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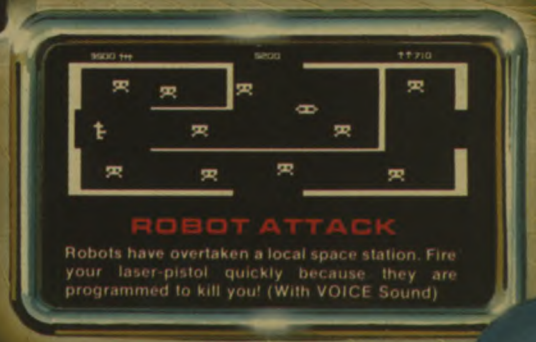

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s issue...in this issue...in this i

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articles

the cover

William Oyler plays a hard game of Startovox at Leisureland Amusement of Morristown, NJ. See page 18 to learn how you can improve your score on five popular arcade games.

applications & software

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CIRCLE 127 ON READER SERVICE CARD

ow...dateline:tomorrow...da

David H. Ahl

BALLY ARCADE GAMES LICENSED TO COMMODORE FOR VIC 20

Bally has licensed Commodore to manufacture its arcade coin-op games in cartridges for the VIC-20 Computer. Retail prices will range from $24.95 to $39.95.

This is the second license agreement Bally has entered into recently, the other being with Atari for PacMan for use on Atari computers.

SEARS TO HANDLE NEC, IBM, VECTOR GRAPHIC

Sears acknowledged recently that it's retail computer stores will handle three lines of computers: the NEC PC-8000, IBM personal computer and Vector Graphics Series 3. This is a big boost for NEC whose internal squabbles between two competing divisions accompanied by on-again, off-again contracts confused and soured many independent retailers.

VIDEODISC MANUFACTURERS THEIR OWN WORST ENEMIES

Elsewhere in this issue, you'll find the first computer/videodisc game. It uses an Apple computer, Pioneer VP-1000 Laser Disc player and Aurora interface. You'd think Pioneer would be delighted to have a new form of software on the market to enhance the usefulness of their player.

Not so. John Talbot, Pioneer's marketing vice president won't speak to us, they refused to loan us a player for development and to show the game at the fall round of personal and home entertainment shows, and haven't responded to our offer to let them demonstrate the game at CES.

Not only that but attorneys at MCA feel the Screen Actors Guild contract prohibits the use of the movie discs for use with computer game software. Apparently a disc is sold only to be viewed straight through as a movie and not for any interactive use.

Do laserdiscs have a future? Technologically, yes. In the real world, not until Pioneer and the SAG take off their blinders.

RCA VIDEODISC ALSO OFF TO SLOW START

RCA geared up to produce 500,000 SelectaVision videodisc players in 1981 but so far has sold only 40,000. At the present sales rate of 750 per week it is obvious that it has not caught the imagination of the consumer in any major way. Apparently most people just don't seem to understand what a videodisc is; nor do they see advantages of the disc compared to tape.

From our standpoint, the RCA system with its grooved disc and stylus has less to offer for computer interfacing than the laserdisc optical system although, as mentioned above, Pioneer is being anything but cooperataive.

CBS, AT&T EXPERIMENT WITH TELETEXT IN GARDEN STATE

Starting next fall 200 households in Ridgewood, NJ will be furnished with an "integrated data terminal" consisting of a color CRT and keyboard which will be able to access a wide array of services including news, sports, weather, entertainment and shopping. The data base material will be transmitted over NJ Bell lines from a host DEC PDP 11/70 computer. CBS will be producing most of the programmed material. The trial is slated to run for 7 months and will have more computer functions than the recently aborted Austin, Texas experiment.

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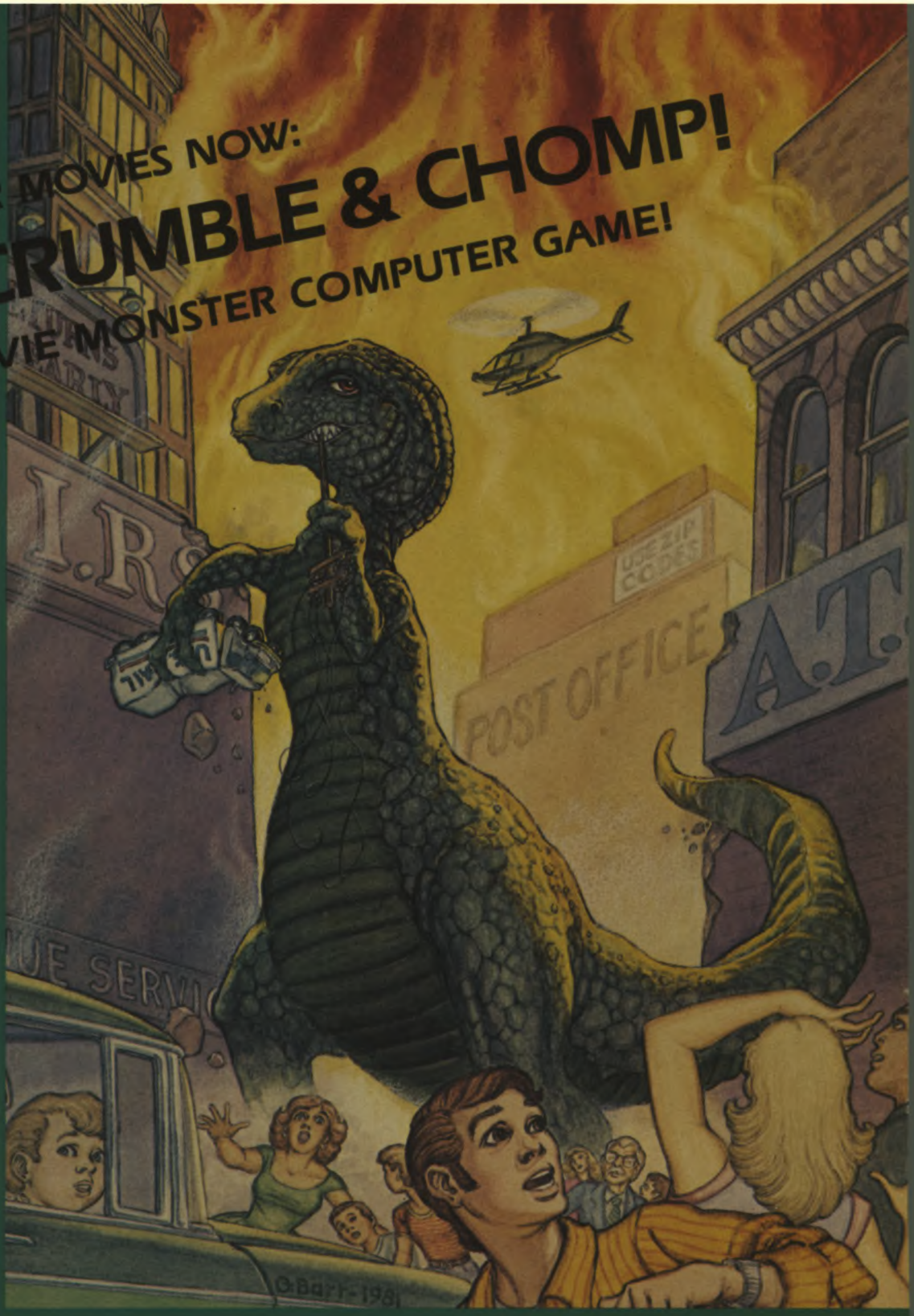

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COMPUTER GAMES THINKERS PLAY

EPYX

CIRCLE 110 ON READER SERVICE CARD

Baked Apple.

Last Thanksgiving, a designer from Lynn/Ohio Corporation took one of the company's Apple Personal Computers home for the holidays.

While he was out eating turkey, it got baked.

His cat, perhaps miffed at being left alone, knocked over a lamp which started

a fire which, among other unpleasantries, melted his TV set all over his computer. He thought his goose was cooked.

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CIRCLE 117 ON READER SERVICE CARD

put...input/output...in

Berlitz

Dear Editor:

The July 1981 issue of *Creative Computing* contains a letter from David Gross commenting on the problems of translating between Basic dialects. As I have just translated the program in question, "Streets of the City" *Creative Computing*, April 1981), from the TRS-80 Basic to Applesoft, perhaps I can help with this problem and also point out some problems in the published program listing.

The most important rule in translating any program is that you must understand the intent of the original code. "Streets of the City" is written in an extended Microsoft Basic and uses only a few features unique to the TRS-80 version.

These features relate primarily to the TRS-80 screen format and character set. The screen is organized as 16 lines of 64 characters each, and may include mixed text and graphics characters. The text characters are the standard 7-bit ASCII character set. These are augmented by 64 graphics characters with ASCII code values of 128 to 191 and which are listed in several recent reviews of printers that come equipped to print them, such as the Epson MX-80; and by 64 "space-compression codes" with ASCII code values of 192 to 255. Each of the latter will produce N-192 spaces, where N is the ASCII code value of the character being printed. In "Streets of the City" they are used to "clear to the end of line."

TRS-80 Basics include a PRINT AT (Level I) or PRINT @ (Level II) statement to allow both horizontal and vertical tabbing on the screen. Each possible screen position is indexed from 0 (zero, upper left) to 1023 (lower right) such that positions 0 to 63 form the top line, positions 64 to 127 the second line, and so on.

This statement causes scrolling on line 16 unless the text printed is followed by a semi-colon. In translating from the TRS-80 version to Applesoft, the main difficulty was to convert from a 64 by 16 format to the Apple's 40 by 24 format.

The only other special function used is RND(N). In TRS-80 Basics it returns a random integer between 0 and N if N > = 1. The Applesoft equivalent is to DEF FNRN(N)=INT(N+1*RND(1)) and replace RND(N) with FNRN(N) in the rest of the program.

The absence of a dictionary to explain the meaning of the variables proved more of a problem than the translation itself.

In addition, I uncovered the following problems in the listing. The lines suggested here should be TRS-80 compatible; they must be translated to other Basics.

Replacement: 3065 IF YR = 1 GOTO 3241
Delete: 3071,3072 (they duplicate lines 3052 and 3053)
Replacement: 3295 IF S2(1)>0 THEN S0 = ... (rest of line ok; eliminates redundant conditional)
Replacement: 3385 IF T15,YR) < T15,0) THEN B3 = T15,YR)-2 ELSE B3 = T15,0)-2(original had B2 = ... in ELSE clause).
Replacement: 3625 IF CV < 6 THEN 15490 (original refers to non-existent line).
Replacement: 3700 PRINT "PROPERTY TAX NEEDED";... (text ok; values are in dollars, not mills)
Replacement: 3784 IF X>2 THEN IF X<=CV THEN X3=RND(5) ELSE X3=RND(8) (original has unreachable code)
Replacement: 3801 IF X1>6 THEN 3805 ELSE IF TB(2,YR) ... (text ok; original lacks ELSE and second IF is unreachable).
Replacement: 10627 IF PC< 2 THEN 10630 ELSE IF LS>=... (same problem as 3801)
Renumber: 15177 BECOMES 15240 (printer went berserk?)
Upgrade: 15180 by deleting all text after "THEN 15190" (as above).

There are many other places where the program can be made more efficient by simplifying expressions and removing parentheses.

Finally, assuming these problems have been corrected in the version sold by Creative Computing Software, let me note that the time it took to translate, enter and debug this program was probably worth about twice the cost of the disk based version I could have ordered. I suspect this is generally true of any lengthy program.

The only value in doing the translation is to learn new Basic "tricks of the trade." Although "Streets of the City" is an excellent simulation that I can wholeheartedly recommend (I still haven't mastered it!), the code is commendably straightforward, so that this task will be of little value to all but the beginning programmer, who will find the lack of a data dictionary especially frustrating when trying to understand the internals of this simulation.

Paul DeBenedictis
300 Kensington Place
Syracuse, NY 13210

Traveller's Checks

Dear Editor:

Congratulations on another great issue of *Creative Computing* (August 1981). Although Lloyd Johnson's simulation "Star Merchant" is an enjoyable game, I thought it would only be fair, to the readers and the source, to mention the source of the simulation.

"Star Merchant" is based on the science fiction role playing system "Traveller." I first became aware of the connection after examining the cargoes and their base prices. I am disappointed by Mr. Johnson's negligence in crediting "Traveller" as his source.

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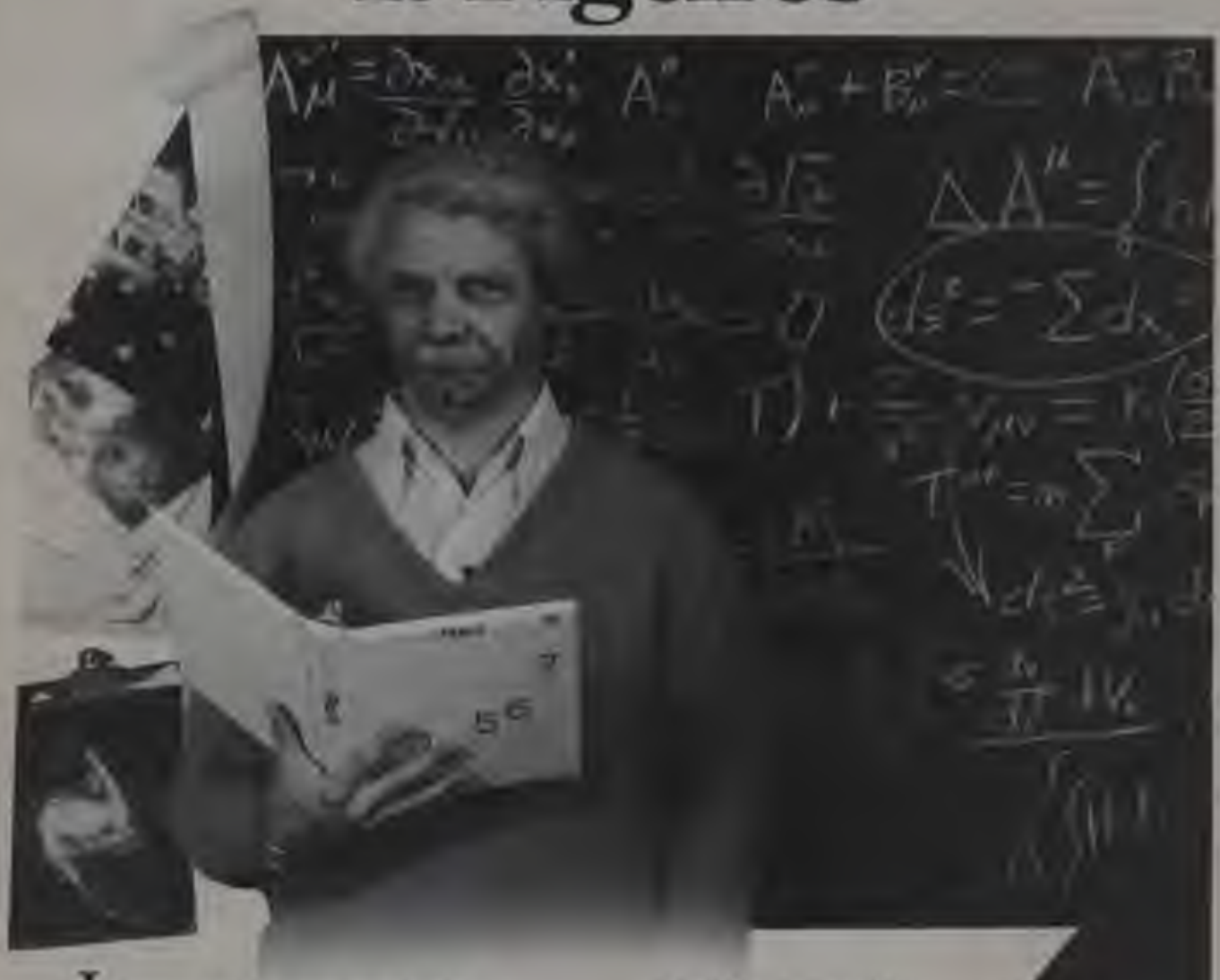

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put...input/output...in

"Traveller" is a role-playing system set in the far future (37th century A.D.) in a vast empire. The Imperium, containing approximately 11,000 worlds. The rules cover many facets of life in The Imperium and are constantly being expanded.

"Traveller" is available from hobby stores or from Game Designers' Workshop, Box 1646, Bloomington, IL 61701. The basic set is $8.98 (US) and *Book 0: An Introduction to Traveller* for $3.98 (US) is an excellent introduction to the "Traveller" universe for the beginner.

Marc Schlichtman
42 Highland Ave.
St. Catharines
Ontario, Canada
L2R 4J2

Thanks for the information. We too enjoy the universe. — EBI

Freeze Your Boots Off

Dear Editor:

I am an occasionally proud and satisfied TRS-80 Model 1 owner. When the system is working, there is none better for the money. But when it's not, it's a prime source of frustration and anger.

As I understand from many other TRS-80 users my ailment is a very common one and it should just be "lived with." The problem/symptom I'm referring to is when the screen "freezes" or less frequently the "random reboot." I have read of a few fixes for these two problems (most center around poor electrical connections at the parallel port connections) and tried them, but none work reliably.

Can you help me with this problem? I would like to know what exactly is causing these symptoms/problems and how the hardware can be fixed permanently.

I have faith that your experience and knowledge with these matters will save me. Please don't let me down.

Ronald W. Graham, Jr.
Graham Marine Electronics
12 Rogers St.
Gloucester, MA 01930

This is a continuing problem, which we have not solved. In fact, it is the main reason that we have been converting to the LNW80 computer for some of our inhouse computing. It has yet to show the problem, while our Model I's and III's do lock up. As you mentioned, cleaning the contacts between the keyboard and expansion interface helps. Radio Shack went through a series of modifications including a buffered cable and a direct refresh circuit connection in an attempt to solve this, so if you have one of the earliest model I's, you may be able to get some help at your repair center.

*Instead of fixing the problem, I rely on saving the information. If you are using TRS-DOS 2.3, NewDOS, LDOS, or DOS-Plus, and running a Basic program, you should be able to recover your program with BASIC *. See the instructions in your manual.*

If you are using Scripsit, press the RESET key and hold down ENTER to override any AUTO message until you return to DOS READY. Then type DEBUG and press ENTER. Next press BREAK to enter the DEBUG monitor. Now type G4000 and press ENTER to return to SCRIPSIT with your file intact.

In desperate situations, I use RAM 20 from Small Systems Software. Their diskette comes with a short BOOT routine that does not disturb resident memory. I load the monitor into the top of memory and use the ASCII dump function to find my program or data. If I just want a copy, I print it at the printer.

If I want to recover my typing efforts, I note the starting and ending locations, convert them to decimal addresses, then return to Basic with one file and protect memory where my material begins.

If the ending address is greater than memory location 32767, you must subtract the ending address from 65536 to get the address in a form that Basic can understand. Then I use this program, with the appropriate starting and ending values substituted for 26810 and -32176, to recover my material.

```
10 OPEN "O",1,"RECOVER/TXT"
20 FORM = 26810 TO 32767:PRINT #1, CHR$(PEEK(M));
   :NEXT
30 FORM = 32768 TO -32176:PRINT #1,CHR$(PEEK(M));
   :NEXT
40 CLOSE
```

This saves your material in a sequential disk file called RECOVER/TXT.

Please do not call me for help on these methods. I regret that my duties make it impossible for me to coach people over the phone. Therefore, I suggest that you practice the methods before you need them with dummy data, so that you can feel confident when you do have a crash. LDOS has special functions to deal with these problems that you might also wish to consider. — GB

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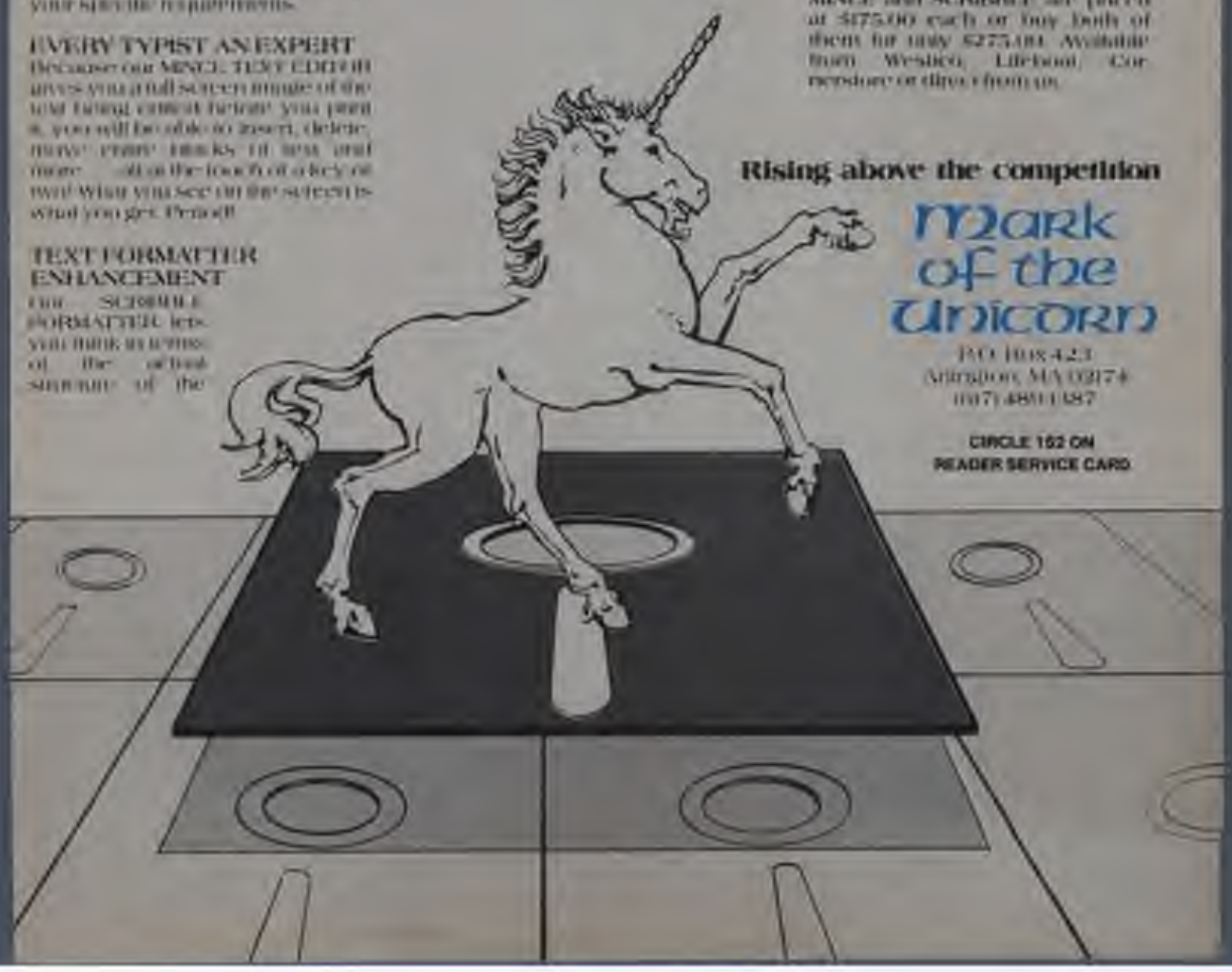

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CIRCLE 152 ON READER SERVICE CARD

Magazines of The FUTURE

David H. Ahl

It's going to be different than many people are forecasting. Despite a tremendous growth in electronic media, I just don't see all the newspapers, magazines, and other printed materials going out of business any time soon. The printed word has been with us for a long time and is remarkably resilient. I don't believe that just because people can connect databases and manipulate facts and figures on a TV screen that these electronic goodies will replace curling up in a chair with an interesting magazine or a good book.

