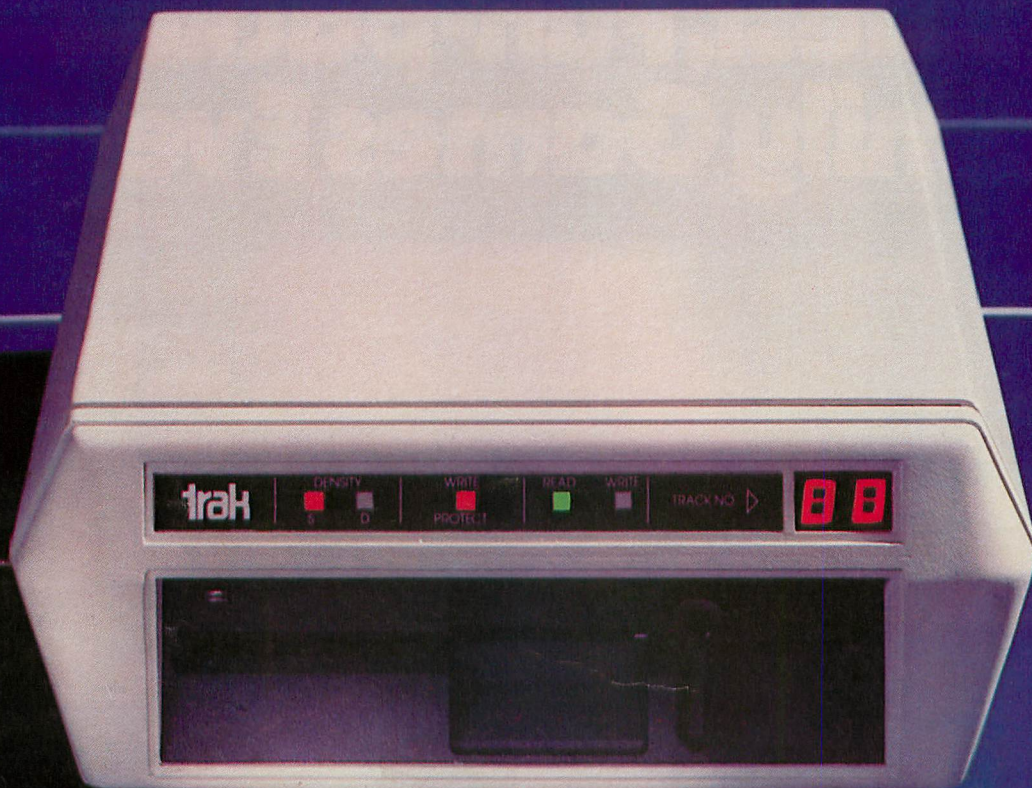
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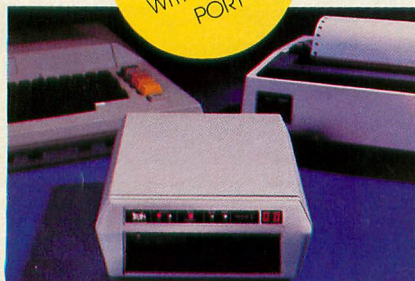
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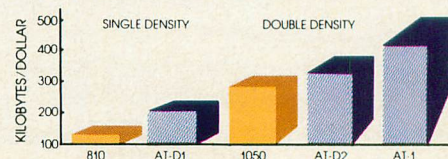
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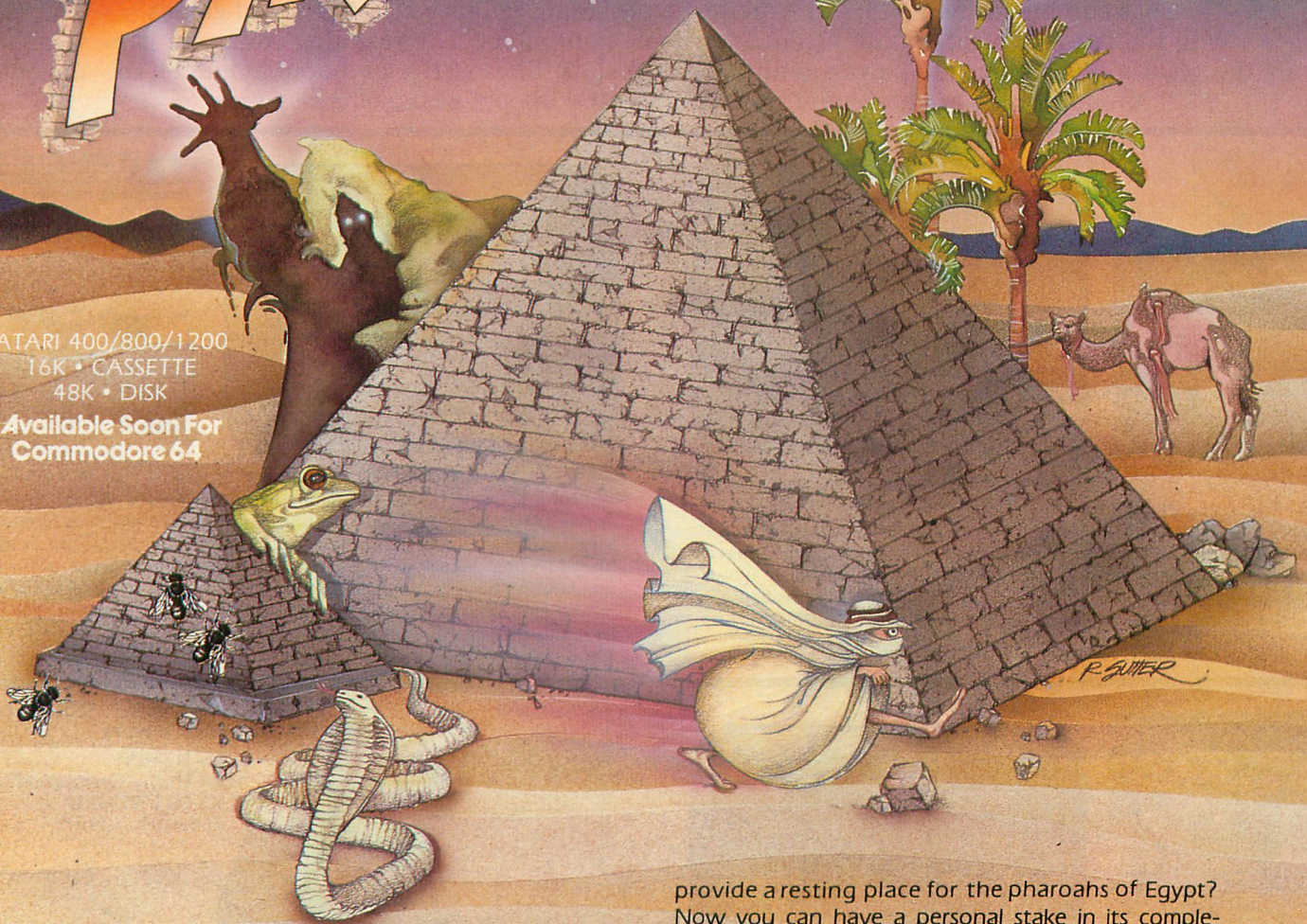
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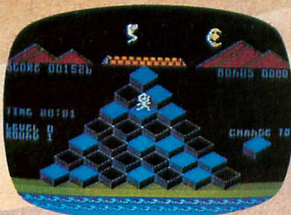
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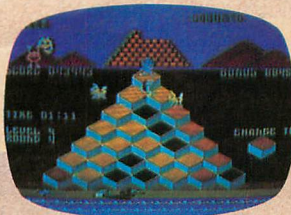
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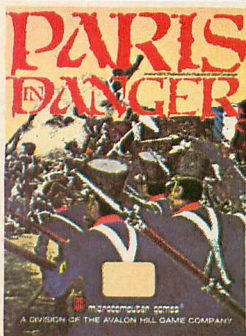