I also believe a substantial number of people, perhaps the majority, would prefer to get things in the mail rather than over the telephone. The motive for this is primarily financial. Having worked for Ma Bell and having been exposed to their desired future directions, it seems to me that the Bell System will be moving as fast as possible toward usage-sensitive pricing. That is, one will pay for the amount of time and distance one uses. There will be no such things as local calling areas or flat rates. Naturally consumers will protest this movement, but in the long run that is the direction that the Bell System is going. Their determination is reinforced by the fact that more and more competitors are active in the areas of equipment and terminal gear and, as a result, the Bell System has to look to network use as their main source of revenue in the future.

Consequently, although today the cost of telecommunications is rising less rapidly than the cost of the US mail or parcel delivery services and the gap between the two is getting narrower, I believe that the gap will begin to widen again in the future.

I also believe from a psychological standpoint that many people, again perhaps the majority, would prefer to do things at their own pace, time, and place. For example, although some people enjoy "timed" games, many people do not. Or, in reading a novel, many people prefer to read a chapter each night before bed while others will sit down and read it straight through. This suggests that services that are geared to the telephone (or other communications service) that force people to be in a particular place for a particular amount of time (as short as possible if you are paying for connect time) and complete everything in one burst may not be welcomed by the majority of the population.

What all this suggests to me is that there may be a good opportunity to provide an alternative to the all-electronic media. In particular, a data base retrieval system that retains the advantages of the printed media. It doesn't take a genius to realize that at the moment this alternative is computer software in the form of floppy disks and tape cassettes, but the speed and capacity of these media are rather limited. The third alternative, of course, is the ROM cartridge as used in the Atari video computer system, Texas Instruments computer and others. However, this is excessively costly and certainly not viable for fast turnaround or short runs of an item. Obviously with double density and two-sided floppy disks, the amount of information that one of them can hold increases. However, if one is looking at a database the size of, let's say, one day's worth of New York Stock Exchange listings (two newspaper pages) this would take several, if not scores, of floppy disks. Furthermore the medium is almost completely useless if we want to intermix moving color pictures, i.e., television quality pictures, along with computer information.

Hence, the medium that I think offers the most promise, because it requires the least additional technology, is the laser scan video disk. At the moment, optical video disks and their players are relatively expensive. However, there are two developments on the horizon that lead me to believe that the costs will be coming down dramatically in the near future. The first one is the 4-1/2" all-digital audio disk recently announced by Philips and for which at least four manufacturers have indicated that they will be producing a player. The second development is another all-digital audio "disk" the size of a credit card which has been developed by Dr. Thomas Stockham and for which he is currently developing a player. In general, the target price for audio components is under $300 and once some of the majors move in, there is usually a flurry of "Chinese copies" so that the devices can usually be had for $100 or less.

What this suggests to me is that there may be a substantial financial opportunity for a company to take the technology which is being developed for the audio field and apply it to the computer field. Like so many other products, the real opportunity is not with the hardware but with the software. Like Gillette, the only reason to sell razor handles is to sell the blades. So the real opportunity I see is for an array of special subscription services offering financial data, coin collection data, engineering data, astronomy data, and all the different things for which people are currently subscribing to special-interest magazines as well as broad-based data retrieval services such as The Source and MicroNet.

Personally I believe this is a much more viable and economically feasible form of "electronic publishing" than that currently being tested by AT&T with their "electronic yellow pages," the Knight-Ridder newspaper tests in Florida, and even The Source, MicroNet, and other general services.

In summary, the device I see being offered is a very inexpensive interface between an RS-232 port and as many of the all-digital audio players as possible. "Electronic magazines" could then be offered for the many special interest areas mentioned above plus others. There are some neat things about this strategy. One, piracy would be practically non-existent since the equipment to duplicate a laser scan disc is rather costly. Two, it's not particularly threatening to the existing printed media (who have strenuously resisted most of the on-the-air electronic experiments) or to the electronic media as it currently exists. Consequently, while the media may not cooperate with a new firm, at least they will not be down right hostile.

Disadvantages: One, it will probably fail, and two, on the way to failing it will cost a bundle. —*DHA*

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The ZX81 is also very powerful. It's with it hooks up to any television set to produce a clear 32 column by 24-line display. And you can use a regular cassette recorder to store and recall programs by name.

If you already own a ZX80

The 8K Extended BASIC which is used in the ZX81 is available as a drop in replacement for your ZX80 for only £29.95 (free shipping and handling – complete with new key board overlay and the ZX81 manual).

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The Expert's Guide to Beating Asteroids, Battlezone, Galaxian, RipOff, and Space Invaders.

David and Sandy Small

Yup, I'm addicted.

I spend my loose change and spare hours in the depths of depravity: coin-op videogames. I play them, pound on them, and above all post money into them. A roll of quarters and a game room are my idea of heaven. Sound familiar?

These games were costing me so much, and beating me so quickly, that I couldn't play them as often as I wanted. So in self defense I decided I'd better get good at playing them. This article describes the techniques I've developed over time and several thousand quarters. It isn't written as an introduction to these games, just as articles on machine language aren't meant for beginning programmers.

This article is meant for those of you who can't sleep without at least one game of Asteroids under your belt daily. It's for you with Space Invader's Wrist (you know, that ache after you've been holding your hand that funny way for three hours). It's for those with Battlezone Tunnel Vision, which makes you drive strangely during rush hour. (How many people aim themselves at cars in front of them and press the lights button, saying "Take that, Supertank?") In short, it's for players who already know how to play the games, but need some tips on how to beat them.

Don't expect any of these techniques I'll mention to be easy!

Some of them require a great deal of practice, but the rewards are great. The first is stretching your roll of quarters considerably. The second is the feeling of intense satisfaction you get from beating a machine that was designed to be nearly unbeatable. The third, and perhaps most satisfying, is the looks on the faces of people walking through the arcades when they see your score. Finally, no one is more popular than a game master, since everyone would like to learn how to beat the machines. It's a great way to meet people.

Let's start with Space Invaders, and find out how to achieve insanely high scores with it.

Space Invaders

Space Invaders, as everyone knows, took the world by storm. In Japan it became a craze of such magnitude that the mint had to triple production of the coin used in the machine. Things have cooled down a bit since then, but it's still a popular game, and a great way to improve your reflexes.

The method used to beat it is twofold. The first part involves the beginning two or three "ranks," or complete screenfuls of invaders. The second is for ranks beyond this.

At the start of the game, the enemy ships are well up there so there's little hurry. Move to the right side of the screen and pick them off one column at a time. (You may have to repeat fire a bit as enemy ships collide with yours, of course, but you want to finish a complete column

David and Sandy Small, 11714 Yucca Drive, Austin, TX 78750.

Make the Most of Your ZX81 or 80

SYNC Magazine

SYNC, a bi-monthly magazine for users and prospective users of the Sinclair ZX80 computer has expanded its coverage to include the ZX81 as well.

Now entering its second year, **SYNC** has been providing nearly 10,000 Sinclair computer owners with information on how to make most effective use of their computers. "Resources," one of the most popular sections of the magazine, has listed over 100 second source vendors of software, peripherals and books as well as user groups.

Each issue of the magazine carries complete application programs, tips and techniques for more effective programming, hardware modifications and in-depth evaluations of software, peripherals and books.

Subscriptions to **SYNC** cost $10.00 per year (6 issues). **SYNC**, 39 E. Hanover Ave., Morris Plains, NJ 07950, (201) 540-0445.

The ZX81 Companion

The ZX81 Companion by Bob Maunder follows the same format as the popular **ZX80 Companion**. The book assists ZX81 users in four application areas: graphics, information retrieval, education and games. The book includes scores of fully documented listings of short routines as well as complete programs. For the serious user, the book also includes a documented listing of the ZX81 ROM Monitor.

MUSE reviewed the book and said, "Bob Maunder's **ZX80 Companion** was rightly recognized to be one of the best books published on progressive use of Sinclair's little micro. This is likely to gain a similar reputation. In its 130 pages, his attempt to show meaningful uses of the machine is brilliantly successful."

"The book has four sections with the author exploring in turn interactive graphics (gaming), information retrieval, educational computing, and the ZX81 monitor. In each case the exploration is thoughtfully written, detailed, and illustrated with meaningful programs. The educational section is the same—Bob Maunder is a teacher—and here we find sensible ideas tips, warnings and programs too."

Softbound, 5 1/2 x 8", 132 pages, $8.95.

The Gateway Guide to the ZX81 and ZX80

The Gateway Guide to the ZX81 and ZX80 by Mark Charlton contains more than 70 fully documented and explained programs for the ZX81 (or 8K ZX80). The book is a "doing book," rather than a reading one and the author encourages the reader to try things out as he goes. The book starts at a low level and assumes the ZX80 or ZX81 is the reader's first computer. However by the end, the reader will have become quite proficient.

The majority of programs in the books were written deliberately to make them easily convertible from machine to machine (ZX81, 4K, ZX80 or 1K, ZX80) so no matter which you have, you'll find many programs which you can run right away.

The book describes each function and statement in turn, illustrates it in a demonstration routine or program and then combines it with previously discussed material.

Softbound, 5 1/2 x 8", 172 pages, $8.95.

Getting Acquainted With Your ZX81

This book is aimed at helping the newcomer make most effective use of his ZX81. As you work your way through it, your program library will grow (some than 70 programs) along with your understanding of Basic.

The book is chock full of games such as *Checkers* which draws the entire board on the screen. Other games include Alien Invaders, Bisteroids, Moon Lander, Breakout, Digital Clock, Roller-Ball, Derby Day, and Star Burst.

But the book is not all games. It describes the use of PLOT and UNPLOT, SCROLL, arrays, TAB, PRINT AT, INKEY$, random numbers and PEEK and POKE. You'll find programs to print cascading sine waves, tables and graphs; to solve quadratic equations; to sort data; to compute interest and much more.

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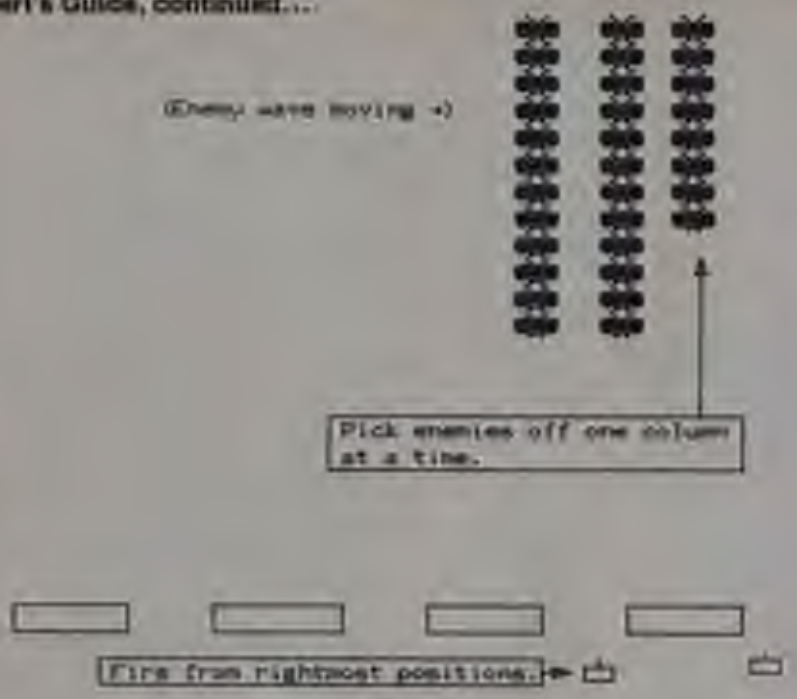

Figure 1.

There is a "gap" between the bottom of the invader and the spot where the missile is first plotted, and, more importantly, where collisions between the missile and your base are first checked for.

at a time.) Try to destroy columns from the extreme right hand side of the screen working left, but if a column is out of range or hidden behind a barrier, take whoever is handiest. See Figure 1.

The key here is that the invaders must complete a full left-right or right-left sweep before advancing a rank down. If you destroy a full column of them, it takes more time for them to complete a sweep and thus slows the advance. With enough time, you'll then be able to destroy them all.

Note: The possibility of an invader firing at you is greatest if you are below him. You'll notice that enemy fire tends to concentrate on you; this is why. If you move a lot, this can be used to your advantage, as the only enemy fire you will have to worry about is random and of less heavy concentration.

To zap the space ship as it goes over, left to right, move your base to the extreme right. Fire when he passes under the "U" of "Score" for Player 2. You'll hit him every time. You can figure something similar out for the other side.

When there's only one invader left, he moves pretty quickly. More importantly, he's likely to be close. Every time he passes over your position, he'll fire at you and you'll have little time to react. So sit near a barrier and fire at him, then immediately start moving once you've fired and get under the barrier. Don't wait for his shot.

It's after you've taken out two or three ranks that the fun really begins. There just isn't enough time to use the above techniques any more, so we have to rely on a bug in the Invaders program.

This bug has to do with where an invader missile appears when first fired. Briefly, there's a "gap" between the bottom of the invader and the spot where the missile is first plotted, and, more importantly, where collisions between the missile and your base are first checked for. This is the way to get really amazing scores with Invaders—especially if you don't have superhuman reflexes.

When the invaders get all the way down to the last row they can be on before winning on the final one, they are very close to your base. In fact, they're so close that the "missile gap" means they won't be able to hit you. It starts plotting below your position and misses. This is useful. See Figure 2.

My technique is as follows: on each new rank past three, when things are really getting hairy, I move one column in from the left side and blast a column completely through the invaders. I then expand it to two columns very carefully to the right side of the one just shot through. This gives a "safe area" in which to hide when the barriers are obliterated, which happens quickly on these ranks. Next, I try to do the same on the other side. This gives a hiding spot on either end. Remember you must leave at least one invader on the extreme ends to maintain the safe area at all times. See Figure 2.

I then sit in the safe area taking potshots at the spaceships flying overhead. When the invaders reach the final row, it's time

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CIRCLE 262 ON READER SERVICE CARD

Enemy ships will have 'water through' barriers and be on bottom row before winning. Stay in 'clear zones' until then. When they reach the bottom row, their shots will always miss; move from one side to the other, against the enemy's direction flow, and pick off the bottom zone.

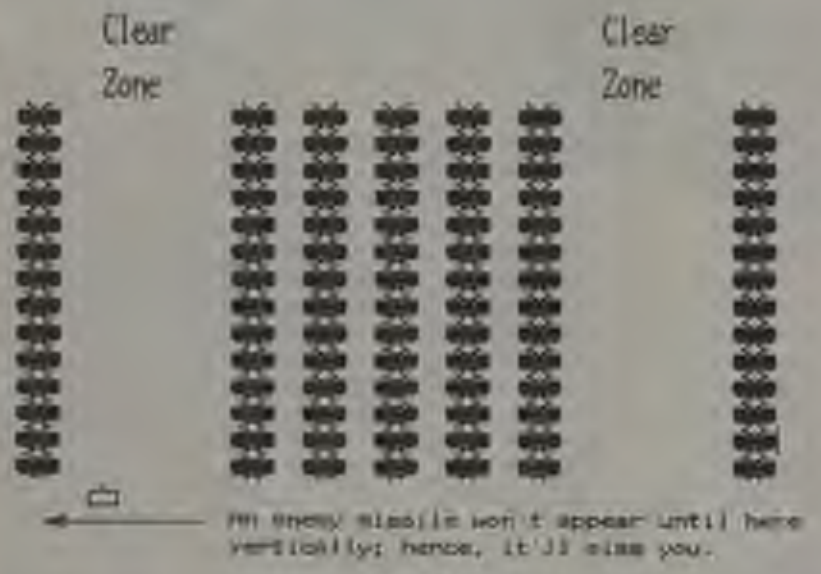

Figure 2.

to eliminate the bottom row. Moving against the flow of the invaders, I blow up the bottom row one at a time. There's no great hurry, so be careful: move right under them and make the shot count. You can't be shot as long as the bottom man exists. When you zap him, go to the next one quickly, as the invader above him will open up at close range, and it's hard to be on your way.

Work your way completely across. After destroying the invader on the far end, move into the other safe zone. Wait for them to move down another row, zap that row, etc. The last row gets a little hairy as the invaders really accelerate; for the last one, I'd recommend moving along with his horizontal motion to lessen the difference in speed between your ships.

If you find they're moving too fast anyway, you'll need to destroy a few columns to increase the amount of time you have on the final row.

After a bit of practice and fine tuning, you'll find yourself destroying endless ranks. You'll learn at what score the invaders flip over and you may even want to try creating your shots to increase the score for the space ships.

Figure 3.

The asteroid cannot be hit from the present ship location; it lies between the minimum increments of the ship's rotation.

Next, let's look at Asteroids, currently second in popularity only to Invaders.

Asteroids

Asteroids is not an easy game. It takes a great deal of practice to win even using the advice I'm about to give. You'll have to know such things as the speed of your missile nearly instinctively, so dig into your pocket and learn.

Perhaps the nastiest thing about Asteroids is that it is endlessly playable. There is no limit to the number of ships you can win. This means that if you get a score of a million, you'll have a hundred extra ships (you get one for each 10,000 points). You can play until your arms turn blue and fall off. This is a rarity among video games: usually only one extra ship can be won.

Here are a few hints to note while learning. First, turning your ship is not a smooth motion. In other words, there is a limited number of positions in which your ship can appear while rotating, but there is a large difference in angle between minimum increments. The result is that from a non-moving position there are many places you can't hit, no matter how carefully you jockey your ship. What invariably kills the people who don't move is that an asteroid comes at them from an angle at which they can't fire. See Figure 3.

The solution is to move! If you're moving, you fire a spread of torpedoes which can sweep an area, versus just a straight line of them. Get used to moving around; you'll need to be good at it. Become especially familiar with going offscreen and note where you reappear on the other side of the screen.

About firing torps: Only four torps can be used at any one time. They are a resource that must be conserved. Don't just hammer on the firing button and let the machine decide when you have a new torp available. Pick your shots. If you don't, you'll be killed when you don't have a torp available when you need it to kill something nearby.

The enemy spaceships come in two sizes, stupid and nasty. The stupid (fat) one fires randomly and is a snap to hit, especially with a spread of torps. The other one fires torps at you and is hard to hit: he's the size of a small asteroid. He fires at you from angles slightly different from yours, with rare shots directly at you. The effect is that he leads you if you're moving relative to him—a deadly trick.

Now when Atari's engineers tested this game (most likely over a keg of beer—they've got pretty good working conditions there) they played it as they expected other people to, by going for asteroids. Sooner or later the field of view gets so cluttered you get blindsided no matter how good you are. The high score they got in testing was around 50,000. But here's

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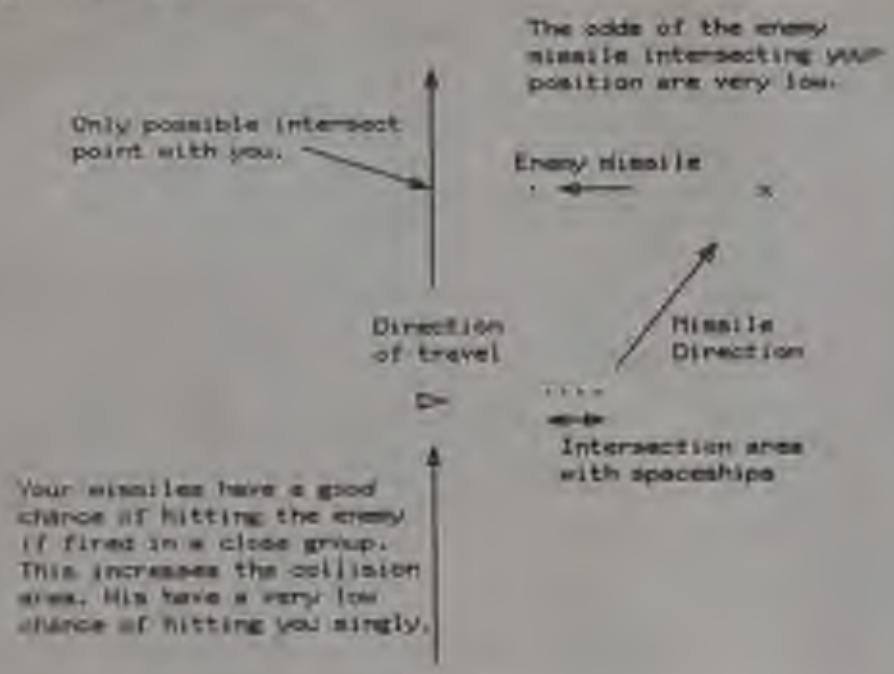

Figure 4

a technique they probably never thought of) ignore the asteroids and go for the small ships, each of which is worth 1000 points.

Blow away all the asteroids but one. It can be any size, but just have one left. Try to make it one that is moving more or less vertically; that will make your next task a bit easier.

Next, pour on the power straight up or down. You may have to shift this a bit to avoid the asteroid as necessary. Try to stay in midscreen. Now when an enemy spaceship appears, turn quickly to the side, fire a very quick burst of four torps to intersect his path, and keep going.

The strategy is as follows: His shots have a very low chance of hitting you, as they will be moving horizontally and you vertically. The chances of one colliding with your position in the brief time it's intersecting your vertical path are very small. But if you space you shots very closely, the odds of your shots hitting him are very high. Your firing speed will have to be very high (I use two fingers alternating on the button) and your shots should be spaced about one quarter inch apart; this will do the job well. You will frequently have to fire at the enemy using the wraparound effect of the screen to catch him as early as possible. See Figure 4.

If you should miss him until he reaches midscreen the chances of his shots colliding with you get much better. They intersect your path more often as he gets closer. Generally if I have missed him by this time, I give up and stay out of his way. You can do this by staying about half a screen away from him. Also, unless the game has been set up to be really nasty, he won't fire at "offscreen" positions, so you can use the wraparound effect to help you.

Now eventually one of your shots or one of his will hit the sole remaining rock and nail it. If it's a large one, no problem; just select which asteroid you want to remain. If, however, it was the last one, you're about to become quite busy. Slow down quickly and center your position; a heap of rocks is about to appear, and you will have to whittle them down again. This may be the most dangerous part of the whole strategy. The advantage of keeping a large rock should now be clear: it extends the open season on the little space ships.

Sure, you'll be killed eventually. But all you have to do to play forever is average a 1:10 kill ratio between you and the little ship, which isn't hard with practice using this technique.

By the way. There is supposedly a bug in the older version of the Asteroid games which allows you to sit in the lower left corner and never be killed. I do know that Atari ruled out a new set of ROMS for their machines, so it may well be true.

There's also a nastified version of Asteroids where the enemy ships do everything possible to kill you, including firing offscreen and such. Go easy on these machines. The less you play them, the fewer of them will be made. Finally, there is Asteroids Deluxe, in which the hyper control has been replaced by shields and in which certain asteroids break up into pieces which then attack and try to destroy you. Try it out; it's a new challenge and hard to beat.

Next, let's look at Galaxian, or Advanced Invaders.

Galaxian

Galaxian is Space Invaders with a good bit of souping up. First, it's in color, which is neat (the colors do tend to dim on an old machine, though). The biggest difference is that the attackers peel off and come at you. I've found no "trick" to beat this game badly, just a set of tricks to stretch the of quarters.

First, destroy the enemies one column at a time. You will have to practice and perfect the little sideways jig required to lead the sideways moving invaders (i.e., fire, jig, fire, and so forth). Leave the red and yellow fellers until later; they are worth significant numbers of points. Killing the attackers off a column at a time increases your killing efficiency, and thus your scores, by reducing the time between your kills.

Interspersed with the above, you'll have to take out various attackers. Stay calm and pick your shots. You will soon find that a missed shot hurts badly because of the time wasted as your missile flies uselessly by. You'll be amazed at how quickly you'll be able to predict the paths of invaders well enough to lead and hit them; the light blue ones always come for you.

Just when you thought it was safe to go back underground again.

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Zork II is the extraordinary successor to Zork I, which hit #4 on the SOFTALK Top 30 in its first month on the market. Both run on 32K Apple II's with a 16 sector disk drive. And both are available now for Christmas.

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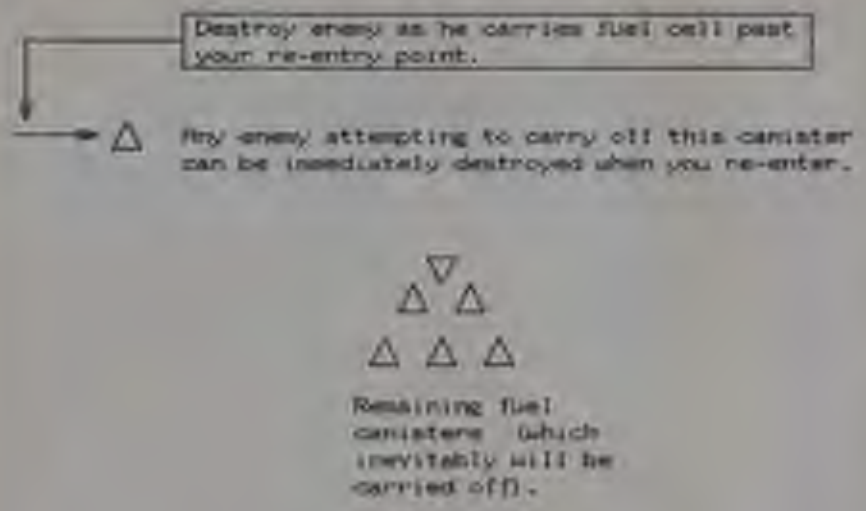


Figure 5.

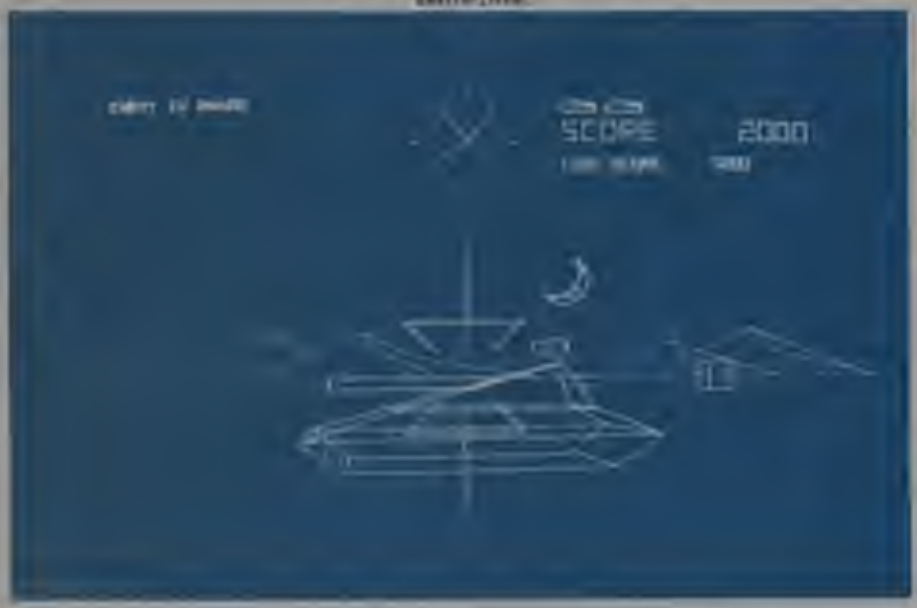
in a straight line, the purple ones have wild parabolic paths, and so on. One helpful trick is to keep your eye on the one ship at which you are aiming while you fire.

Zap the triple group red ones first, then the yellow ones. You'll get 800 points for this order if you manage it. One important point about the yellow ones is that if you destroy an attacking yellow ship, all ships attacking stop firing at you. This can save you if you are pinned down by a large wave.

Watch the purple ships! Their parabolas can be pretty radical – even to the point where they'll hit you from the side. The parabolas get wilder as the game progresses. All ships key on your position as of the moment they peel off to attack, and aim to intersect at that point. Use this to help you. For example, if you're in a corner when they peel off, you're likely to be trapped.

At the end of each rank, when only two or three enemies are left, things get pretty tough. Try to pick off the attackers at the top of the screen, before they start dodging. One thing they do can be turned to your advantage: they follow your movement control, so if you dodge left, they will, too. Try wobbling your control back and forth, and the enemy will dance all over the screen. Remember that if you keep the control pegged to one side or another, you're giving the attacker unnecessary assistance. Should you be pinned on one side, with him coming across at you, center the control; that will help prevent him from getting far enough over to hit you.

Battlezone.



RipOff

Never, never play RipOff alone. It is truly a rip off if you do. The machine's edge, as you will have figured out by now, is the time between your death and re-entry. With one player, you haven't got a chance. With two, your partner can cover for you while you get back in.

You will always be killed in RipOff. There's really nothing you can do about it with the high speed enemy ships, since by the time you can see them you're dead. If you have a partner, however, and you stay split up, they can't usually get both of you at once.

If an intruder should "drop" a fuel cell near your re-entry point, you have it made. Generally, they are not too co-operative about dropping it for you, so you will have to kill them there. Anytime you get killed, you will come back in a fine position to cover the fuel cell. Let an enemy go for a bit if it looks like he's headed that way, then kill him when his vertical position is the same as the entry point. I manage a Bonus +120 or so with little trouble when this happens. See Figure 5.

Fire into corners and edges during the times between enemy attacks. You may catch the enemy as he enters the screen and take him out, and believe me, you need all the help you can get. Your partner should select another edge and fire at it.

The best way to win this game is the firing technique. A good bet is "walking the rudders" while firing to spread out your shots from a straight line; this gives you a much larger collision area with the enemies. Once you have some practice you will be able to lay a one-inch wide spread easily, which is quite effective for killing enemy ships, one good hint for just before you die on a new fast enemy wave is to fire a spread into the fuel cells; generally some idiot enemy ship will fly right to the center, and be killed even as you die.

I generally fly straight at the enemy, ensuring that I get him even if I miss him with my shots. One problem with RipOff reflexes, however, is that the rudder walking and collision habits you build up are exactly what you don't need to win at Asteroids. Ah, well.

Battlezone

First, should you have a comment or suggestion about Battlezone, there's a guy you can send it to. He's not an official PR person, but rather the manager of the coin-op group that invented it: Ed Rotberg, Coin-Op Supervisor, Atari Inc., 1196 Borregas Ave., Sunnyvale, CA 94086.

Tell him Dave sent you. (He'll probably never speak to me again for this, but maybe someone will send him some good ideas.)

Here are a few very helpful hints for this addictive game.

High-Resolution Color Graphics for the Apple and Atari

Graphics Breakthrough

How many programs have you written that would benefit from animated high-resolution graphics? Probably several. It is this kind of dramatic graphics that distinguish outstanding programs from ordinary ones. But if you've ever agonized for hours or days just to get one image perfected, you're probably not anxious to do it again. Now there's a better way.

New Graphics Entry System

Today there is a new graphics system available that is not only amazingly user-oriented but surprisingly economical. Called VersaWriter, it starts with an ingeniously simple entry board consisting of a 14" X 12" high impact plastic bed with a tough clear plastic overlay sheet. The original drawing or diagram is fastened with masking tape to the plastic bed and then covered with the clear sheet. Instead of using a light pen or complicated electronic X-Y head, the VersaWriter uses a double jointed arm attached to the top of the entry board at one end and a magnifying lens with crosshairs at the other end. The VersaWriter resembles a draftsman's pantograph on a smaller scale.

At each joint in the arm of the VersaWriter is a potentiometer. A cable from these potentiometers connects to the paddle input of the computer. No special interface electronics or board is needed. Since the arm of the VersaWriter bends only in one direction, each point on the plotting head corresponds to a unique set of resistances on the potentiometers. All that is needed now is software to translate these resistances into usable screen coordinates.

Exceptionally powerful software

It is in the software where VersaWriter really stands out. VersaWriter comes with two full disks of user-oriented software. First it has sets of "low level" commands for entering, creating and copying drawings and diagrams. Secondly, it has extensive sets of application routines for moving, enlarging, rotating, coloring or animating drawings that the user has created.

Of course the basic commands let you enter a drawing freehand or by tracing it. Want a wider brush stroke? Six widths are available. Drawings can be independently scaled in both the vertical and horizontal directions. An enclosed shape may be filled in with any of 106 colors. No, that is not a misprint—By the same technique that a printing press can create hundreds of colors from the three primary ones, so can VersaWriter.

Here a shape (the letter A) is being scanned. After putting it in a shape table it may be used in other programs.

From the shape table, a shape (the letter A) may be enlarged, rotated, colored or moved about the screen.

Create Animation for Other Programs

The shapes you create with VersaWriter can be used and manipulated with ease in other programs. Up to 255 shapes can be entered into a shape table. These shapes may then be placed on the screen in any position or may be overlaid on a full or partial screen image. Animation is produced easily by moving about a portion of the image created by VersaWriter. For example, by alternating between two images of an airplane propeller it will appear to be spinning.

Other VersaWriter software includes text-writer with which text can be added to graphics. Upper and lower case, choice of color, text size, direction and starting point all may be specified.

The Area/Distance program lets you calculate distances (or perimeters) by entering a scale and tracing a shape or map route with the drawing arm. Areas of figures, open and irregular, can be similarly calculated.

The software also includes sets of electronic and computer logic shapes. In addition, an entire disk of dramatic demonstration graphics is included. These twelve full-screen graphics run the gamut from a fully labeled cross section of a human skull to colored maps to animated cartoons to an electronic schematic.

Software Updates

You may have read a review of VersaWriter that indicated that the color fill routine was slow. It was. But not any more. Several routines and improvements were added to the VersaWriter software since its introduction. An added feature, the Expansion Pac, is also now available. This third disk of software contains an area distance program, a microscope feature, and will save your graphics in the exact colors you prefer. It also includes shape tables for architecture, plumbing, electrical, circuit boards, landscape, chemistry, games, and more. 350 predefined shapes in all.

At Peripherals Plus, we evaluated every graphics device. We wanted to handle the best one regardless of price. VersaWriter has the best performance bar none. Surprisingly, it also has the lowest price, just $299.00 for the Apple version. It requires an Apple II Applesoft in Rom (or an Apple II Plus), disk, and 48K memory. VersaWriter comes complete with two disks of software, a comprehensive instruction manual, and a 90-day limited warranty. The additional Expansion Pac is available for $39.95.

The Atari version, which varies slightly from the Apple version in number and types of functions performed, is available for $299.00. As new updates are developed for the Atari, Peripherals Plus will furnish them free to all customers—just send us the disk and we'll supply the updated material. We make this unique offer because it is in our best interest to have you make the best use of your computer. We're also convinced that if other people see your VersaWriter in use they'll want one too.

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To order, specify Apple or Atari version, send payment plus $3.00 shipping and handling to Peripherals Plus, 39 East Hanover Ave., Morris Plains, NJ 07950. (New Jersey residents please add 5% Sales tax.) Credit card customers should include card number and expiration date of Visa, MasterCard or American Express card. Credit card customers may also call toll free 800-631-8112 (in NJ 201-540-0445).

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Figure 6

Figure 7

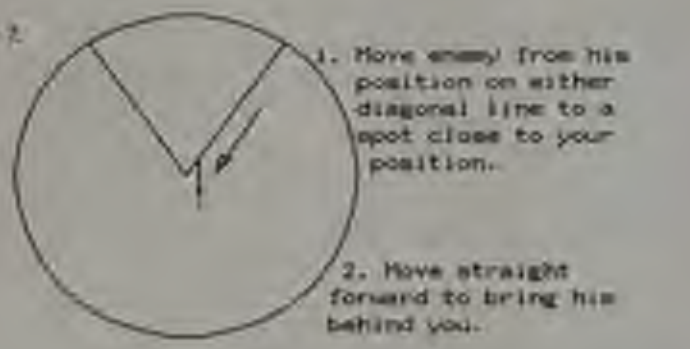

Figure 8

Enemy tanks never lend you. This means that you must *keep moving*! If you have one handle forward, you're moving forward in a slow curve and are OK; if you have one forward and one back, you're sitting in one spot, and have little time to live. Never do this except just prior to zapping a tank.

To kill a tank, reliably:

1. Wait until the tank appears on the radar. If he appears right in front of you, try zapping him once carefully, then turn and move cause he'll start firing soon. Note his radar plot position.

2. Move him, by moving one handle only, to twin diagonal lines on the radar display. If he's behind you, you can back up also. Be patient, and spin him around to one of the lines. See Figure 6.

3. Bring him toward you down the line with a combination of forward and one handle forward. When he gets close, go straight forward, and continue until he's one quarter inch or so on the display behind you. See Figure 7.

4. Back up quickly, right in front of him. He'll still be pointing forward, not back. Spin to his side (going up there and running into him is fun, too) and blow him away. See Figure 8. This works every time. What more could you ask?

Minor Flourishes: If you should hit a barrier while backing up, or rotating, keep moving away from it, then go around.

Super tanks are handled in the same way. Don't let them get directly behind you, or you're dead. Keep them in the forward area and expect them to try to run into you; they're designed to. Circle on the collision and see what you can do to out-turn them.

The Saucer always tries to maneuver you into the worst possible position. For example, it tries to line up a tank directly behind you by heading that way and encouraging you to turn in that direction. If this happens you haven't long to live. Sometimes, however, the enemy hits his own saucer!

Buzzbombs

I hate Buzzbombs.

The first couple are simple. You can blow them away as they come at you. But then they begin to dodge back and forth until there's no clear shot at them, and they zap you from the side. I tried *everything* and spent a lot of money until I learned their secret.

I reasoned it out as follows: The tank you are driving has no "depth" to the machine. Hence, I wondered: if you were right up against a barrier (which I had seen buzzbombs hop), would they hop you too? The answer is yes. If you're snuggled up against a barrier in the way of a buzzbomb coming at you, it will hop the barrier and miss you every time. See Figure 9.

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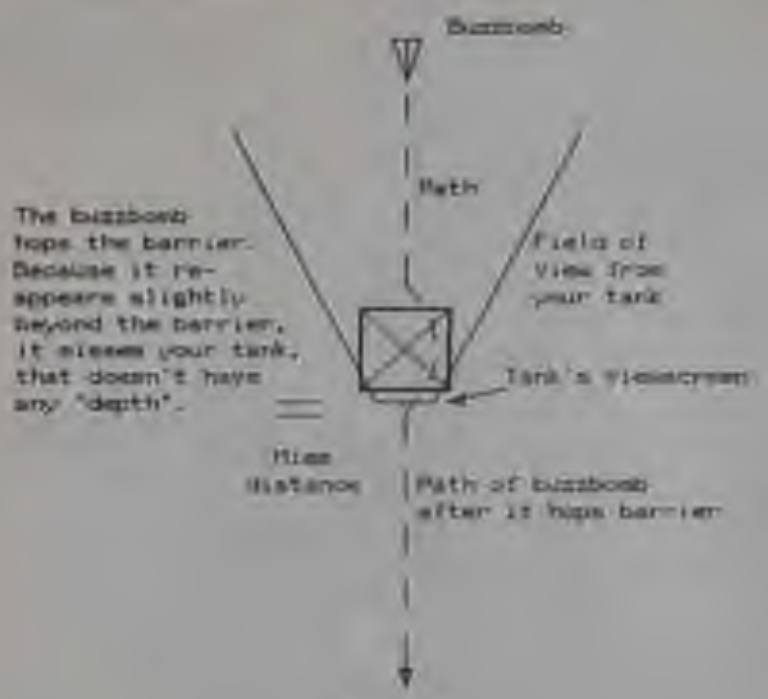

Figure 9

I can hear those of you who have experienced the Bazzbomb Certain Death saying, "Yeah? Neat!"

Using the Battlezone barriers this way is a joy. See bazzbombs that would be deadly hop right over you. Learn the art of hanging back from the barrier a little, taking a potshot at the buzzer as it comes for you, then running for cover if you miss. Supertanks may also be clobbered this way; they will come straight for you, firing all the way. Interpose a barrier and they will hit it. Be on the other side, naturally, and back up a tad. He will back way up to one side. As soon as his tail end is visible, blast him. It's an excellent way to finish off a tough opponent.

Conclusion

I love video games. I'm looking forward to the next introduction of a new one. There's a new one with above-three-dimension controls called Defender that I'm starting to look over now, and I still have plenty of quarters ready. I hope the advice I've given will stretch your playing time and paycheck some, and increase your enjoyment of the games.

Good luck! Oh, and if you should find any other good strategies, please feel free to drop me a line at the address listed in the beginning of this article. I'm always looking for new ideas! □

Invaders for the TRS-80

Owen Linzmayer

The software market has been saturated with versions of Space Invaders for the TRS-80; few great, some OK and many horrendous. Rather than criticizing the deplorable, this review is intended to praise two exemplary programs modeled after the famous arcade game. The programs are Super Vaders from Soft Sector Marketing and Space Intruders from Adventure International.

Space Invaders is the grand-daddy of arcade games. In it, rows of aliens march left and right, criss-crossing the screen, launching lethal missiles at the lone defender below. When the army of invaders reaches either side of the screen, it drops down one step closer to the player's laser base. If the invaders manage to get down to the level of the cannon, the game is over and the Taito Corp. is twenty-five cents richer.

As the number of intruders decreases, the speed of the remaining aliens increases. When the first screenful of invaders has been cleared, a second, faster group appears, only this time they start off a notch lower than the preceding wave.

Even though there are four shelters to protect him, the player must constantly be on the alert as he glides across the bottom of the screen picking off any unfortunate invader that gets caught in his line of fire. Occasionally, a UFO will traverse the uppermost portion of the sky, daring the player to blow it away.

Although these UFOs are worth big points, their objective is to draw your attention away, in the hopes that you won't notice an oncoming missile. The arcade version of Space Invaders is endless; if you can manage to keep one base intact you may play forever, racking up scores in excess of hundreds of thousands of points.

Super Vaders

Super Vaders is a machine language program written by Larry Ashmun of Soft Sector Marketing. It is a modified and greatly enhanced version of Invaders Plus. There are nine levels of play, not including the Blitz mode. Blitz is no for the timid; bombs are hurled towards you at dizzying speeds as the invaders whiz through the heavens. I'm told by the author that the number of bombs/screen in the Blitz mode is infinite, but I have never gotten past the second set of insuperable invaders.

If you are playing any level other than Blitz, you must destroy only four waves of invaders before the game is over. This is a slight drawback, but with nine levels of play, the game is challenging to novice and expert alike. At the beginning of each new onslaught, the number of laser bases is always four (these will disappear quicker than you think).

The sound-effects are exceptional.

Every time one of your bases is destroyed, the number of ships left is flashed momentarily where your last ship was hit. This is a novel feature that more programs should use. In the old version of Invaders Plus, you could only do one thing at a time, move or shoot. In Super Vaders you can do both simultaneously, with rapid-fire shooting no less!

The sound-effects are exceptional. Something is always coming out the cassette port, from the zapping of an invader to the ever-increasing background tempo which intensifies the game.

There are only two small complaints I have about this game. The first dealing with the scoring; your score is only shown after the game is completed. This is a minor problem but I can see why it was done this way. To have on-screen scoring, the top row would have to be set aside for the score section instead of being reserved for the UFO ship.

My second complaint is that the two-player option is not really that at all. The second player doesn't get to man the controls until after his opponent has been annihilated four times and is finished with his game.

Space Intruders

Space Intruders, also a machine language program, is written by Doug Kennedy. It differs from Super Vaders in that it is modeled after Space Invaders Part II (commonly know as Deluxe Space Invaders). Intruders replicates every aspect of the arcade game, and very well, I might add.

One of the first differences between the original and deluxe arcade games you will notice is that there are "splitting invaders." That is, if you hit one, it duplicates itself and a clone appears beside it. These two do not split again if hit.

There are three different types of UFOs in Space Intruders; the regular ship, a flashing ship and a reinforcement ship. The flashing UFO blinks on and off as it flies across the screen. To destroy it, your laser blasts must hit it when it is "on." The reinforcement ship periodically comes by to drop extra aliens into the empty slots in the uppermost row. This can be nerve-wracking when you thought you

creative computing SOFTWARE PROFILE

Name: Super Vaders
Type: Arcade
System: TRS-80 Model I/III, 16K
Format: Cassette or disk
Language: Machine
Summary: Top of the line Space Invaders game for the TRS-80
Price: $19.95
Manufacturer:
Soft Sector Marketing
6250 Middlebelt
Garden City, MI 48135

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invaders, continued...

were almost finished with a wave and suddenly more intruders are strewn in your path to victory.

Space Intruders is so much like Deluxe Space Invaders that it even has two features many people don't even know exist in the arcade game. The first is "counting your shots." Contrary to popular belief, the UFO point values are not random, but rather follow a pattern depending on the number of shots you have fired. By counting shots and hitting the UFO at the right time, you can consistently get the maximum point rating.

The other feature, one that only a few people know about, is referred to as the "rainbow effect." If the last alien on the screen is one from the bottom row and you destroy it, you are awarded bonus points and treated to an interesting graphics display (the rainbow).