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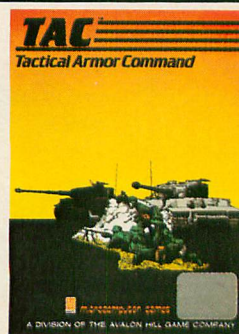
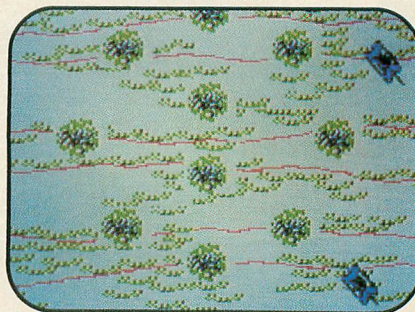
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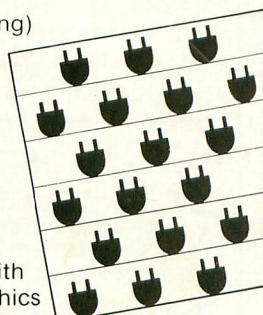
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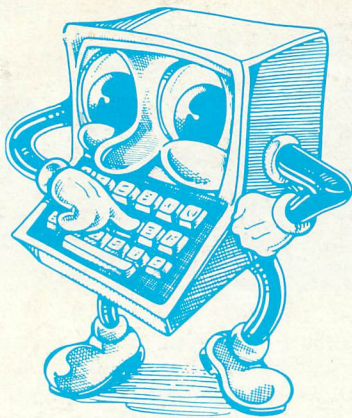
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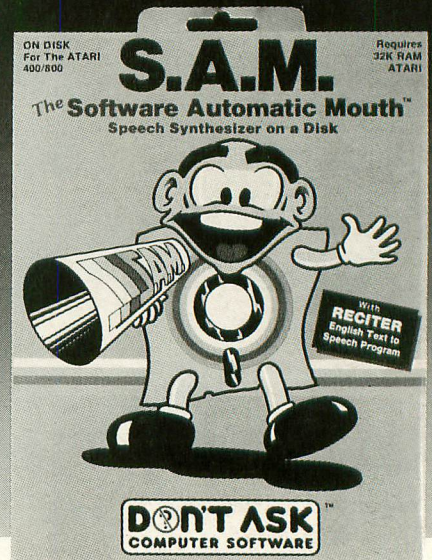
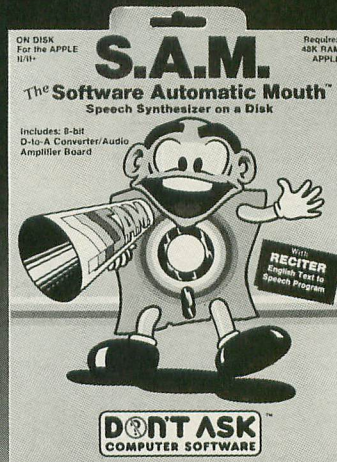
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S.A.M. programmed by Mark Barton.

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