There is a two-player option in this program in which players alternate turns after being destroyed, but the time allotted for changing positions is not sufficient.

One extra ship is awarded at 2000 points; that's the only freebie you'll get, so use it well. Unlike Super Vaders, this program does have on-screen scoring and also lets the high-scorer input his name (eight letters maximum). On the lower left, the number of ships remaining is shown and at the right, the number corresponding to the wave you are presently battling.

Both Super Vaders and Space Intruders use excellent sound routines and lightning-fast, smooth graphics. They are the top-of-the-line Space Invader games for the TRS-80. I don't recommend one over the other because they are modeled after different games.

If you like the original Space Invaders then get Super Vaders; if you prefer the Deluxe arcade game, then by all means, get the Space Intruders program. Better yet, buy them both. Then you'll have all the invader games you'll ever need. Both games are virtual black-holes, capable of sucking up hours and hours of play time while improving your game. □

creative computing

SOFTWARE PROFILE

Name: Space Intruders

Type: Arcade

System: TRS Model I/III, 16K

Format: Cassette or disk

Language: Machine

Summary: Excellent TRS-80 rendition of Deluxe Space Invaders

Price: Space Intruders $19.95 tape; Model I and III, $20.95 disk; Model I

Manufacturer:
Adventure International
Box 3435
Longwood, FL 32750

"Come now, Mary — what makes you think we've been watching the invaders from outer space?..."

Contrary to popular belief, the UFO point values are not random.

The story behind the two best selling computer games books in the world.

Computer Games

by David H. Ahl

Everybody likes games. Children like tic tac toe. Gamblers like blackjack. Trekkies like Star Trek. Almost everyone has a favorite game or two.

It Started in 1971

Ten years ago when I was at Digital Equipment Corp. (DEC), we wanted a painless way to show reluctant educators that computers weren't scary or difficult to use. Games and simulations seemed like a good method.

So I put out a call to all our customers to send us their best computer games. The response was overwhelming. I got 21 versions of blackjack, 15 of nim and 12 of battleship.

From this enormous outpouring I selected the 90 best games and added 11 that I had written myself for a total of 101. I edited these into a book called 101 Basic Computer Games which was published by DEC. It still is.

When I left DEC in 1974 I asked for the rights to print the book independently. They agreed as long as the name was changed.

Contents of *Basic Computer Games* (right) and *More Basic Computer Games* (below)

Artillery-3
Baccarat
Bible Quiz
Big 9
Binary
Blackbox
Bobstones
Bocce
Bagel II
Bombrun
Bridge-It
Camel
Chase
Chuck-A-Luck
Close Encounters
Column
Condensation
Conklot
Convoy
Corral
Countdown
Cup
Dealer's Choice
Deepsearch
Deluxe
Dodgem
Doors
Drag
Dr. Z
Elza
Father
Fila
Four In A Row
Geowar
Grand Prix
Guess-It
ICBM
Inkblot
Joust
Jumping Balls
Kaos
L Game
Life Expectancy
Lissajous
Magic Square
Man-Eating Parrot
Maneuvers
Mastermind
Mastertapes
Matouzzle
Maze
Millionaire
Minotaur
Motorcycle Jump
Nomad
Not One
Obstacle
Ocelot
Pasert
Pasert 2
Pinball
Rabbit Chase
Roadblock
Rotate
Safe
Scales
Schnoz
Seahaffie
Sewer
Shock
Smash
Strike 9
Tennis
Ticketape
TV Plot
Twenty
Two-to-Ten
UFO
Under & Over
Vah Gam
Warfish
Word Search Puzzle
Wumpus 1
Wumpus 2
Introduction
The Basic Language
Conversion to Other Basics
Alley Oooey
Amazing
Animal
Avari
Bagels
Banner
Basketball
Bizmum
Battle
Blackjack
Bombardment
Bombs Away
Bounce
Bowling
Boxing
Bug
Bullfight
Bullseye
Bunny
Buzzword
Calendar
Change
Checkers
Chemist
Chief
Chomp
Civil War
Combat
Craps
Cube
Depth Charge
Diamond
Dice
Digits
Even Wins
Flip Flop
Football
Fur Trader
Golf
Gomoku
Guess
Gunner
Hammurabi
Hangman
Hello
Hexapawn
Hi-Lo
High I-Q
Hockey
Horserace
Hurkle
Kinema
King
Letter
Life
Life For Two
Literature Quiz
Love
Lunar LEM Rocket
Master Mind
Math Dice
Mugwump
Name
Nicomachus
Nim
Number
One Check
Orbit
Pizza
Poetry
Poker
Queen
Reverse
Rock, Scissors, Paper
Roulette
Russian Roulette
Salvo
Sine Wave
Slalom
Slots
Splat
Stars
Stock Market
Super Star Trek
Synonym
Target
3-D Plot
3-D Tic-Tac-Toe
Tic Tac Toe
Tower
Train
Trap
23 Matches
War
Weekday
Word

Converted to Microsoft Basic

The games in the original book were in many different dialects of Basic. So Steve North and I converted all the games to standard Microsoft Basic, expanded the descriptions and published the book under the new name Basic Computer Games.

Over the next three years, people sent in improved versions of many of the games along with scores of new ones. So in 1979, we totally revised and corrected Basic Computer Games and published a completely new companion volume of 84 additional games called More Basic Computer Games. This edition is available in both Microsoft Basic and TRS-80 Basic for owners of the TRS-80 computer.

Today Basic Computer Games is in its fifth printing and More Basic Computer Games is in its second. Combined sales are over one half million copies making them the best selling pair of books in recreational computing by a wide margin. There are many imitators, but all offer a fraction of the number of games and cost far more.

The games in these books include classic board games like checkers. They include challenging simulation games like Camel (get across the desert on your camel) and Super Star Trek. There are number games like Guess My Number, Stars and Battle of Numbers. You'll find gambling games like blackjack, keno, and poker. All told there are 185 different games in these two books.

Whether you're just getting started with computers or a proficient programmer, you'll find something of interest. You'll find 15-line games and 400-line games and everything in between.

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Basic Computer Games costs only $7.50 and More Basic Computer Games just $7.95 for either the Microsoft or TRS-80 edition (please specify your choice on your order). Both books together are $15. Send payment plus $2.00 shipping and handling to Creative Computing Press, Morris Plains, NJ 07950. Visa, MasterCard and American Express orders should include card number and expiration date. Charge card orders may also be called in toll-free to 800-631-8112 (in NJ 201-540-0445).

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Andrew Brill

Escape from Castle Wolfenstein

Imagine how excited I was when, after using the Apple in the Editorial department of Creative Computing for auditing but mundane record keeping, several new games appeared on my desk for review. I began to drool as my grubby little hands hoisted the games for the first time. One of them, Castle Wolfenstein from Muse, has made me an addict.

After the almost endless list of tedious instructions for playing Castle Wolfenstein, an Allied prisoner shows up in the first room of a maze of winding rooms that is guarded by Nazi soldiers. The mission is to maneuver the Allied soldier past cruel Nazi guards and sadistic SS stormtroopers, recover the secret war plans, and escape the deadly confines of Castle Wolfenstein.

Armed with a gun loaded with ten bullets, the Allied captive attempts to kill Nazi guards who scream with piercing shrillness when shot. After shooting a Nazi, the prisoner can search him for such goodies as bullets, grenades, and door keys by standing over the dead body and pressing the space bar. However, the prisoner can take bullets from a dead guard only if the guard's clip contains more than the prisoner's supply. Sometimes a guard will surrender to the prisoner when an empty gun is pointed at him from point-blank range. Then the prisoner can search the guard and shoot him with his own ammunition.

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SOFTWARE PROFILE

Name: Castle Wolfenstein

Type: Action/Adventure game

System: Apple II or II Plus with 48K, Applesoft ROM

Format: Disk

Language: Machine Language

Summary: Challenging and interesting game

Price: $29.95

Manufacturer:
Muse Software, Inc.
330 N. Charles St.
Baltimore, MD 21201

Once the pesky Nazis are eliminated from the first room, the prisoner can search the supply chests that are located in most of the rooms by pointing his gun at the chest and pressing the space bar. By pressing the 'U' key, the prisoner obtains the contents of the chest. The contents of these chests enable the prisoner to replenish depleted supplies of bullets and grenades; he may also find Nazi uniforms and bulletproof vests. Once the prisoner is wearing the uniform and vest, he can wander from room to room unnoticed by all Nazis except the SS men. The SS stormtroopers are particularly nasty because of their uniforms and even whelming power. They are hard to identify, and it usually takes a direct hit from a grenade to kill them. Often, a missed attempt at killing a stormtrooper spells a quick, sure end for the Allied prisoner.

Once the prisoner has a full supply of ten bullets, three grenades, and is wearing the uniform and vest, all he needs to complete his escape are the war plans. But the road to escape is long and hard, and blocked by ruthless Nazis.

There are many pitfalls to hinder the escape of the Allied prisoner. Depleted supplies of bullets and grenades, confusing paths of escape, and frequent encounters with the seemingly unconquerable SS stormtroopers all contribute to a very low success rate.

Castle Wolfenstein is not without its annoying features. One of them is its irritating habit of disrupting the game's graphic layout when the Allied prisoner accidentally bumps into a wall. But the most frustrating feature is the length of time it takes to escape. This is due mainly to the time it takes to open the supply chests. Even more frustrating is waiting a

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Escape, continued...

long time for a chest to open only to find that it contains something completely useless like sauerkraut, bratwurst, or schnapps.

Shooting bullets at a chest cuts down the amount of time it takes to open it but also diminishes the supply of bullets. You quickly learn that patience is the most important virtue when playing Castle Wolfenstein.

With a little luck and a lot of patience, you can escape from the castle. If you are lucky enough to escape with the war plans, you will definitely be promoted in rank; if you escape without the plans, you may or may not be promoted. With each escape, the layout of the castle changes and escape becomes more difficult.

The graphics of the game are simple but effective. The three different soldiers—the Allied prisoner, Nazi soldiers, and SS men—are easily distinguished from each other by their clothing. The prisoner (unless he is wearing a Nazi uniform or vest) has no distinctive markings; an ordinary Nazi soldier has a dark uniform with a stripe across it; and the powerful storm troopers wear the ominous letters SS on their vest.

Explosions are brightly flashed on the screen to signal the demise of the prisoner and the end of the game. Escaping from the castle is depicted by the escaped prisoner triumphantly standing out on an open drawbridge with the brightened sky overhead filled with birds.

Castle Wolfenstein can be played with a joystick or paddle, or on a keyboard. The joystick allows for the easiest maneuverability, while the keyboard is the most difficult of the three controls to direct movement.

Castle Wolfenstein may be a little slow to play, but the thrill of the escape is worth the wait. Auf wiedersehn! □

Ed Zaron: The Man from Muse

W.H. Earle

It looks like a computer store. The offices behind it look like the offices of any other small software house, awash in disks, sales brochures, and documentation manuals.

But to 30-year-old Ed Zaron, founder and president of Muse Software, his company's offices are his recording studio, and his staff a support group comparable to the studios and sound technicians a rock group employs when it's recording an album.

And just as a rock musician's crew frees him from worrying about details so that he can concentrate on his instrument, so does the Muse staff free Zaron so that, as he explains with a laugh, "I can spend my time playing with the computer."

A computer can be anything you want.

"Playing with the computer" has taken up a major portion of Zaron's life since he first bought an Apple in February, 1978. The machine arrived just as a ten-year stint as a programmer/analyst with Commercial Credit was beginning to lose its appeal. The predictable result? Instead of spending his off-hours worrying about office problems, Zaron plunged into the task of mastering his new machine. "It got to be a routine where every single day I just came in the front door, turned the computer on, and went back to work—almost an obsession."

It was not long after the onset of that obsession that friends began asking for copies of programs Zaron had written. Seeing the opportunity that such demands represented, he began haunting computer

W.H. Earle, 44 Springdale Court, Baltimore, MD 21207

shows with shopping bags full of cassettes containing games produced either by Zaron or by his Commercial Credit (and now Muse Software) associate, Silas Warner.

By the fall of 1978, that modest sales effort had left the first floor of Zaron's house littered with cassettes, duplicating gear, and shipping materials. By November it was time to hire a friend's wife to help duplicate tapes in newly rented offices and to leave Commercial Credit once and for all.

Muse's progress has been uphill ever since then—the initial staff of one now numbers 13—but it was touch and go at first. "I started the company with about $17, and for the first six months we hardly had more than that." Sales in that first year were around $10,000, but "over every four or five month period, our sales have at least doubled"—a progression that could lead to somewhere between $2.5 million and $3 million in sales in 1981.

That kind of financial action usually involves management on Zaron's part, but he counts himself lucky that best friend Jim Black is able to handle most of the administrative work involved in managing a growing concern. That arrangement frees Zaron to spend most of his time—"day and night"—serving as the primary creative force behind Muse's growing list of highly regarded software products.

"I really love working with computers," says Zaron. "There's nothing I think about more than that. A computer can be anything you want. If you sit back and have a good idea, you can just go and do it on a computer. It's just the realization of one dream. It's tremendously creative."

Computer artists are going to be recognized in the same way that rock stars are now.

That creativity is in turn the explanation for the development of Muse's product line: "Creativity is first here, and marketing kind of follows it to help keep sales up so we can keep on being creative." Games, thus, came first because they offered the most obvious opportunity for Muse's "computer artists" to exercise their skills. Business and educational products appeared only in response to demand—and only after Zaron realized that the "elegance" he likes to cite as the hallmark of Muse software was yet another expression of the creative process.

Muse plans to continue its involvement with business and educational programs in the future, but games will continue to dominate the product line.

The development of Muse will continue to be guided by Zaron's conception of himself, his staff programmers, and the freelancers whose work Muse occasionally markets. Their creative skills determine the products the company will produce, and that fact leads to the obvious parallel between the software and music businesses: each is dominated by its artists, and each is engaged in a constant search for an unending stream of hits.

Eventually, says Zaron, "Computer artists are going to be recognized in the same way that rock stars are now. Everything they do is just so personal. What kind of experience can somebody take you through? They can take you through a music experience, or they can take you through an experience on your computer. Just as, if you listen to any John Lennon album, you hear his rhythm in there, I think if you look at any program by the same guy, you hear his rhythm in there."

The analogy has its limits, of course: Zaron doesn't plan to start doing concerts on tour any time soon, and *Creative Computing* isn't ready to run a Top Ten just yet.

But if you some day can across a diskette titled *Muse's Golden Oldies*, you'll know who's at the keyboard. □

Ed Zaron of MUSE Software

Former Real World Programmer Makes Good in Computer Software Business

Less-than-outstanding public relations photo from understaffed PR department who have more profitable things to worry about.

Wilting plants show effects of unsuccessful runs of "Three Mile Island."

Sunglasses to shield eyes from glare of continuous playing of Robotwar on CRT screen.

Big smile resulting from big profits from "Castle Wolfenstein."

Diehard battery for instant computer power to "The Voice" in case of brownout.

Panoramic view from penthouse suite of MUSE Software Building.

Wrench and pliers in pencil clip for immediate repair of balky computer keyboards.

"White out" to make last-minute corrections on software manuals not produced by "Super-Text."

Slightly rumpled, macho look makes it big in downtown Baltimore software industry.

Vending machine coffee (and refill) to steady nerves after 20-hour bout with "ABM."

Five for the Vic20

David Lubar

In many cases, the first release of software for a new computer is of the "so what?" variety; there are hangmen aplenty, unlimited variations of nim, and rehashes of teletype-oriented games from ages ago. Let us pause and praise Commodore for knowing better. The first batch of VIC software is here, and it looks pretty good. They supplied us with four games and one personal utility. The games range from fair to very good, and the personal utility is useful if you need a quick graph of your biorhythms. Only two of the programs bear any hint of the early-release syndrome.

550 Deductible

Modeled after a popular arcade game, *Car Chase* was the best game of the lot. The player moves through a course of concentric rectangles, attempting to drive over a series of dots while avoiding head-on collisions with a computer-controlled vehicle. There is an opening on each side of each rectangle, allowing the player's car (and the chase car) to change lanes. The chase car is endowed with unerring accuracy, and capitalizes on any mistake the player makes. Balancing this, the player has three chances per game. Four keys are used to control the car: "A" accelerates, "D" decelerates, "J" is used for moving inward, and "K" is used for moving outward. This arrangement works well once one gets used to it.

If the player succeeds in clearing the screen of dots, he gets a new screen. This process continues until the third collision. At this point, the program displays the most recent score, and the highest score achieved by the player. A press of the space bar starts the game again. *Car Chase* is fun, challenging, and a good omen for the future of the VIC.

For Goodness Snake

Slither and *Super Slither* are two games on another VIC cassette. *Slither* puts the player in control of a snake with an appetite for numbered squares. The player guides the snake around the screen, using the "I," "J," "K," and "M" keys to move up, left, right, and down. The game lasts for sixty seconds. During this time, boxes appear at random locations on the screen. The object is for the snake to collide with the box, while avoiding any collision with the wall or his own body. Each box contains a number, from one to nine, representing a point value. Every time the snake scores points, it grows an extra segment, increasing the danger that the head will hit the body. Only one box appears on the screen at a time, and the boxes only last for a certain amount of time before disappearing.

Super Slither expands on the above game in two ways. First, up to three boxes can be on the screen at any one time. Second, instead of gaining one segment for every box, the snake gains a segment for every point. When the player's score reaches the forties or fifties, maneuvering can become a bit tricky. The only disadvantage with this package is that the two games must be loaded separately. It would be nice if they had been combined, allowing the user to switch between games without stopping to load a program. Aside from this, the games are quite good, and will appeal especially to the younger members of the VIC community.

Busted Again

While *Casino-Style Blackjack* is a vestige of the early days of computer software, this VIC version is well done, incorporating all the features of the game except for insurance bets. Designed for one or two players, with the VIC as the house, the game is a good buy for the casino lover who lives far from Atlantic City or Las Vegas.

Octopus Wanted

Blue Meanies from Outer Space was the one weak game of the group. The player uses six lasers, controlled by six keys, to shoot at the Blue Meanies as they drop from the sky. If a Meanie hits the ground, he destroys a small square area. If enough of the ground is destroyed, the base is overrun and the player loses. The

ground can be repaired using a robot which is controlled with five more keys. This combination leaves one in danger of prematurely involved fingers.

If the player survives the first twenty Meanies, the attack begins anew with twenty Meanies. The player is given a certain amount of energy. When the runs out, he can't shoot. Since the VIC, like the PET, seems to buffer keyboard input, a keypress while power is drain can result in a shot from the laser when power is restored. This usually happens after the Meanie has moved past the laser and can be a touch frustrating. While there is nothing really bad about the game, your summer campers loved it. Blue Meanies just doesn't compare well to the other releases.

In the Mood

Biorhythm Commodore draws a graph of a person's physical, emotional, and intellectual cycles, displays critical days, and can predict the compatibility of any two people whose birthdates are entered. As with blackjack, the biorhythm program is old stuff though well executed. While opinions vary as to the validity of biorhythms, the program is ideal for parties and other gatherings of humans in need of something to do.

Sweeping It Up

The early VIC line was obviously not rushed to market. The games are filled with error traps that aren't allow bad input. The first improvement Commodore should make is better documentation. Each game is accompanied with a single sheet which, though it explains the game, is more a summary than full instructions, leaving the user to discover the fine points through trial and error. Beyond this, the first release of VIC software is nothing but good news for VIC owners. The tapes are available for a suggested retail price of $14.95 each. The five reviewed above, along with another program, are also available in a six pack retailing for $99.95.

The Future

A discussion with Commodore revealed ambitious plans for further software releases. The next six pack of tapes will include programs for personal finance, home inventory, and line-oriented word processing. For recreation, there will five cartridges with Scott Adams Adventures, and one with the popular Sargon chess program. In the arcade area, releases will include *Vic Avenger*, *Super Lander*, and *Super Alien*. Planned utilities include *VIC-MON* with machine language aids and *Programmer's Aid for Basic*. Finally, to gladden the heart of old Trekkies, Commodore has selected William Shatner to be their commercial spokesman for the VIC.

Commodore Business Machines, Inc. is located at 950 Rittenhouse Rd., Norristown, Pa. 19403. ☐

creative computing software evaluation

THE ATARI GOES TO WAR

George Blank

creative computing SOFTWARE PROFILE

Name: Eastern Front

Type: War Game

System: Atari 400 or 800

Format: Cassette, Disk, MicroNet download

Language: Machine

Summary: Outstanding Computer War Game

Price: $23.25 to $29.95

Manufacturer:
Atari Program Exchange
P.O. Box 427
Sunnyvale, CA 94086

Why would a multimillionaire ex-movie star seek a job as President of the United States with a salary of a mere $200,000 a year, or the head of a major corporation join the Cabinet with a salary even lower? The answer is that of all the success drives that captivate the human imagination, the strongest is the lust for power. Power is far broader than sex, wealth, or fame, and may make the others easier to obtain.

No exercise of power can compare with the job of a commanding general in time of war, marshaling millions of soldiers and the industrial resources of many nations in an all-out drive for supremacy on a battlefield that covers a continent. One of the largest such campaigns in human history was Operation Barbarossa, the German invasion of Russia that began in the summer of 1941. During the course of this four year campaign, nearly 20 million human lives were lost. Eastern Front, one of the best microcomputer war games ever produced, allows the player to take on the role of the commander of the German army, and try to do better than the German forces actually did.

Nearly every aspect of the game is a technical masterpiece.

In the past, among war games, board games have had a major advantage over computer games. War gamers like to operate on a theatre level, with an overview of dozens or even hundreds of units scattered over a wide area. Until now the limitations of computer displays have made it difficult to get a satisfying situation map.

Special Features

In Eastern Front, Chris Crawford has produced the first really satisfactory solution to the display problem by using the fast fine-scrolling ability of the Atari computer to produce a magnificent map of Eastern Russia that occupies ten display screens.

Nearly every aspect of the game is a technical masterpiece. Eighteen colors are used on the screen at a time. Player missile graphics are used to move a cursor over the map to give instructions without disturbing the map underneath. Several different redefined character sets permit the natural mixing of a colorful and detailed terrain with a text display. Display list interrupts are used to set the weather conditions, with ice gradually taking over the rivers in winter and receding in the spring, and making the player deal with mud and snow at different times in different areas.

The program uses intricate artificial intelligence routines and multiprocessing to control the Russians and their allies. This means that the longer the German player takes to form his strategy, the better the Russian strategy will be. The Russian side can analyze its position, recognize danger and opportunity, avoid traffic jams, recognize the effects of terrain, and plan accordingly.

Atari SOFTWARE

Air Traffic Controller

In this popular, fast-moving simulation you must successfully control the flight paths of 27 aircraft as they take off, land and fly over your airspace. You give orders to change altitude, turn, maintain a holding pattern, approach and land at two airports. With five different airport configurations and variable skill levels, you won't easily tire of this absorbing and instructive simulation. Cassette CS-7004 $14.95.

Original Adventure

Only the brave enter the Colossal Cave, and only the clever survive. The entire evil cast of this classic game, from deadly dragon to nasty dwarf, will try to stop your quest for treasures. Using English commands, you explore the cave, travel through more than 100 locations, gather treasures, and attempt to think your way out of dangerous situations. Every aspect of the game is faithfully reproduced from the Original Adventure born on large computer systems. For weary travelers, there is even a SAVE GAME feature. Add this classic to your software collection. Order CS-7504 for disk $24.95, CS-7009 for cassette $19.95.

*Dominoes

Take on your computer at a game of draw dominoes. With options for repeating or alternating draw, **Dominoes** gives the game player a tough opponent who's always ready. From Thorn/EMI. Order cassette CS-7007, $11.95.

*Cribbage

Can you be the first to peg below around the board? Your computer will put up a tough fight in this head-to-head game of cribbage. A graphic display of board and cards highlight this game of skill. From Thorn/EMI. Order cassette CS-7008, $11.95.

*Tilt

A favorite craze for years, the familiar wood labyrinth that tilts in all directions has entered the computer age. One or two players attempt to navigate balls through a maze and into scoring holes. With nine skill levels and nine speeds, **Tilt** will provide hours of fun. And, since each player can use a different skill level, **Tilt** is ideal for family play. From Thorn/EMI. Order cassette CS-7013 $11.95.

*Pool

Put a games room in your computer. Old pros and beginners alike will thrill to the challenge and realism of **Pool**. From the satisfying click of a tough combination shot to the accuracy required for a three-cushion bank, **Pool** has it all. You control the angle and force of your stroke, then watch the object ball speed toward the pocket. It's so real you can almost feel the felt.

There is a practice mode for one player, and 9-Ball and Tournament Pool for two. Take a break with **Pool** today. From Thorn/EMI. Order cassette CS-7010 $14.95.

*Darts

Enter the pub, grab a pint of lager and a handful of darts, then try for a bull's eye in this amazing graphic game. One or two players can go at it, testing their aim at ten skill levels. Whether you want to throw a few, or just show your friends what the Atari computer can do, **Darts** is an ideal addition to your software library. This is Britain's most popular Atari game from Thorn/EMI. Order cassette CS-7011 $14.95.

*Billiards

This captivating British game is played with three balls on a standard pool table. Each player attempts to score by sinking a shot or hitting two balls with his cueball. From Thorn/EMI. Order cassette CS-7012 $14.95.

*Snooker

A tough British Game using 26 balls requiring the eye of sharpshooter and the strategy of a chess master. From Thorn/EMI. Not available on cassette.

Atari is a registered trademark of Atari, Inc.

Trucker

This program simulates coast-to-coast trips by an independent trucker hauling various cargos.

If all goes well, you can obey the speed limits, stop for eight hours of sleep each night and still meet the schedule. Bad weather, road construction or flat tires may put you behind schedule. You may try to increase your profit by skimping on sleep, driving fast or carrying an overweight load. Not available on cassette.

Streets of the City

During your tenure, you must construct streets and Interstate highways, repair existing streets, and improve traffic safety. For the Transit Authority you have to upgrade and replace a dilapidated bus fleet, increase ridership, reduce maintenance downtime and improve on-schedule performance. Not available on cassette.

Outdoor Games

Fight a raging inferno in Forest Fire. User options allow for endless variety and skill levels. When the fire is out, relax with Fishing Trip, but watch out for sharks. The brave may wish to trek through the wilderness in Treasure Island I and II. Beware the sentinels—they're after you. Order cassette CS-7002 $11.95.

Haunted House

You are trapped in a mansion, alone except for the spirits that haunt the place eternally. Can you find the exit before midnight? This ever-changing game, complete with sound effects, is a perfect companion for dark evenings and rainy days. Order cassette CS-7003 $11.95.

Disk Packages

Pool, Snooker Billiards	CS-7509 $24.95
Darts and Tilt	CS-7508 $24.95
Dominoes and Cribbage	CS-7507 $19.95
Outdoor Games and Haunted House	CS-7502 $19.95
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Figure 1. The opening display of Eastern Front shows the Baltic Sea, with two Finnish Infantry Units (German Allies in Finland) and three Russian infantry units. This black and white picture does not distinguish between the units, but the Russians are red and the Axis are white. The city in the top center of the screen, directly below a Russian unit, is Leningrad.

Figure 2. German and Russian units face each other in Central Poland. This display shows mountains, rivers, forests, marshes, and the city of Kiev, along with Russian and German Infantry and Armor units. The cursor is over a Russian Unit. Pressing the button would cause the unit to disappear, identifying the terrain underneath, and also display information on the unit: in this case, the 6th Russian Tank Army, a weak unit with a morale level of 76 and a current strength of 77.

The human engineering of the game is also a major accomplishment, with all information entered by the player using only the joystick, trigger button, start button, and space bar. This eliminates the drudgery of most war gaming. The multiprocessing even allows the German player to move the cursor around and view different sections of the map while the battles are taking place. Of course, since all battles and movement are real time, it is impossible to see everything that is happening. Excellent sound effects do indicate the extent of the overall action.

The computer adds a great deal to wargaming, particularly by providing a dynamic environment in place of the static nature of board games. Each turn, representing one week of actual time, is broken down into 32 time periods in which units move and fight. Thus a player might program a particular unit to attack an adjacent enemy unit and move toward a city. During the course of a single turn, that unit might destroy the first enemy unit, move forward to engage a unit behind it, force the second enemy to retreat, turn toward the city, and engage in battle a third enemy unit that has come up from the reserves during the turn. Terrain affects both movement and combat, with rivers, forests, marshes, mountains, and cities to complicate strategy.

Playing the Game

At the beginning of the game the German commander has the advantages of concentrated force, short supply lines and superior mobility. However, the Russians have overwhelming numbers, vast territory, and the Russian winter on their side. The object of the game for the German commander is to push as large a force as possible as far East as possible and maintain them. Extra points are awarded for capturing key Russian cities. The Russians are trying to move their forces West, which also affects the German player's score. The score, which is calculated from week to week, can range from 0 to 255 points. It is fairly easy to get a high score by early fall, but nearly impossible to hold that advantage over the winter.

During the war, large concentrations of German troops were bogged down in the Pripet marshes between Minsk and Kiev, allowing the Russians to concentrate their forces. This is a recipe for disaster in the game, as it was also a German

Figure 3. The instruction book contains a map of the whole area covered by the game. Only one tenth of this area is displayed on the screen at one time.

disaster in real life. My own best strategies have involved splitting up my forces to prevent the Russians from concentrating theirs, and avoiding combat with superior mobility unless I had overwhelming superiority. Another possibility might be to crash through the Pripet marshes and break into open territory beyond, splitting forces at that time. Uncertain winter supply lines require that the German player draw back during that season.

Regardless of my strategy, my success rate in my first ten games was abysmal. The game ends automatically after the week of March 29, 1942, and in nine of my games my score was 0 on that date. In the one game where I held a score to the end, I seized the city of Leningrad (worth 10 points) and defended it to practically my last man. My total score was 10 points.

After many hours of play, I found only a few real weaknesses. Giving all these instructions with the joystick can give you a sore palm and wrist. The lack of a clear-cut set of victory conditions is frustrating; as is the overwhelming advantage of the

I have no hesitation in calling this one of the very best war games available for a personal computer.

Russians. I would also like an option to be able to see the whole theatre at once, however limited the detail might be at that time. The designer mentions in the instructions that test players became frustrated with random logistics problems and traffic jams, but I tend to think these are realistically handled.

Recommendation

I have no hesitation in calling this one of the very best war games available for a personal computer. It is also a virtuoso demonstration of the awesome built-in capabilities of the Atari computer. This game literally could not be done on any other computer in as satisfactory an execution. By all means, if you are at all interested in strategy games, buy it.

If you are a serious war gamer, buy it even if you have to buy a computer in order to run it. Eastern Front comes on disk, requiring 32K of RAM, for $29.95. It is also available on cassette, requiring 16K of RAM, for $26.95. The cassette version can be downloaded from MicroNet at a price of $23.25. □

Expanding Your TRS-80 Model I

Alternatives to the Radio Shack TRS-80 Expansion Interface

If you are considering memory expansion, floppy memory, serial I/O, etc. for your TRS-80 read on.

Exatron MM+

Harley Dyk

If you own a 16K Level II TRS-80 Model I, you own a very cost effective computer. This does not necessarily mean, however, that you are content with your computer. If you are a programmer you are aware that programs often grow to fill (or exceed) available memory. If you are a serious user of your system you probably long to add a disk drive or alternative, such as the Stringy Floppy or the Beta-80. In either case you may need more memory and/or a floppy controller.

The MM+ (memory plus interface) by Exatron and the System Expansion by LNW Research provide quality alternatives to the Radio Shack Expansion Interface and either could save you some money depending on your needs.

MM+

The MM+ has just been introduced by Exatron (the Stringy Floppy company). The unit comes assembled and is made to fit under the TRS-80 monitor. Standard features are: 32K of memory, built-in power supply, parallel printer port (Radio Shack/Centronics compatible), serial printer port (RS-232C), light pen port, real-time clock, and general parallel port (IBM Model 50 compatible). The unit was designed with Stringy Floppy owners in mind, and this accounts for the fact that a floppy controller was not included as a standard feature.

The MM+ has room for an additional board and its power supplies run at or under 50% capacity. An additional 32K (bank 2) and floppy controller will be the first options available on the second board. Exatron is polling its Stringy Floppy owners to find what other options they would like to have available on the second board. The company plans to work on the options in order of preference indicated by their customers. Some of the other things under consideration are: color graphics, hard disk controller, RS-232C serial I/O, IBM Model 50 bidirectional interface (use typewriter keyboard), multi-port parallel I/O, A/D and D/A interface, TRIAC/SSR/OPTO-Isolator control interface, port 255 audio output circuit (for sound effects), IEEE-488 interface, and a communications modem.

A unique feature of the MM+ is the light pen port. This port is designed for use with the "Photopoint" light pen made by MicroMarts. The light pen can be used with a cassette recorder serving as an amplifier, but the light pen port makes the amplifier more convenient and leaves the recorder free. The port should work with any light pen that normally connects to the Radio Shack cassette recorder.

The MM+ is guaranteed to run at double CPU speed (3.55 MHz). This makes the MM+ compatible with the TRS-80 speed-up kit offered by Exatron.

The Memory + Interface (MM+) by Exatron.

Harley Dyk, 1644 Orion, Grand Haven, MI 49417.

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CIRCLE 340 ON READER SERVICE CARD

	MM+	LNW
Size	17" x 7" x 3"	10" x 12" x 3" (in LMB 10825 chassis)
State	Assembled only	Bare board only
Cost	$399	$270-$300 including power supply and 32K
Memory	32K only	16K or 32K
Floppy Interface	No (but an option soon)	Add $50 plus cable
Real-Time Clock	Yes (can use with Level III Basic)	Add $4
Serial I/O	Printer output only (300 and 600 baud)	Add $22
Parallel printer port	Yes	Add $3
Dual cassette port	No	Add $10
Light pen port	Yes	No
Bus extender	Yes	Yes
On-board power supply	Yes	Yes (minus transformer)
Dealers	No, mail-order (order through program chairman (active Strings Floppy owner)	None established. However some dealers may stock this board, otherwise mail-order
Warranty	Year/30-day money-back	90 days (board only)
Toll free number	Yes	No
Contact	Exatron 181 Commercial St. Sunnyvale, CA 94086 800 538-8559	LNW Research 8 Holbrayden St. Irvine, CA 92714
Misc.	Guaranteed to run at 3.55 MHz, has memory bank select circuit so can add another 32K, has on-board memory-mapped address decoding.	Prices of options above are accurate only if built in the order listed. Any other order could change prices since parts are shared in many sections.

Table 1.

Comparison

The key to selecting one of the two expansions lies in the answers to the following important questions. Do you want to build your expansion unit? Do you need a floppy interface immediately? Do you need serial I/O now? (The MM+ has output only at this time.) Do the additional features being considered for the MM+ interest you? These questions address the basic differences between the two units. Table 1 can also help you compare the major features at a glance.

Both units have performed well for many users. Both work well with disk alternatives such as the String Floppy and Beta-80. Both units are of top quality and are produced by reputable companies. At a minimum, either unit should fix your OM errors and provide many additional features.

The LNW System Expansion

Richard Zatarga

This article addresses those computerists who are ambitious, industrious, and capable of reading a schematic diagram; possess a better than average ability to use a soldering iron; and have a desire to upgrade a TRS-80 Model I computer and save over $100 in the process.

The above exordium may sound like science fiction, however, if I have just described you and you are willing to spend a few—well actually, quite a few—evenings with iron and solder in hand, you can have an Expansion Interface for two-thirds of Radio Shack's price, and with a serial RS-232C/20mA interface thrown in as a bonus.

"Sounds too easy!" "What's the catch?" you ask. Well read on and I'll tell you how I did it. First, I parted with $69.95 plus $3.00 for shipping and handling for the LNW Research System Expansion printed circuit board. Please note that this is a bare P.C. board. What you are paying over $70 for is a meticulously traced and silk screened epoxy circuit board and LNW's electronic expertise.

Ten days after I placed my order for the P.C. board, UPS delivered the board and the assembly/user manual. After opening the box, I inspected the board for damage. The board was fine, but what I noticed during the inspection was the very tight and dense component layout. I've built a few electronic kits in my day from a simple speaker system to a complex color television, but I had never run across a you-build-it circuit as tightly packed as the System Expansion. This project is definitely not—I repeat, not—for the novice solder jockey or the sweat solder expert who works with copper tubing and a propane torch. Construction of this unit requires time, patience and precision.

With the board inspected, I sat down in my favorite easy chair and begun to read the manual. Quickly thumbing through its 87 typewritten pages, I was initially impressed. However, after reading it thoroughly from cover to cover, I found the manual to be a bit of a disappointment due to the lack of detail, especially in sections on assembly, testing and trouble-shooting.

The next thing I did was to collect all of my electronic component catalogs and a few back issues of some computer

Richard Zatarga, 888 Towers Avenue Rd., Trumbull, CT 06611

4MHZ, DOUBLE DENSITY, COLOR & B/W GRAPHICS . . THE LNW80 COMPUTER

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[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

magazines. Armed with the component checklists provided in the LNW assembly manual, I perused the catalogs and magazine advertisements looking for the best buys on the various components I needed to construct the System Expansion.

I found that resistors were a bargain from one supplier, while integrated circuits were better purchased from another. Another vendor had great IC prices, but his capacitor prices were outrageous. The results were a parlite orders to six vendors in four states. With my orders for parts in the mail, I sat back and impatiently waited for the components to arrive.

A stroke of luck—the first order to arrive consisted of some integrated circuits and all of the IC sockets I needed for the interface. Actual construction began with mounting and soldering all of the sockets on the PC board. Next, the resistors and capacitors were added. Finally, all the diodes were inserted and soldered in place. I worked on the interface a few evenings a week over a period of two months.

It was just three days shy of the second month when my final parts order arrived. If all the components had been readily available, eight or nine evenings would have been all the time needed to complete the board and thoroughly check my handiwork.

Testing

The main power to the System Expansion is provided by a TRS-80 computer transformer. The LNW onboard power supply takes the raw transformer voltages and provides the regulated +5V, -5V, +12V, and -12V needed to activate the rest of the board. These voltages are isolated from the main part of the System Expansion by five jumpers, and the LNW assembly manual has a procedure for testing them out before the jumpers are added and power is supplied to the rest of the board.

When I first powered up the System Expansion, I expected something to happen, such as blowing both onboard fuses or at least a little puff of smoke. Nothing! I proceeded with LNW's test procedure taking voltage readings at designated test points with a DMM. Everything in the power supply section checked out fine.

Next, I added the jumpers providing power to the rest of the board. Please note, all of the IC sockets were empty at this time. I saw no reason to test a fully loaded board and take the chance of incinerating some expensive integrated circuits.

I proceeded with LNW's next test procedure. All voltage supplies checked out except for one of the +5 volt sections. I traced the +5 volt supply through the schematic and onto the board, and found a couple of terminating resistors bridged together with solder and loading down the +5 volts to less than 3.2 volts. A light touch with the tip of a soldering iron rectified the problem and all voltages checked out.

Verifying the power supply voltages is the extent of the testing procedures provided in LNW's manual. Still being cautious, I decided to test the rest of the System Expansion one section at a time. The first section I tested was the Dual Cassette Control.

Using the parts list by section, I inserted the required IC chips into their proper sockets, and attached two cassette recorders to the DIN connectors. I powered up the System Expansion and the keyboard, and loaded blank tape into each recorder. I wrote a short Basic program and entered CSAVE#-1"TEST". The first recorder responded. I then entered CSAVE#-2"TEST" and the second recorder fired up. To complete the test of the Dual Cassette Control, I CLOADed the test program from each recorder and run the program. Both recorders saved and loaded data perfectly. So far, so good.

The next section I tested was the 32K memory. I tested this section in 16K increments. Why annihilate 16 RAM chips at once when I could do it in two easy steps. The first eight chips were inserted and power was applied to the system. I entered ?MEM from the keyboard and lo and behold a number greater than 15,572 magically appeared on the screen. I run a RAM test routine and all the memory checked out. I was feeling pretty good at this point and inserted the other eight RAM chips.

PRINT MEM yielded 48,340 this time. The RAM test confirmed that all, including the new 32K memory addition, was functioning properly. Now my ego was really soaring. It must have been up to eleven points on a ten point scale. Confidence in my construction ability was at an all time high, so I decided to forge ahead: even though it was 1:30 in the morning.

Next on the list for testing was the parallel printer port. The relevant chips were inserted and a printer cable connected between the System Expansion and a borrowed printer. I powered up the entire system and CLOADed the test program mentioned earlier. I entered LLIST and *Eureka* the program listing was output to the printer. I modified the program by changing all the PRINT statements to LPRINT. RUN ENTER produced a nicely formatted report on the printer. Three sections tested and I was batting a thousand. I decided to check one more and call it a night.

I inserted the integrated circuits required for the Floppy Disk Controller section. The 40-pin FD-1771 disk controller chip took some effort to get into its socket. There always seemed to be one or two pins that slipped out of alignment. Finally, the FD-1771 was properly inserted, and I connected a borrowed disk drive to the interface and applied power to the system—again.

I inserted a diskette into the drive and pushed the reset button. Nothing happened! What was wrong? I checked the power switches. Everything was on. I checked the floppy cable and that looked fine.

I read the DOS manual (When all else fails, read the instructions. Right?) and discovered that DRIVE 0 must be the terminal drive, i.e., the last drive on the cable, and it must be the drive farthest away from the interface. Also, the connector nearest the interface must always be attached to a drive. My borrowed disk drive and cable came from a friend with a two drive system and he only lent me one drive. I moved the drive to the first connector on the cable, and this time when I pushed the reset button the drive activated, the CRT screen went blank for a second, and voila! DOS READY appeared on the screen. I run the TEST2 utility provided on the TRSDOS diskette

The LNW Research System Expansion with power supply and 32K. Transformer not shown.

to stress test the floppy controller. The test was successful and I decided to pack it in for the night. I'd test the RS-232C/20mA interface in the morning.

The last of the ICs was put on the board. The 40-pin UART went into its socket without a hitch. It's amazing what a little experience or a couple hours of sleep and four cups of coffee will do for one's manual dexterity. I entered a serial interface routine LNW provided in the appendix of their manual. The RS-232C/20mA interface worked like a charm. Testing of the System Expansion was complete. All sections worked and I had an expansion interface equal to Radio Shack's with the added plus of an RS-232C/20mA serial interface.

The Bottom Line

Did I really save money by going the construction route to upgrade my Model I? My answer has to be a definite yes. Was the completed unit worth the time, effort and, on occasion, aggravation required to construct it? Again, I must answer in the affirmative. Permit me to elaborate.

My total cost for the printed circuit board, sockets, resistors, capacitors, power pack, miscellaneous hardware, integrated circuits, including sixteen 4116 memory chips, was $310. I built a case for the completed board and two power packs—one for the System Expansion and one for the CPU—from some scrap lumber I had in my workshop. If you don't have access to any scrap lumber, another $30 or so can be added to the overall cost.

A substantial investment indeed, but still quite a bit under Radio Shack's price.

Check the discount mail order advertisements in this magazine for the cost of a Radio Shack Expansion Interface. The cheapest one I found was $299. Check out the prices on 4116 memory chips. The best value I found was $40 for eight chips. That totals to $349—only $29 more than I invested and no construction required. But hold on for just one second, the System Expansion includes an RS-232C/20mA I/O section and my total cost includes the components required for this serial interface.

Check the advertisements again, and you'll find that $89 is about the best buy you can find for Radio Shack's RS-232C option. Now your cost is up to $418. A $100 savings should be worth the time and effort required for anyone to build the unit. It was for me.

An added advantage of contracting the LNW System Expansion is the ability to repair any problems that may develop with the unit. Armed with the schematic diagram, the sectionalized parts list and the circuit descriptions provided by LNW, a minimum of time and effort should be all that is needed to locate and fix most troubles. Please note that this last statement assumes some electronic and trouble-shooting ability.

Conclusion

I've been using my System Expansion for the past four months. I have my own printer and disk drive attached to the unit. You can borrow hardware from friends for only so long before they start forcing lease with option to buy contracts on you. Well, the System Expansion has been performing very well. I haven't experienced any crashes or erratic operation. Disk I/O has been impeccable. Everything has been functioning perfectly.

So, if you possess the skills I mentioned earlier, want to save some of your hard-earned money and want the satisfaction of building a sophisticated piece of computer equipment, then I recommend the LNW System Expansion. You won't be disappointed. □

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CIRCLE #170 ON READER SERVICE CARD

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Aurora Systems Videodisc Controller

David H. Ahl

For years, we have been enthusiastic about coupling a computer to a videodisc. Initial proponents predicted that the main function of the videodisc would be to carry programs and data in very large quantities, and serve principally as a local data base. After all, a disc can hold 10^{11} bits of information which is a very great amount indeed.

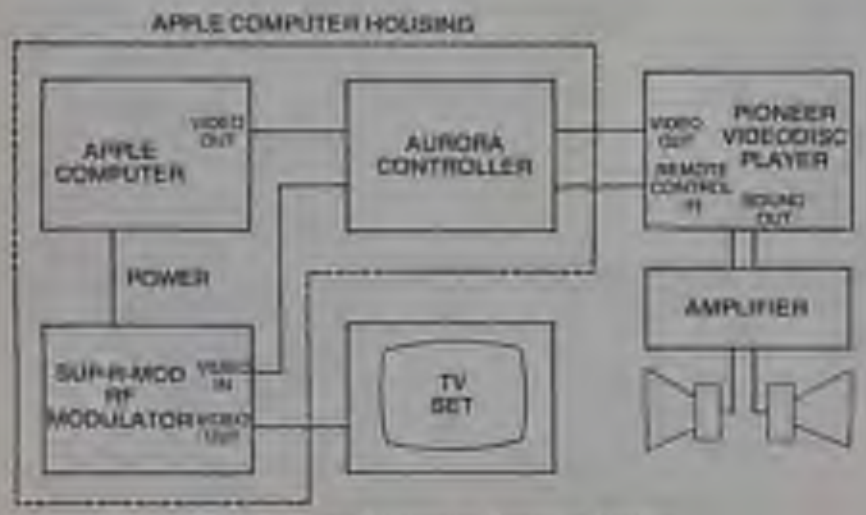
However, videodisc players first came into their own as industrial and educational learning devices and several commercial players for industrial use were introduced in 1978 and 1979. For use as a home entertainment device, further engineering and cost reductions were necessary, and players did not become commercially available until late in 1981. Unfortunately, the first player (Magnavox) did not have provision for external remote control. Thus, to build a computer-to-videodisc interface would have involved disassembling the player and messing about with wires, integrated circuits, and the like. Furthermore, this sort of messing around would have voided the guarantee of the player and consequently no one was anxious to introduce an interface for which there would be a small, if not non-existent, market.

However, the Pioneer VP-1000 Videodisc Player, introduced in early 1981, is much more hospitable to an external interface. This is because it has a remote control unit which can either work by an infrared light signal from across the room or hard-wired with a long cable to a jack in the back of the player.

Unlike many video cassette recorders in which the remote control unit provides only a few functions, the Pioneer RU-1000 remote control unit duplicates all of the videodisc player functions. Thus, it is a relatively straightforward job to produce a computer-to-videodisc interface which will duplicate the functions of the Pioneer remote control unit.

In addition to sending a control signal to the player, a good interface must also accept the video signal from the player and marry it to the video signal from the computer. The designers of the Aurora Systems videodisc controller chose the easy way to solve this problem. In particular, the interface merely switches back and forth between the two video signals. In other words, the output from the computer or the output from the videodisc player may be displayed on the screen but not both at once. Some other interfaces permit mixing the computer and video signal, however, their price puts them out of the range of most home or educational systems. (Can you justify paying more for the interface than for the videodisc player itself?)

Insofar as providing the control signals to the videodisc player, the Aurora controller does a very good job.



Block Diagram Of Videodisc Controller Hookup

The Hardware

The hardware consists of one printed circuit board which is normally plugged into slot number 4 in the Apple. Both the video signals from the Apple and the videodisc player must be plugged into this board. A short cable is provided to plug into the output of the Apple video signal and plug into the board. Another cable is provided to connect the video out of the Pioneer VP-1000 player and the board. (This cable was missing from our interface kit.) The last video cable is an output from the video board: it provides a composite video signal which can be connected to a monitor.

To use the controller with an ordinary television set (as opposed to a video monitor) it is necessary to connect the video output from the controller to the input of an RF modulator such as the Sup'R Mod modulator. The manual admonishes one to "be sure to disconnect any other video inputs to the modulator (such as may be connected to pin #2 of the auxiliary video connector on the Apple II board). This may involve clipping of the video input wire or removing the #2 contact of the Molex KK100 connector. If your modulator derives its power from the Apple you must leave the other three wires undisturbed."

I wasn't anxious to clip the wire because it might be one that I wanted to use again. However I found that a very small screwdriver would easily unfasten the contact from the Molex connector. The question then became: which is the number 2 contact? Trial and error revealed it was the second contact from the right of the connector as one faces the front of the Apple.

One other cable had to be constructed between the board and the remote control input on the videodisc player. The cable with the Pioneer remote control unit handled this job nicely.

The Software

The interface comes with a DOS 3.3 disk of software. This disk includes all the necessary routines, both in Basic and machine language, to incorporate into user programs to allow control of the videodisc player. The routines are located in page three of the Apple memory, so they do not interfere with normal programs.

The manual gives a rather sketchy discussion of how to use the software in user programs. However, we found that by listing the demonstration program on the disk it was quite easy to see how things were done and we had no trouble incorporating the routines into our own programs. Since these demonstration programs are rather lengthy and only a small portion fits on the screen at one time, we found it very helpful to list the programs on a line printer and refer to the listings when writing our own programs.

Instrument Interfaces
Videodisc Controller Code Table

Character	Function	Hex	Decimal
1	Screen Set	014	85
2	Screen File	018	88
3	Pause	034	52
4	Play	030	48
5	Fast Reverse	54E	78
6	Fast Forward	54F	79
7	Slow Reverse	548	72
8	Step Reverse	54A	74
9	Slow Reverse	019	89
0	Slow Forward	01E	85
1	Step Reverse	014	84
2	Step Forward	54D	77
L	Left Audio	54C	76
R	Right Audio	052	82
S	Search	057	83
C	Reject	051	81
C	Chapter	543	67
F	Frame	544	68
[illegible]		030	48
[illegible]	Subcode	[illegible]	[illegible]
[illegible]		039	57

The videodisc control codes table in the manual had one nasty typo which caused us several minutes of consternation. One of the most frequently used commands is "step forward" because it is the one that freezes a video frame on the screen. Unfortunately, the manual lists the incorrect hex and decimal code for this function. Indeed, the code listed sends the numeral 2 to the player. The correct code is shown in the code table with this review.

Nothing is Perfect

As with every new technology, there are bound to be some bugs and glitches, particularly in early production models. Such was the case with our Pioneer VP-1000 player. We found that the "step reverse" function worked on some disks and not on others. And even when it was working, it was frequently intermittent and unreliable. Since, of course, "slow reverse" depends upon "step reverse" working, it did not work either. It did, however, work at "full speed," that is, with the slow motion control set on 100% (which is not slow motion at all) the slow reverse function would work.

We also found that "scan reverse" would only work if held down for a second or two. This is normal and does not seem to be a player malfunction. Unfortunately, the videodisc interface has no good way of sending some commands for just a burst and others for a second or more. It is possible, but inconvenient, to get around this in the user software.

Price of the interface is about $250. It is available from Aurora Systems Inc., 2040 East Washington Avenue, Madison, WI 53704. □

Adwar Video Proc Mod

David H. Ahl

Have you ever tried to make a video tape from your Apple? If so, you may have noticed a loss of color, particularly if you have an older Apple computer. The reason for this is that the standard video signal from the Apple does not conform to standard video references. This is especially noticeable on certain home video cassette recorders which are somewhat unforgiving when presented with a non-standard signal. Newer Apple computers are less prone to have this problem as the video circuitry has been "cleaned up" somewhat.

The Adwar Proc Mod is a circuit board which plugs into slot 7 of the Apple and processes the sync information portion of the video signal. It brings the Apple signal closer to standard video references so that video tape recorders and other equipment receive the expected synchronization level, phase, and width.

The Proc Mod is simple to install. The board plugs into slot 7 and a wire with a black connector on it is connected to the second pin from the right on the Mod's video connection at the back of the Apple. This connection does not disturb the RF modulator which is normally plugged into this connector.

The Proc Mod circuit board has a male BNC connector which becomes the new video output connector. Unfortunately, today most video equipment uses either F or RCA phono connectors and the BNC connector is not something you would be likely to have lying around. My Zenith videotape recorder, for example, has an RCA phono plug for the video input. I looked for and later and could find no cable supplier that stocked RCA male to BNC female cables. However, a $1.50 connector and some wires solved the problem and I was on my way to making some of the cleanest, sharpest videotapes of my computer that I had ever seen.

Incidentally, it is possible to use the Proc Mod in conjunction with the Aurora Systems Videolink interface (discussed elsewhere). I used the word "possible" loosely because by the time everything was hooked up, the inside of my Apple was an incredible jungle of cables and looked like a nest of worms. Nevertheless, it did work, and we have been showing the resulting tapes at several conventions and trade shows this fall.

The Scanning Rate Problem

The Apple computer uses a non-standard scanning rate of 524 lines per frame. This will prevent many time base correctors in professional video equipment from accepting the Apple signal. The Adwar Apple Proc Mod will not correct this because more sophisticated signal processing is required. Adwar Video makes such a product, the ARS-170A signal processor. It stores in solid state memory an entire Apple frame and reads it out at the proper scanning rate (525 lines per frame) for NTSC video equipment. It actually remembers two complete frames, storing one while reading out the previous frame, performing all this in real time (with one frame delay).

This signal processor would generally not be needed for most home or commercial equipment. Only if one contemplates serious professional studio work would such a processor be required for one method).

Price of the Adwar Apple Proc Mod is $301. Price of the ARS-170A is $1850. Both products are available from Adwar Video, 100 Fifth Ave., New York, NY 10011. ☐

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CIRCLE 173 ON READER SERVICE CARD

Adventures in Videoland

David Lubar

Rollercoaster: A Computer/Videodisc Adventure

Frame One: *Editorial meetings, lack thereof, and a romp through the Acropolis.*

With the right mixture of eye contact, it's possible to survive a meeting intact and leave without any awesome assignments. The meeting in question was almost over when the words "I've been saving the best assignment for last," put a choke hold on my spirit of survival. No doubt, the phrase was aimed in my direction. Realizing that the meaning of "best" varies considerably, depending on who is doing the listing, I tore my gaze from the sky tiles on the bookshelf and waited to see what the boss had in mind. Since previous assignments had run the range from covering conferences to reviewing printers, there was no way to predict what might come. The suspense was short lived.

Photos are courtesy of Six Flags Over Texas, Arlington, TX and Six Flags Magic Mountain, Valencia, CA. The roller coasters pictured are "The Colossus" and "The American Revolution."

"I want you to write a videodisc adventure," the boss said in the casual manner usually associated with phrases such as "please pass the butter."

"Need it by tomorrow?" I asked.

"For January." End of topic.

Could be fun, I thought, though I had never written an adventure or toyed with the fringes of video technology. This project would require three-part harmony between an Apple computer, a Pioneer Laserdisc player, and an Aurora Systems Interface. A vague suspicion that I was in over my head prompted a stroll down to the software department. After trying all available personnel, it was obvious that no one there could be talked into whitewashing the fence. Looked like the job was mine. Since the November issue was still under construction, I put the video project on temporary hold, hoping the subconscious would start the work.

Frame Two: *Distorted disc, death of procrastination, and the birth of a framework.*

November doesn't last forever. The harbinger of flying time came in the form of a memo. While I had been blithely trying to forget the project, the boss had been busy. He had taken title one of the movie *Rollercoaster* and compiled two pages of notes listing the frame numbers for every scene. At this point, it dawned on me that he really wanted the program. I got down to work, keeping an eye open for an easy way out.

The first problem was figuring a way to write the program in Basic while avoiding the long delays associated with that language. Taking a slice at modular programming, I started by writing units that would handle essential tasks, such as gathering and parsing input, in an efficient manner. Since actual work with the disc player and interface would require a trip to the boss's house, I wanted to finish as much of the programming as possible before taking the act up to the Fortress of Solitude. This situation, coupled with the eternal search for the easy way out, gave birth to the adventure framework which

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Apple Demonstration Diskette
MECC-1701, $19.95

A sample of the different kinds of explorations available on the MECC diskettes is shown. The software demonstrates applications in drill and practice, tutorial, simulation, problem solving, and worksheet generation. Samples from music, science, social studies, industrial arts, reading and mathematics are provided.

Elementary – Volume 1 (Mathematics)
MECC-102, $24.95

The first elementary diskette contains programs to be used in the elementary mathematics classroom. Games of logic such as BAGELS, TANGRAM, and NUMBER, and drill and practice programs, such as SPEED DRILL, ROUND, and CHANGE, and programs about the metric system such as METRIC ESTIMATE, METRIC LENGTH, and METRIC 21 are included on the diskette.

Elementary – Volume 2 (Language Arts)
MECC-105, $24.95

The teacher can enter lists of spelling words in the computer and have them used by the program SPELL, which drills students on the spelling. MIXUP which presents the word in mixed up order, or WORD FIND, which will create a word find puzzle for the teacher to duplicate. If words and definitions are entered, a CROSS WORD puzzle can be generated or a WORD GAME can be played. Two other programs included on this diskette are TALK, a program designed to introduce students to the computer or AMAZING which prints out numbered mazes. Several programs on this diskette use a printer.

Elementary – Volume 3 (Social Studies)
MECC-104, $24.95

The sell series, SELL APPLES, SELL PLANTS, SELL LEMONADE, and SELL NICKELS which appears on the ELEMENTARY VOLUME 3 diskette can be used to teach elementary economics to students in grades 3-6. CIVIL will review battles of the CIVIL war while STATES and STATES2 provide drill and practice on the location of states in the U.S. and their capitals.

Elementary – Volume 4 (Mathematics and Science)
MECC-105, $24.95

Two mathematics programs ESTIMATE use MATHGAME provide reinforcement on estimating and basic facts. Food chains in fish can be studied through DOELL LAKE while DOELL WOODS deals with food chains in animals. SOLAR DISTANCE teaches the concepts of distances in space and URSA provides a tutorial on constellations.

Elementary – Volume 5 (Language Arts)
MECC-116, $24.95

ELEMENTARY – VOLUME 5 deals with the reading concept of prefixes. The diskette contains five lessons which both teach the combines of UN, RE, DIS, PRE, and IN. Two review lists, DRAGON FIRE and PRE-APP 1, are also contained on the diskette.

Elementary – Volume 6
MECC-120, $24.95

Historical simulations, OREGON, VOYAGEUR and FUR3 are included in the ELEMENTARY – VOLUME 6 diskette. Along with these programs are ROMAC which teaches Roman reading and SLOWER.

Special Needs – Volume 1 (Spelling)
MECC-127, $24.95

This diskette is designed to drill formerly mispelled students on frequently misspelled primary and intermediate words. Reading essay problems by either using the game buttons, the game paddles or only hug on the keyboard.

Science – Volume 2 (Senior High)
MECC-106, $24.95

Many of the programs on this diskette were developed by Minnesota Electronic FEET which dealt with the use of pedometers and DOELL MEMBRANE which the use dialysis bag part of a cell membrane can be used in biology classes. SPELL deals light refraction demonstrating SNELL's law while COLLIDE simulates the collision between two bodies. DIFFUSION deals with the diffusion rates of various gases. NUCLEAR SIMULATION shows radioactive decay of some different radioisotopes. SOBM and RADAR teach angles and projections on a coordinate system.

Science – Volume 3 (Middle School)
MECC-107, $24.95

The FISH program through the use of low resolution graphics shows the circulatory system of a fish. Simulating the DOELL LAKE which is used to study food chains. URSA which teaches about constellations, and QUAKES which simulates earthquakes are on the diskette. MINERALS can be used in the area of earth science to identify 25 minerals by having students perform simple tests.

Mathematics – Volume 1 (Senior High)
MECC-108, $24.95

BAGELS, DRAWK, ICBM, and RADAR will teach students logic while reinforcing the concepts of plotting points or angle measurements. ALGEBRA provides drill and practice in solving equations. Three programs on Parabolas can be used in solving equations on a grid. SLOPE which is designed for use in lower grade with linear functions, POLY-GRAPH which will plot any equation on a rectangular coordinate system, and POLAR which graphs functions on polar coordinates.

Geometry – Volume 1
MECC-116, $24.95

Geometry teaches the topic of curves by viewing curves from two perspectives. The first method demonstrates the "spirit concepts" of unusual, periodic and hypnotic curves. Curve sketching designs are developed to provide an aesthetic view of geometric shapes. The second method uses a mathematical approach and defines a curve as the intersection of planes with a cone. The support booklet provides worksheets and classroom ideas.

Teacher Utilities – Volume 1
MECC-115, $24.95

The TEACHER UTILITIES diskette is designed to aid the teacher and would be used by the student unless the teacher knows questions using the REVIEW program. This program allows the teacher to set up a list of questions which can be used either by the REVIEW program or the TEST GENERATOR program. The teacher can also make CROSS WORD puzzles, WORD FIND puzzles, SLOW LETTER puzzles and PICTURE using the program. FREQUENCY and KEYLOAD can be used to customize practice and study materials and analysis. A review of modified versions of the programs on this diskette.

Programmer's Aid – Volume 1
MECC-121, $24.95

The PROGRAMMER'S AID diskette provides programs for the programmer. Programs for the MECC utilities, programmed in Basic with the ability including PRINT, RENUMBER, SEARCH, SEQUENTIAL EDITOR and TEXT LIST along with programs which will bump every line, CONVERT TO ASCII, SUMMARY, FILE TEST, Communication Test generator, TABLES which shows the user memory usage and manage which is useful for use as a program. PYTHIC DRAWS will let the program all types on the monitor while MONITOR CHARACTERS will locate control characters. STARTER will set memory location such as zero for zero program which is not being installed or initially provided.

MICAR – Volume 1
MECC-101, $24.95

Microcomputer Integrated Computer Aided Recognition Software (MICAR) is a multiple TAU transducer with printer. The MICAR computer and instrumentation provide a a medical instrument with automatic acquisition system. The system consists of transducers, a power supply, a printer, a computer, and a keyboard.

Shape Tables – Volume 1
MECC-120, $24.95

The SHAPE TABLES diskette includes 12 files of TEXT shapes that can be changed, deleted or used in basic. Files included are well formatted to work with shape editor.

Listing 1. Video Adventure. Note that the odd spacing in some of the print statements is for screen formatting. To play without a video interface, change line 40000 to RETURN and change 22000 and 31000 to REM.

To view the video scenes, load Side 1 of the videodisc, Rollercoaster (MCA Videodisc). The listing was formatted using a program by Kerry Shetline.

is described and annotated in the accompanying sidebar. Since the idea is fairly simple, and has most likely been developed more than once in the past, I make no claims of great originality here.

The framework handles all the procedures that are common to most adventures. It is, in essence, a golem, keeping track of a player's moves and the location of objects, and handling common commands such as "GET" and "DROP." By plugging in a couple buckets full of variables, any adventurous realm could be defined. The task of creating a specific adventure now seemed less monstrous (and next year, when they invent the neutrino disc, I'll be able to write a neutrino adventure in record time).

The project requires three-part harmony between an Apple computer, Pioneer Laserdisc player and Aurora interface.

Frame Three: *Onward to Olympus, empathy for hermits, and getting down to the hard stuff.*

I hit the mansion on the hill early one Monday morning, ready to wrestle with technology. The boss flipped a handful of switches, powering up computer, disc player, television, and stereo, while dimming lights throughout the neighborhood. After showing me how to use the interface and disc player, the boss left for the office, and I was on my own. Being alone in someone else's house is a rather strange experience which I will not dwell on here. It should suffice to say that I trod gently so as not to risk breaking the carpet.

The first, and easiest task, was watching the movie. This not only helped pass the time, but gave me a glimpse of scenes that could be used in the adventure. *Rollercoaster*, for those of you who missed the movie, concerns an extortionist who plants bombs on rollercoaster tracks, merry-go-rounds, and other fun places. The movie occupies five sides of three discs. The side used for the adventure contains good

```
  1 GOSUB 30000: REM  INITIALIZE
  2 GOSUB 34000: REM INSTRUCTIONS
  3 GOSUB 22000: REM DISPLAY 1ST ROOM
 10 GOSUB 10000: REM INPUT ROUTINE
 30 IF NOT SPACE THEN
      VB=VB
 40 IF AB=" " THEN 10
 45 PRINT: PRINT
 50 IF ASC(VB)=32 AND LEN(VB)>1 THEN
      VB=RIGHT$(VB,LEN(VB)-1): AB=RIGHT$(AB,LEN(AB)-1): GOTO 50
 60 IF LEN(VB)=LEN(AB) THEN
      HFLAG=0: GOTO 90
 70 AB=RIGHT$(AB,LEN(AB)-LEN(VB))
 80 IF ASC(VB)=32 AND LEN(VB)>1 THEN
      AB=RIGHT$(AB,LEN(AB)-1): GOTO 80
 85 IF AB=" " THEN
      HFLAG=0
 90 A=ASC(VB)-64
100 IF A<1 OR A>26 THEN 10
110 ON A GOSUB 10100,10200,10300,10400,10500,10600,10700,10800,10900,11000,
    11100,11200,11300,11400,11500,11600,11700,11800,11900,12000,12100,12200,
    12300,12400,12500,12600
120 IF NOT KM THEN
      PRINT "I DON'T KNOW HOW TO DO THAT": KM=1
125 T=T+1:
    IF T>150 THEN
      INVERSE: PRINT "I THINK TIME JUST RAN OUT": NORMAL: THE VCR=
      "STANDBY": GOSUB 40000: GOTO 50000
170 PRINT: GOTO 10
1000 AB=" ": SPACE=0: BB=" ": VB=" ": HFLAG=1
1010 GET BB:
     IF ASC(BB)<13 THEN
       RETURN
1020 IF ASC(BB)=8 AND SPACE AND MID$(AB,1)=" " THEN
       SPACE=0
1025 IF LEN(AB)>1 AND BB=" " THEN 1010
1030 IF ASC(BB)=8 AND LEN(AB)>1 THEN
       AB=LEFT$(AB,LEN(AB)-1): PRINT BB;" ";BB;: GOTO 1010
1040 IF BB=" " AND NOT SPACE THEN
       VB=AB: SPACE=1: GOTO 1040
1050 IF ASC(BB)<65 OR ASC(BB)>91 THEN 1010
1060 PRINT BB;
1070 AB=AB+BB
1080 GOTO 1010
9999 REM FOLLOWING ROUTINES ACT ON THE INPUT, SW 1: KEYWORD FLAG
10100 KW=0: RETURN
10200 IF AB="BREAK BOX" THEN 53000
10210 IF AB="BREAK DOOR" THEN
        PRINT "TOO SOLID TO EVEN TRY": RETURN
10299 KW=0: RETURN
10300 KW=0: RETURN
10400 IF VB="DROP" AND HFLAG THEN 26000
10499 KW=0: RETURN
10500 IF AB="E" THEN
        D=2: GOTO 20000
10501 IF VB="EXAMINE" AND HFLAG THEN 27000
10599 KW=0: RETURN
10600 IF AB="FIND BATTERIES" THEN
        PRINT "TRY THE BEAR": RETURN
10610 IF VB="FIND" THEN
        PRINT "I CAN'T HELP YOU": RETURN
10699 KW=0: RETURN
10700 IF VB="GO" THEN 19000
10710 IF AB="GIVE COINS" AND L<5 THEN 43000
10720 IF AB="GIVE TICKET" AND L=16 THEN 40000
10799 KW=0: RETURN
10800 IF VB="HELP" THEN
        PRINT
        "JUST KEEP MOVING AND EXAMINING THINGS, AND AVOID UNDERDAN PLACES."
        RETURN
10899 KW=0: RETURN
10900 IF AB="I" OR AB="INV" OR AB="INVENTORY" THEN 24000
10999 KW=0: RETURN
11000 IF VB="JUMP" THEN 54000
11099 KW=0: RETURN
11100 IF VB="KILL" THEN
        PRINT "THAT IS BEYOND MY POWER.": RETURN
11199 KW=0: RETURN
11200 IF AB="LOOK" THEN 22000
11210 IF VB="LOOK" AND HFLAG THEN 27000
11299 KW=0: RETURN
11300 IF AB="MAKE JAMMER" THEN 53000
11399 KW=0: RETURN
11400 IF AB="N" THEN
        D=11: GOTO 20000
11499 KW=0: RETURN
11500 IF AB="OPEN BEAR" THEN
        PRINT "TWO BATTERIES JUST FELL ": PRINT "OUT OF THE BACK.": PRINT
        "THEY'RE ON THE GROUND": BB(11)=1: RETURN
11599 KW=0: RETURN
11600 IF VB="PUT" OR VB="PLACE" AND HFLAG THEN 25000
11610 IF VB="PLAY" AND L=6 THEN 42000
11620 IF VB="PLAY" AND L=15 THEN 40000
11630 IF AB="PUSH BUTTON" OR AB="PRESS BUTTON": AND L=2 THEN 51000
11699 KW=0: RETURN
11700 IF AB="QUIT" THEN
        END
```

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CIRCLE 224 ON READER SERVICE CARD

scenes of carnival rides and explosions, making it highly suitable for an action adventure.

Having checked out the scenery, I started getting acquainted with the interface. The software included a short machine-language driver that could be called from Basic. Instructions went from computer to interface via the USR command. As the videodisc obeyed my commands, I felt like Archimedes hanging from the tub. This was POWER. I was the demigod of the disc, making it fulfill my every whim. It all seemed too easy. I could search for frames, play sequences, switch from computer to video display, do almost anything except make it roll over and beg.

As is the way in life, there was rain on this parade. Since the precipitation occurred later that day, I won't go into it now. With spirits still undampened, I started mapping the adventure, trying to create a scenario that could best exploit the available video. Thanks to the framework, the rooms and objects were plugged in fairly

The fusion of computer and videodisc will produce spectacular results.

quickly. While the game wouldn't have the magnitude of Crowther and Wood's colossal cave, it would have enough locations to allow the player to get lost once or twice before catching on.

Frame Four: *The problem with adventures, an emergency guide to dizzy subterranean, and the coming of the rain.*

The problem with the average adventure is that it is linear, frustrating and, ultimately, boring. The first one is fun, the second entertaining, but after that the novelty wears thin. I realized I could either put a lot of hard work behind my feelings on the subject and produce a *different* sort of adventure, or rely on the novelty of the video to save the day. Following the sage advice of Occam's Razor and other convenient laws of laziness, I took the easy way out and stuck with the standard adventure format.

This sort of work definitely called for vast quantities of coffee, which led to the following discovery. If you are ever out of milk and sugar, but have peppermint stick ice cream in the freezer, try some in the coffee. It's not bad.

Having mapped the adventure, I was ready to add some video. As a start, I

```
11799 RAM=0: RETURN
11800 IF (A$="READ BOOK") AND (OB(4)=6 OR OB(4)=L) THEN
        PRINT "YOU NOW KNOW HOW TO MAKE A" PRINT "JAWBER FROM A PAPIER" P=1:
        RETURN
11810 IF A$="READ TICKET" THEN
        A$="LOOK TICKET": GOTO 27000
11899 RAM=0: RETURN
11900 IF A$="S" THEN
        D=3: GOTO 20000
11910 IF V$="SHOOT" THEN 43000
11920 IF A$="SHOW TICKET" AND L=11 THEN 49000
11999 RAM=0: RETURN
12000 IF V$="WAKE" AND WFLAG THEN 25000
12010 IF (A$="TURN KNOB" OR A$="TURN DIAL") AND L=2 THEN 13000
12099 RAM=0: RETURN
12100 IF A$="USE JAWBER" THEN 54000
12199 RAM=0: RETURN
12200 IF A$="VISIT BAKER" THEN
        PRINT "SHE DOESN'T WANT TO SEE YOU": RETURN
12299 RAM=0: RETURN
12300 IF A$="W" THEN
        D=4: GOTO 20000
12310 IF (A$="BEAR (WITHOUT)" AND (OB(3)=6 OR OB(3)=L)) THEN
        VC$="STOPPED": GOSUB 40000
        FOR I=1 TO 1000
        NEXT I:
        VC$="": GOSUB 40000: PRINT "IT FITS WELL AND TAKES A NAP": PRINT
        "DISGUISE": FM=1: RETURN
12399 RAM=0: RETURN
12400 RAM=0: RETURN
12500 RAM=0: RETURN
12600 POP: STOP: REM (0000)(00) BIG. INPUT (W I 3)(0)(0) WOODWAL
12800 REM  PARSER FOR DIRECTION
12810 D=ASC(A$): D=(D-78)*(D-83)*2+(D-83)*3+(D-87)*4
      IF NOT D THEN
        PRINT "I HAVE A DIRECTION": RETURN
12900 REM MOVE ROUTINE:D=DIRECTION:R=ROOM MOVED INTO:L=PREVIOUS LOCATION
12904 R=ASC(MID$(R$(L),D,1))-64
12970 IF NOT R THEN
        PRINT "YOU CAN'T GO THAT WAY": RETURN
12980 L=R
13000 IF RND(1)<.6 AND A$="LOOK" THEN
        VC$="SCREAM":
        FOR I=1 TO LEN(VC$)
          A=ASC(MID$(VC$,I,1))
          POKE 0,A
          FOR J=1 TO 4000
          NEXT J:
        NEXT I:
        FOR I=1 TO 4000
        NEXT I:
        A=USR(ADR("")):
13001 IF V$(1,1)="" THEN
        VC$=V$(1,1): GOSUB 40000
        FOR I=1 TO 4000
        NEXT I:
        VC$(1,1)="": VC$="": GOSUB 40000
13000 PRINT "YOU ARE IN ";
13010 PRINT RM$(L): PRINT RM$(L): PRINT "THIS LOCATION CONTAINS: ": F1=0
13020 FOR I=1 TO NO
13030   IF OB(I)=L THEN
          PRINT OB$(I): F1=1
13040 NEXT I:
      IF NOT F1 THEN
        PRINT "NOTHING"
13050 PRINT "VISIBLE EXITS: ";
13060 FOR I=1 TO 4
13070   IF MID$(RM$(L),I,1)<>"0" THEN
          PRINT DIR$(I)" ": F1=1
13080 NEXT I:
      IF NOT F1 THEN
        PRINT "DON'T EXIST"
13090 RETURN
13100 IF L=8 THEN 41000
13102 IF L=9 THEN 47000
13103 IF L=10 THEN 47500
13104 IF L=18 THEN
        PRINT
        "YOU FOLLOW A WINDING PATH. FINALLY,        RETURNING TO FAMILIAR GROUND":
        L=11: GOTO 22000
13105 IF L=9 THEN 49000
13106 RETURN
24000 F1=0: PRINT "YOU ARE CARRYING:"
      FOR I=1 TO NO
24010   IF OB(I)=0 THEN
          PRINT OB$(I): F1=1
24020 NEXT I:
      IF NOT F1 THEN
        PRINT "NOTHING"
24030 RETURN
25000 F1=0: F2=0
      FOR I=1 TO NO
25000   IF A$=OB$(I) AND OB(I)=L THEN
          PRINT "YOU ALREADY HAVE THE ";OB$: RETURN
25010   IF (A$=OB$(I) OR A$="ALL" OR A$="EVERYTHING") AND (OB(I)=L) THEN
          OB(I)=0: PRINT OB$(I)" TAKEN": F1=1:
25020   IF A$=OB$(I)" THEN
          F2=1
```

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```
25025 NEXT I
25030 IF F1=0 AND F2=0 AND N$(2)="ALL" AND N$(1)="EVERYTHING" THEN
        PRINT "I CAN'T TAKE THE "I$$1 RETURN
25035 IF F1=0 AND F2=0 THEN
        PRINT "THERE IS NOTHING HERE I CAN TAKE."
25040 IF F1=0 AND F2=1 THEN
        PRINT "I DON'T SEE IT HERE."
25045 RETURN
26000 F1=0:
      FOR I=1 TO NI
26010   IF (OB$(I)=N$ OR N$(2)="ALL" OR N$(2)="EVERYTHING") AND (OB(I)=0)
          THEN OB(I)=CL: F1=1
26020 NEXT I
26030 IF NOT F1 THEN
        PRINT "YOU CAN'T DROP WHAT YOU WEREN'T CARRYING": RETURN
26040 PRINT "OK": RETURN
27000 F1=0:
      FOR I=1 TO NI
27010   IF (OB(I)=0 OR OB(I)=CL) AND (OB$(I)=N$) THEN
          F1=1: PRINT OD$(I);
          IF OB$(I)="" THEN
            PRINT "I SEE NOTHING IMPORTANT.": RETURN
27020   IF (FL(I)=CL OR FL(I)=0) AND (FB$(I)=N$) THEN
          F1=1: PRINT FD$(I);
          IF FB$(I)="" THEN
            PRINT "NOTHING EXTRAORDINARY OBVIOUS": RETURN
27030   IF F1 THEN
          RETURN
27040 NEXT I
27050 PRINT "I CAN'T DESCRIBE THAT"
27060 RETURN
28000 FOR I=1 TO NO
28010   IF NR(OB$(I) OR OB(I)<>0) THEN
          NEXT I:
          PRINT "YOU WEREN'T CARRYING THE "I$$1 RETURN
28040 PRINT "OKAY"
28050 I$=N$
28100 GOSUB 1000
28102 N$=T$
28105 PRINT
28106 IF N$="[KEY]" THEN 28000
28110 IF NV(1)="ON" AND NV(2)="ON" THEN
        PRINT "I CAN'T DO THAT": RETURN
28115 T$=RIGHT$(N$,LEN(N$)-LEN(V$))
28116 IF LEFT$(T$,1)=" " AND LEN(T$)>1 THEN
        T$=RIGHT$(T$,LEN(T$)-1)
28117 IF T$="FLOOR" OR T$="TABLE" THEN 28000
28120 FOR I=1 TO NO
28130   IF T$=OB$(I) OR (OB(I)=0 AND OB$(I)=N$) THEN
          NEXT I:
          PRINT "THE "I$$1" ISN'T HERE": RETURN
28140 PRINT "OK"
      IF (T$="RADIO" OR T$="JUKEBOX") AND N$="QUARTER" THEN
        I=1
28200 RETURN
30000 DIM OB$(12),OB(12),RM$(8),RM(8),N$(10),OD$(12),FB$(12),FL(12),FD$(12)
      ,R$(8)
30001 RM$(1)="THE MIDWAY": RM$(2)="THE FIRST AID STATION": RM$(3)="THE MIDWAY":
      RM$(4)="THE MIDWAY": RM$(5)="A RESTAURANT": RM$(6)="A SHOOTING GALLERY"
30002 RM$(7)="A MAINTENANCE ROOM": RM$(8)="THE BILLY BANGER'S TENT": RM$(9)=
      "THE TOP OF THE ROLLER COASTER": RM$(10)="A CLOSET"
30003 RM$(11)="AN ALLEY": RM$(12)="THE OBSERVATION TOWER": RM$(13)=
      "A CRAWLWAY": RM$(14)="A STORAGE ROOM": RM$(15)="A SMALL SHACK": RM$(16)=
      "A GAME BOOTH": RM$(17)="A NARROW TUNNEL": RM$(18)=
      "A DARK, TWISTING PATH"
30010 R$(1)="EAST": R$(2)="BACK": R$(3)="SWAY": R$(4)="WEST": R$(5)="NORTH":
      R$(6)="DOWN": R$(7)="NOON": R$(8)="DARK": R$(9)="WARM"
30011 R$(10)="WARD": R$(11)="WACK": R$(12)="DOWN": R$(13)="EAST": R$(14)=
      "WARD": R$(15)="FAR": R$(16)="WARD": R$(17)="SALE": R$(18)="WARM"
30100 L=18: NO=12
30110 OB$(1)="CLOTHS": OB$(2)="TOOLKIT": OB$(3)="TICKET": OB$(4)="BOOK": OB$(5)=
      "LAMP": OB$(6)="CHAIR": OB$(7)="POSTER": OB$(8)="BEAR"
30111 OB$(9)="UNIFORM": OB$(10)="RADIO": OB$(11)="WATER": OB$(12)="JUKEBOX"
30140 OB(1)=41: OB(2)=7: OB(3)=14: OB(4)=15: OB(5)=1: OB(6)=1: OB(7)=1:
      OB(8)=1
30145 OB(9)=18: OB(10)=14: OB(11)=14: OB(12)=1
30150 DIR$(1)="NORTH": DIR$(2)="SOUTH": DIR$(3)="EAST": DIR$(4)="WEST"
30160 RD$(1)=
      "WHICH STRETCHES TO THE EAST AND WEST. A RESTAURANT IS TO THE NORTH"
30161 RD$(2)=
      "CONTAINING STORAGE EQUIPMENT. LIGHTS      FLASH FROM AN ELECTRONIC BOY"
30162 RD$(3)=
      "AN AID STATION IS TO THE NORTH. THE       SOUND OF GUNFIRE COMES FROM A SH
      OOTING  GALLERY TO THE SOUTH."
30163 RD$(4)="FROM A TENT TO THE SOUTH YOU HEAR EXCITEMENT."
30164 RD$(5)="THE ROOM IS CROWDED BUT YOU SEE AN EMPTY TABLE IN THE CORNER"
30165 RD$(6)="A SIGN READS 'A SHOTS FOR 25 CENTS'"
30166 RD$(7)=
      "THERE ARE SHACKS TO THE NORTH AND SOUTH. THE NORTHERN DOOR IS OPEN. YOU C
      AN HEAR THE ROLLER COASTER."
30167 RD$(8)="SHE STOPS AND LOOKS AT YOU"
30168 RD$(9)="A DANGEROUS PLACE TO BE."
30169 RD$(10)="": RD$(11)=
      "THERE IS A DOOR LEADING TO A SMALL ROOM TO THE SOUTH"
30170 RD$(12)=
      "BELOW. YOU CAN SEE THE WHOLE CARNIVAL.  THE TOP OF THE ROLLER COASTER IS
       IN      SIGHT."
```

decided to display a still frame or sequence for each location. I wrote a short parser that would take strings of command codes and send them to the interface. The routine can be found starting at line 40000 in the main program. (If the code at 40000 is replaced with a RETURN, the game can be played without a videodisc, though lack of visuals makes it as exciting as watching salt dissolve.)

Once the visuals were defined, I tried a test run. After giving instructions, the game displayed a scene of the carnival midway. So far, so good. I went east. The disc player whirred. The wrong picture came up. A few tests produced the following realization: the computer is a lot faster than the disc player. If you send commands to search for frame 12345, you might get frame 135. To compensate for this, I added delays in the video parser. Now that the disk had time to digest the whole command, another problem appeared. Commands are not buffered by the interface; they are executed immediately. Sinking into the mind of the disc player, the process goes something like this: *Hey, I gotta search for frame 20123, O.K., I'm on my way. Half-way there. Getting closer. Almost there. Hey, a PLAY command. Here goes.* Thus Mr. Disc doesn't care if the search is finished. The PLAY command takes priority, giving whatever scene was under the beam at that moment. Enter more

delay loops. End result: no matter how quickly the main code executes, there are inevitable delays associated with calling frames from the videodisc.

Frame Five: *Meat on the bones, showing chicks, and an end to modularity.*

With the rooms mapped out and the video stuffed in, the next task was to add all those conditional actions that turn an adventure from a Sunday drive into a real game. In the real world, most problems have more than one solution. In an ideal adventure, any intelligent input should be greeted with an intelligent response. Any attempt to introduce such reality into a program would probably lead to either insanity or an OUT OF MEMORY error. Keeping this in mind, I first added routines to check for any commands that were required for the player to win. Any such input caused the program to jump to the appropriate subroutine. Had all this been planned out beforehand, these subroutines would be neatly organized into meaningful groups. Since I was creating as I went along, the structure of the program suffered somewhat.

> ***To add spice to the game, I tossed in some more video sequences to go along with special actions.***

To add a bit of spice to the game, I tossed in some more video scenes to go along with special actions. If the player tries his hand at the shooting gallery, he sees metal ducks being flattened. If he tampers with a certain box, he is rewarded with a view of the rollercoaster being blown off the tracks.

By the end of the second day, the game was approaching finished form. All correct moves were recognized, and some incorrect moves produced special responses. So much for the easy part.

Frame Six: *Error checks, custom changes, and the true meaning of déjà vu.*

While the programmer in the role of game creator must try to anticipate various inputs, the programmer in the role of debugger has to create all possible situations. This can be a rather tedious process. Seeing the same scenes over and over is rather akin to drowning. Eventually, self preservation overcame perfectionism, and I decided that all the bugs were eliminated.

```
30071 RD$(13)=
      "THE PASSAGE LEADS NORTH TO THE TOP OF  THE ROLLER COASTER. THE NOISE IS
       QUITE  LOUD"
30072 RD$(14)=
      "THE DOOR IS LOCKED BEHIND YOU. BUT THERE'S A WINDOW TO THE WEST"
30073 RD$(15)=
      "THE ROOM IS LITTERED WITH FRAGMENTS OF  ELECTRONIC PARTS. BUT NONE OF IT
       IS      AVAILABLE.  A GUARD BLOCKS YOUR PATH"
30074 RD$(16)="A SIGN SAYS, 'SR CRAZE A BALL, WINNER'S CHOICE.'"
30075 RD$(17)="THE PASSAGE LEADS SOUTH TO THE TOP OF  THE OBSERVATION TOWER"
30100 OD$(1)="TWO DIMES AND A NICKEL": OD$(2)=
      "IT CONTAINS EVERYTHING NEEDED FOR SMALL ELECTRONIC REPAIRS"
30101 OD$(4)="THE TITLE IS 'RADIO FREQUENCY JAMMING  TECHNIQUES'": OD$(5)=
      "IT IS VERY GAUDY": OD$(6)="THICK AND FLUFFY": OD$(7)=
      "WHOOPIE--IT'S THE DALLAS CHEERLEADERS": OD$(8)=
      "WHEN YOU PUSH THE BUTTON ON ITS BACK, IT SAYS 'I LOV YOU'"
30102 OD$(9)=
      "IT SAYS, 'GOOD FOR 1 FREE GAME AT THE  BALL TOSS, COURTESY OF CREATIVE
              COMPUTING, THE #1 MAGAZINE OF SOFTWARE  AND APPLICATIONS.'"
30200 FR$(1)="BOX": FD$(1)=
      "IT IS FIRMLY ATTACHED TO THE TABLE. THERE ARE KNOBS AND A BUTTON ON IT":
      FL(1)=(2)
30201 FR$(2)="RIFLE": FL(2)=6: FD$(2)="IT IS CHAINED TO THE COUNTER"
30202 FR$(3)="GUN": FL(3)=6: FD$(3)="IT IS CHAINED TO THE COUNTER"
30300 VB(1)="5397BSPX": VB(2)="8211BSPX": VB(3)="8400BSPX": VB(4)="5475BSPX"
30310 VB(5)="8231BSPX": VB(6)="8310BSPX": VB(7)="8400BSPX": VB(8)=
      "8117BSPX": VB(9)="8126BSPX"
30320 VB(10)="": VB(11)="5010BSPX": VB(12)="5147105PX": VB(13)="8310BSPX":
      VB(15)="5279926PX": VB(16)="5729BSP"
30330 VB(17)="": VB(18)=""
30400 KW=1
31000 IF PEEK(3*256)<>32 THEN
        PRINT "D-BLOAD VIDEO.CODE": POKE 10,78: POKE 11,9: POKE 12,3
32000 RETURN
34000 VC$="SKSB75": GOSUB 40000: TEXT: HOME: REM SET TO FIRST VIDEO FRAME WHEN
       OF TIME. PLAYER SHOULD BE ON BEFORE RUNNING PROGRAM
34001 PRINT "WHAT IS YOUR FIRST NAME?": GOSUB 1000: NA$=A$
34010 PRINT: PRINT "YOU HAVE JUST RECEIVED AN ANONYMOUS": PRINT
      "TIP THAT A BOMB HAS BEEN PLANTED": PRINT "ON A ROLLER COASTER,"
      FOR I=1 TO 1000:
      NEXT I:
34011 VC$="SKSA75": GOSUB 40000:
      FOR I=1 TO 2000:
      NEXT I:
      VC$="PX": GOSUB 40000:
      FOR I=1 TO 15200:
      NEXT I
34012 VC$="X2": GOSUB 40000
34015 PRINT: PRINT "YOU ARE CALLED TO INVESTIGATE AND FLY": PRINT
      "OFF TO STOP THE SHOOTER."
      FOR I=1 TO 1000:
      NEXT I
34016 VC$="SSWRDS": GOSUB 40000:
      FOR I=1 TO 6000:
      NEXT I:
      VC$="PX": GOSUB 40000:
      FOR I=1 TO 9000:
      NEXT I
34017 VC$="X2": GOSUB 40000
34018 PRINT
34020 PRINT "ON HIS SIDE, HE HAS THE BRILLIANCE OF": PRINT
      "AN INSANE MIND, AND THE AID OF ALLIES": PRINT
      "WHO ARE DETERMINED TO SEE THAT YOU FAIL."
34030 PRINT: PRINT "ON YOUR SIDE, YOU HAVE COURAGE, ": PRINT
      "TRAINING, AND DEDICATION"
34035 PRINT: PRINT "YOU HAVE ENFILTRATED THE PARK  WITH": PRINT
      "THE KNOWLEDGE THAT THE SHOOTER": PRINT "WILL STRIKE SOMETIME TONIGHT":
      PRINT: PRINT "ALL YOU NEED DO IS STOP HIM."
34054 PRINT: INVERSE: PRINT "PRESS ANY KEY TO CONTINUE": GET A$: NORMAL: HOME
34060 PRINT "BY GIVING THE RIGHT COMMAND, YOU CAN ": PRINT
      "MOVE, EXAMINE OBJECTS, AND PERFORM ": PRINT "OTHER ACTIONS"
34070 PRINT "I UNDERSTAND TWO-WORD COMMANDS SUCH AS": PRINT
      "'DROP BOOK' OR 'TAKE KNIFE'.": PRINT
      "TO MOVE, YOU CAN SIMPLY ENTER 'N' FOR": PRINT "NORTH, ETC."
34080 PRINT: PRINT "AT TIMES, I WILL AWAIT YOUR COMMAND": PRINT
      "IN OTHER SITUATIONS, I WILL PRESENT YOU": PRINT
      "WITH A CHOICE OF ACTIONS": PRINT "BUT SUCCESS OR FAILURE IS UP TO YOU."
34090 PRINT: INVERSE: PRINT "PRESS ANY KEY TO BEGIN, MAY LUCK BE": PRINT
      "WITH YOU, "NAME$": GET A$: NORMAL: PRINT: RETURN
40000 FOR I=1 TO LEN(VC$):
        A=USR(ASC(MID$(VC$,I,1))):
40010   IF MID$(VC$,I,1)="S" AND I>1 THEN
          FOR J=1 TO 4000:
          NEXT J
40020   FOR J=1 TO 4000:
        NEXT J:
      NEXT I:
      RETURN
41000 PRINT: PRINT "A WAITER APPROACHES AND ASKS, IF YOU": PRINT
      "WOULD LIKE A SEAT": PRINT: PRINT "SINCE YOU MISSED LUNCH TODAY, YOU":
      PRINT "ARE HUNGRY"
41010 PRINT: PRINT "DO YOU WANT TO EAT?": GOSUB 1000
41020 IF A$<>"NO" AND A$<>"YES" THEN
        PRINT "PLEASE ANSWER YES OR NO": GOTO 41010
41025 POKE7
41030 IF A$="NO" THEN
        PRINT "THE WAITER CALLED YOU A SLOB": PRINT "AND THREW YOU OUT": LAT:
        GOTO 22000
```

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Though this is never true, the thought can be comforting. Leaving the message, "Play me," on the diskette sleeve, I packed it in for the day.

I was eager to learn the boss's reaction to the program. "Not bad," he told me the next day, "though I do have a few changes to suggest."

I looked at the three pages of notes, feeling some empathy for the ancient mariner, Sisyphus, and other bearers of long sentences. A close inspection revealed that most of the changes would not be difficult. "I'll take a shot at it," I told him, trying not to give signs of relief.

Back at the fortress, I plugged in the changes and started another round of error checks. By the end of the afternoon, I could close my eyes and see rollercoasters. But the program was finished. In an odd way, the project had almost been fun.

Frame Seven: *Conclusions, the future of video, and the meaning of it all.*

Naturally, there is a post-natal pleasure associated with the completion of any programming task. After the glow dims, some questions remain. Was the project worth doing? Did it accomplish the desired functions? The main goal was to try an experiment with a fairly new technology. Here I feel partial failure. The new medium was used in an old way. Beyond the video scenes, the program is just another adventure. It was as if I had been given Vulcan's forge and used it to produce a souped-up Ford Pinto. Despite the racing stripes and whitewalls, it's still a compact car. But the exercise has convinced me of the potential power of the video-computer connection. The fusion of these two devices will produce some spectacular results. Rather than add to existing concepts, people will create applications that open new areas, merging computers and video rather than just tacking picture to a program. The rollercoaster ride has just begun. □

```
31040 PRINT: PRINT "YOU ARE SERVED A DELICIOUS MEAL": PRINT
      "UNFORTUNATELY, THE SERVICE IS": PRINT "RATHER SLOW": VC$="[illegible]"
      GOSUB 40000:
      FOR I=1 TO 12000:
      NEXT I:
      VC$="32": GOSUB 40000:
41040 PRINT
41050 PRINT "THE BOMB VENT OFF AND THE BOMBER ESCAPED":
      FOR I=1 TO 3000:
      NEXT I:
      GOTO 50000
42000 IF OB(I)<>0 THEN
        PRINT "THE MAN BEHIND THE COUNTER TELLS": PRINT
        "YOU, 'IF YOU WANNA PLAY YOU GOTTA PAY.'": RETURN
43010 PRINT "YOU HAND OVER THE COINS AND PICK": PRINT "UP THE GUN": OB(I)=-1
43020 VC$="[illegible]": GOSUB 40000:
      FOR I=1 TO 3000:
      NEXT I:
      VC$="32": GOSUB 40000:
43030 PRINT "GOOD SHOOTING": PRINT "HE HANDS YOU A TEDDY BEAR": OB(I)=0
43035 PRINT "A PASSERBY LOOKS AT THE BEAR AND": PRINT
      "SAYS, 'MODERN MONGRELS, WHAT EVER        HAPPENED TO SIMPLE STUFFED ANIMALS
      LIKE'": PRINT "HE SHAKES HIS HEAD AND LEAVES."
43040 RETURN
47000 PRINT:
      IF OB(10)<>0 THEN
        PRINT "SHE SAYS YOU CAN'T COME IN UNLESS YOU HAVE A PRESIDENT FOR HER":
        PRINT "SHE PUSHES YOU OUT.": L=41 GOTO 22000
47005 IF OB(8)=-2 THEN
        PRINT
        "SHE SAYS, 'YOU THINK THE PRESIDENT ENTITLES YOU TO COME IN HERE ANY TIME
         YOU WANT?'": PRINT "SHE TURNS HER BACK AND IGNORES YOU.": RETURN
47010 PRINT "SHE LETS YOU IN AND GIVES THE BEAR": PRINT
      "DO YOU WANT TO GIVE IT TO HER?": GOSUB 1000
47020 PRINT:
      IF A$(1)="Y" AND A$(2)="YES" THEN
        PRINT "SHE THROWS YOU OUT": L=41 GOTO 22000
47030 OB(8)=-21 PRINT "SHE UNLOCKS THE DOOR TO THE [illegible]"
47040 RETURN
47100 IF OB(9)<>0 THEN
        PRINT "HE SAYS, 'EMPLOYEES ONLY' AND THROWS YOU OUT": L=41: GOTO 22000
47110 PRINT "THE DESK YOUR UNIFORM AND LETS YOU IN"
47120 RETURN
48000 IF OB(3)<>0 THEN
        PRINT "YOU CAN'T AFFORD THE GAME": RETURN
48010 PRINT "YOU HAND OVER THE TICKET AND THROW THE  BALL.": PRINT "[illegible]"
      PRINT "IT'S A WINNER,": PRINT "YOU HAVE A CHOICE OF FOUR PRIZES:"
48020 PRINT "A LAMP, TOWELS, RADIO, OR POSTER."
48030 PRINT "WHICH DO YOU WANT?": GOSUB 1000
48040 A$=UPCASE$(A$,LEN(A$)-1)
      FOR I=0 TO 19
48050   IF OB(I)=48 THEN
          OB(I)=0: PRINT: PRINT "IT'S YOURS":
          IF A$="RADIO" THEN
            VC$="[illegible]": GOSUB 40000:
            FOR I=1 TO 1000:
            NEXT I:
            VC$="32": GOSUB 40000: RETURN
48060 NEXT I:
      PRINT: PRINT "PLEASE ANSWER WITH LAMP, RADIO OR TOWEL": GOTO 48030
49000 INVERSE: SPEED=200: PRINT "IF YOU LOOK BACK, YOU'LL NOTICE": PRINT
      "A CAR SPEEDING TOWARD YOU": VC$="[illegible]"
49010 NORMAL: SPEED=255: GOSUB 40000: GOTO 50000
50000 HOME: VTAB 10: PRINT "IT IS ONE YEAR LATER": PRINT
      "THE ROLLER COASTER HAS BEEN REBUILT": PRINT
      "THE SABOTEUR PLANS TO DESTROY IT AGAIN": PRINT
      "WOULD YOU LIKE TO TRY TO SAVE IT?"
50010 GOSUB 1000: PRINT
50020 IF A$="YES" OR A$="Y" THEN
        GOSUB 30000: GOTO 22000
50030 IF A$(1)="N" AND A$(2)="O" THEN
        PRINT "YES OR NO": GOSUB 1000: PRINT: GOTO 50020
50040 END
51000 PRINT "OH OH, I THINK THAT WAS A MISTAKE": VC$="[illegible]": GOSUB
      40000: PRINT "YOU SET OFF THE BOMB":
      FOR I=1 TO 2000:
      NEXT I:
      GOTO 50000
52000 IF L<>10 THEN
        PRINT "YOU AREN'T IN LINE OF SIGHT WITH": PRINT "THE ROLLER COASTER":
        RETURN
52010 IF OB(12)<>0 THEN
        PRINT "YOU DON'T HAVE A HAMMER": RETURN
52020 IF NOT B THEN
        PRINT "IT DOESN'T WORK, MAYBE IT NEEDS BATTERIES": RETURN
52030 VC$="[illegible]": GOSUB 40000:
      FOR I=1 TO 3000:
      NEXT I:
      VC$="32": GOSUB 40000:
[illegible] HOME: VTAB 10: HTAB 12: INVERSE: SPEED=100: PRINT "CONGRATULATIONS":
      NORMAL: PRINT: HTAB 6: PRINT "YOU SAVED THE ROLLER COASTER": SPEED=255:
      END
53000 IF NOT B1 THEN
        PRINT "YOU DON'T EVEN HAVE": RETURN
53010 IF OB(14)<>0 THEN
        PRINT "SOMETHING VITAL IS MISSING": RETURN
53020 IF OB(13)<>0 THEN
        PRINT "YOU DON'T HAVE THE REQUIRED TOOLS": RETURN
53030 PRINT "[illegible] YOU NOW HAVE A ": PRINT "HAMMER": OB(12)=-1:
      OB(13)=99: RETURN
```

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But don't take our word for it. Wizardry received reviews in the May issue of Creative Computing, the April issue of Popular Mechanics, page 38, and the August issue of Softalk magazine

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An Adventure Framework

There are two key parts to the framework: the input routine and the partial parser. Rather than use an INPUT statement, each character is obtained with GET. This has several advantages. First, each character can be checked on entry. Second, commas won't cause an EXTRA IGNORED error message. Finally, there is plenty of time between each character to process the preceding one. With INPUT, the program receives the whole phrase at once and any processing has to be done after the user has hit return. To separate a two-word phrase, the program would have to search through the input string for a space, adding to the delay time. On the other hand the GET routine can immediately identify a space and define anything prior to it as the first word of input. The rest of the routine just traps illegal characters and checks for controls such as the back arrow or return. For back arrows, the routine erases characters as the cursor crosses them.

The input routine accepts one or two words, but no more. In its present form, it accepts only letters. It could be easily modified to recognize other characters if required. Upon returning from the input routine, there is a horrendous ON A GOSUB command with twenty-six parameters for the variable A. This causes the program to branch to different lines depending on the first letter of the command. While such a solution might be considered inelegant, it cuts down the delay considerably. Once the branch has been made, the program has just a few possible key words for which to check.

Next, I took the basic concepts encountered in an adventure (moving, picking up and dropping objects,

```
   1 GOSUB 30000: REM  INITIALIZE
   2 TEXT: HOME
   3 GOSUB 22000
   4 MTAB 1
  10 GOSUB 1000
  30 IF NOT SPACE THEN
       VB=VB
  40 IF AB=" " THEN 10
  45 PRINT: PRINT
  60 IF ASC(VB)=32 AND LEN(VB)>1 THEN
       VB=MID$(VB,LEN(VB)-1): AB=MID$(VB,LEN(VB)-1): GOTO 50
  68 IF LEN(VB)=LEN(AB) THEN
       NFLAG=0: GOTO 90
  70 AB=MID$(AB,LEN(AB)-LEN(VB))
  80 IF ASC(AB)=32 AND LEN(AB)>1 THEN
       AB=MID$(AB,LEN(AB)-1): GOTO 80
  85 IF AB=" " THEN
       NFLAG=0
  90 A=ASC(VB)-64
 100 IF A<1 OR A>26 THEN 10
 110 ON A GOSUB 10100,10200,10300,10400,10500,10600,10700,10800,10900,11000,
     11100,11200,11300,11400,11500,11600,11700,11800,11900,12000,12100,12200,
     12300,12400,12500,12600
 120 PRINT
 130 PRINT: GOTO 10
1000 AB=" ": SPACE=0: DB=" ": PB=" ": NFLAG=1
1010 GET B$:
     IF ASC(B$)=13 THEN
       RETURN
1020 IF ASC(B$)=8 AND SPACE AND MID$(AB,1)=" " THEN
       SPACE=0
1025 IF LEN(AB)=1 AND B$=" " THEN 1010
1030 IF ASC(B$)=8 AND LEN(AB)>1 THEN
       AB=LEFT$(AB,LEN(AB)-1): PRINT B$;" ";B$;: GOTO 1010
1040 IF B$=" " AND NOT SPACE THEN
       VB=AB: SPACE=1: GOTO 1060
1050 IF ASC(B$)<65 OR ASC(B$)>91 THEN 1010
1060 PRINT B$;
1070 AB=AB+B$
1080 GOTO 1010
10100 RETURN
10200 RETURN
10300 RETURN
10400 IF VB="DROP" AND NFLAG THEN 30000
10499 RETURN
10500 IF AB="E" THEN
        D=2: GOTO 20000
10501 IF VB="DOWNONE" AND NFLAG THEN 27000
10599 RETURN
10600 RETURN
10700 IF VB="GO" THEN 19000
10799 RETURN
10800 RETURN
10900 IF AB="I" OR AB="INV" OR AB="INVENTORY" THEN 24000
10999 RETURN
11000 RETURN
11100 RETURN
11200 IF AB="LOOK" THEN 22000
11210 IF VB="LOOK" AND NFLAG THEN 27000
11299 RETURN
11300 RETURN
11400 IF AB="N" THEN
        D=1: GOTO 20000
11499 RETURN
11500 RETURN
11600 RETURN
11700 RETURN
11800 RETURN
11900 IF AB="O" THEN
        D=3: GOTO 20000
11999 RETURN
12000 IF VB="TAKE" AND NFLAG THEN 25000
12099 RETURN
12100 RETURN
12200 RETURN
12300 IF AB="W" THEN
        D=4: GOTO 20000
12399 RETURN
12400 RETURN
12500 RETURN
12600 POP: STOP: REM DEBUGGING AID. INPUT OF 2 BYTES PROBLEM
19000 REM NUMBER FOR GO DIRECTION
19010 D=ASC(AB)-34: D=(D=78)+(D=69)*2+(D=83)*3+(D=87)*4:
      IF NOT D THEN
        PRINT "I NEED A DIRECTION": RETURN
20000 REM MOVE ROUTINE:D=DIRECTION:R=ROOM MOVED INTO:L=PRESENT LOCATION
20010 R=ASC(MID$(RM$(L),D,1))-64
20020 IF NOT R THEN
        PRINT "YOU CAN'T GO THAT WAY": RETURN
20030 L=R
22000 REM LOOK ROUTINE
22005 PRINT "YOU ARE IN ";
22010 PRINT RM$(L): PRINT RE$(L): PRINT "THE ROOM CONTAINS ";: F1=0:
22020 FOR I=2 TO NO
22030   IF OB(I)=L THEN
          PRINT OB$(I);: F1=1
```

Listing 2. Adventure Framework. This is not a playable game as is. It is a framework handling common Adventure features.

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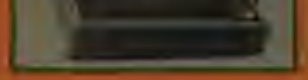

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CIRCLE 910 ON READER SERVICE CARD

examining objects, and looking at a location), and designed the framework in such a way that objects and rooms could be changed with little effort. For movement, I limited the program to four directions; adding up and down would be easy if required later. The rooms were given two identifiers, a number from 1 to 26 and the corresponding letter of the alphabet. For each room, there is a string containing the rooms that can be reached by going north, east, south, and west. Disallowed directions are marked by a null character. This information, stored in an array called RS, serves not only to determine where a person would end up, but also for printing visible exits.

There are two other string arrays associated with rooms. The RM$ array contains a brief description of each room. RD$ contains a complete description. By separating them, it is possible to print a full description the first time a person enters a room, and a short description if he returns. (I ended up printing the full description each time since most weren't that long.)

Objects are also held in an array, OB$, and another array OB, contains the location of each object. OB holds either a room number, a zero if the person has the objects, or a negative number if the object is out of play. This is the same sort of technique used in most Basic adventures.

One further concept was the use of variables for what I consider "furniture." This would cover objects that can't be taken but can be examined. Furniture is contained in the array FR$, its description is in FD$, and FL contains its location. If the value of FL is zero, that furniture can occur in any location. For example, if all rooms have walls, FR$ would be WALL, FD$ might be "IT IS MADE OF STONE AND CONTAINS NO CRACKS OR MARKINGS" and FL would be 0. Since the routines for LOOK and TAKE check through both objects and furniture, these two sets of arrays must have the same value, even if the higher numbers of one set aren't used.

The rest is reasonably straightforward. Once rooms and objects have been taken care of, routines need only be added to handle special situations. Note that the LOOK routine checks to see whether an object is either in the player's possession or in the same room as he. This avoids the frustration encountered when a player wants to examine something and is told he isn't carrying it. The general framework, with dummy room and object definitions, is given in Listing 2 or those who might want to construct their own adventures.

—*DL*

```
22040 NEXT I:
      IF NOT F1 THEN
        PRINT "NOTHING"
22060 PRINT "VISIBLE EXITS: ";
22060 FOR I=1 TO 4
22070   IF MID$(RS(L),I,1)<>"*" THEN
          PRINT DIR$(I);" ";: F1=1
22080 NEXT I:
      IF NOT F1 THEN
        PRINT "DON'T EXIST"
22090 RETURN
24000 F1=0: PRINT "YOU ARE CARRYING";
      FOR I=1 TO NO
24010   IF OB(I)=0 THEN
          PRINT OB$(I); F1=1
24020 NEXT I:
      IF NOT F1 THEN
        PRINT "NOTHING"
24030 RETURN
25000 F1=0: F2=0:
      FOR I=1 TO NO
25005   IF NA=OB$(I) AND OB(I)=0 THEN
          PRINT "YOU ALREADY HAVE THE ";NA: RETURN
25010   IF (NA=OB$(I) OR NA="ALL" OR NA="EVERYTHING") AND (OB(I)=L) THEN
          OB(I)=0: PRINT OB$(I);" TAKEN": F1=1
25020   IF NA=OB$(I) THEN
          F2=1
25025 NEXT I
25030 IF F1=0 AND F2=0 AND NA<>"ALL" AND NA<>"EVERYTHING" THEN
        PRINT "I CAN'T TAKE THE ";NA: RETURN
25035 IF F1=0 AND F2=0 THEN
        PRINT "THERE IS NOTHING HERE I CAN TAKE."
25040 IF F1=0 AND F2=1 THEN
        PRINT "I DON'T SEE IT HERE."
25045 RETURN
26000 F1=0:
      FOR I=1 TO NO
26010   IF (OB$(I)=NA OR NA="ALL" OR NA="EVERYTHING") AND (OB(I)=0) THEN
          OB(I)=L: F1=1
26020 NEXT I
26030 IF NOT F1 THEN
        PRINT "YOU CAN'T DROP ANY YOU DON'T CARRY";NA: RETURN
26040 PRINT "OK": RETURN
27000 F1=0:
      FOR I=1 TO NO
27010   IF (OB(I)=0 OR OB(I)=L) AND (OB$(I)=NA) THEN
          F1=1: PRINT OD$(I);
          IF OD$(I)="" THEN
            PRINT "I SEE NOTHING IMPORTANT.": RETURN
27020   IF (FL(I)=L) OR FL(I)=0) AND (FR$(I)=NA) THEN
          F1=1: PRINT FD$(I);
          IF FD$(I)="" THEN
            PRINT "NOTHING EXTRAORDINARY HERE": RETURN
27030   IF F1 THEN
          RETURN
27040 NEXT I
27050 PRINT "I CAN'T PERCEIVE WHAT YOU'RE HERE"
27060 RETURN
30000 DIM OB(26),OB$(26),RM$(26),RD$(26),RS(26),DD$(26),FR$(26),FL(26),FD$(26)
30001 RM$(1)="A DIMLY LIT HALL": RM$(2)="A DARK HALL": RM$(3)=
      "A VERY DARK HALL": RM$(4)="MIDDLE HALL": RM$(5)=
      "THE DARKEST HALL OF ALL": RM$(6)="A FITCH BLACK HALL"
30002 RM$(7)="THE CELLAR": RM$(8)="THE ATTIC": RM$(9)="THE BEDROOM": RM$(10)=
      "THE LIVING ROOM": RM$(11)="THE CELLAR STAIRS": RM$(12)="A TUNNEL":
      RM$(13)="THE PARLOR"
30003 RM$(14)="A BATHROOM": RM$(15)="THE WINE CELLAR": RM$(16)=
      "THE BILLIARDS ROOM": RM$(17)="A THRONE ROOM": RM$(18)="A HALLWAY"
30004 RM$(19)="A BALCONY": RM$(20)="THE FOYER": RM$(21)="THE LIBRARY": RM$(22)=
      "THE BLUE ROOM": RM$(23)="THE GREEN ROOM": RM$(24)="THE PINK ROOM":
      RM$(25)="THE YELLOW ROOM": RM$(26)="THE RED ROOM"
30010 RS(1)="NSEW": RS(2)="NSEW": RS(3)="NSEW": RS(4)="NSEW": RS(5)="NSEW":
      RS(6)="NSEW": RS(7)="NSEW": RS(8)="NSEW": RS(9)="NSEW":
30011 RS(10)="NSEW": RS(11)="NSEW": RS(12)="NSEW": RS(13)="NSEW": RS(14)=
      "NSEW": RS(15)="NSEW": RS(16)="NSEW": RS(17)="NSEW":
30012 RS(18)="NSEW": RS(19)="NSEW": RS(20)="NSEW": RS(21)="NSEW": RS(22)=
      "NSEW": RS(23)="NSEW": RS(24)="NSEW": RS(25)="NSEW": RS(26)="NSEW"
30020 L=1: NO=26
30030 OB$(1)="BATTERIES": OB$(2)="KNIFE": OB$(3)="DETONATOR": OB$(4)="WATCH":
      OB$(5)="WALLET": OB$(6)="COIN":
30031 OB$(7)="MAT": OB$(8)="BALL": OB$(9)="CAR": OB$(10)="BLADE": OB$(11)=
      "PAN": OB$(12)="CARPET": OB$(13)="LETTER": OB$(14)="KNIFE": OB$(15)=
      "GUN":
30032 OB$(16)="WINE": OB$(17)="DANGER": OB$(18)="PAINT": OB$(19)="HAMMER":
      OB$(20)="SAW": OB$(21)="BOOT": OB$(22)="WINDOW": OB$(23)="PIN": OB$(23)=
      "CANDLE": OB$(24)="PLUG": OB$(25)="WALLET": OB$(26)="CHAIR"
30040 FOR I=1 TO NO:
        OB(I)=I:
      NEXT I
30050 DIR$(1)="NORTH": DIR$(2)="SOUTH": DIR$(3)="WEST": DIR$(4)="EAST"
30060 RD$(1)="A SMALL WATERFALL TRICKLES DOWN THE FLOOR, WETTING EVERYTHING":
      RD$(2)="THERE IS AN ODOR OF DEATH HERE"
30100 DD$(1)="PLAIN DURACELLS": DD$(2)="IT IS PRETTY": DD$(3)=
      "IT APPEARS TO BE HOME MADE": DD$(5)="IT IS EMPTY"
30200 FR$(1)="WATERFALL": FD$(1)="IT IS COLD AND WET": FL(1)=1: FR$(2)="WALL":
      FD$(2)="JUST AN ORDINARY WALL": FL(2)=0
30201 FR$(3)="FLOOR": FL=0
32000 RETURN
```

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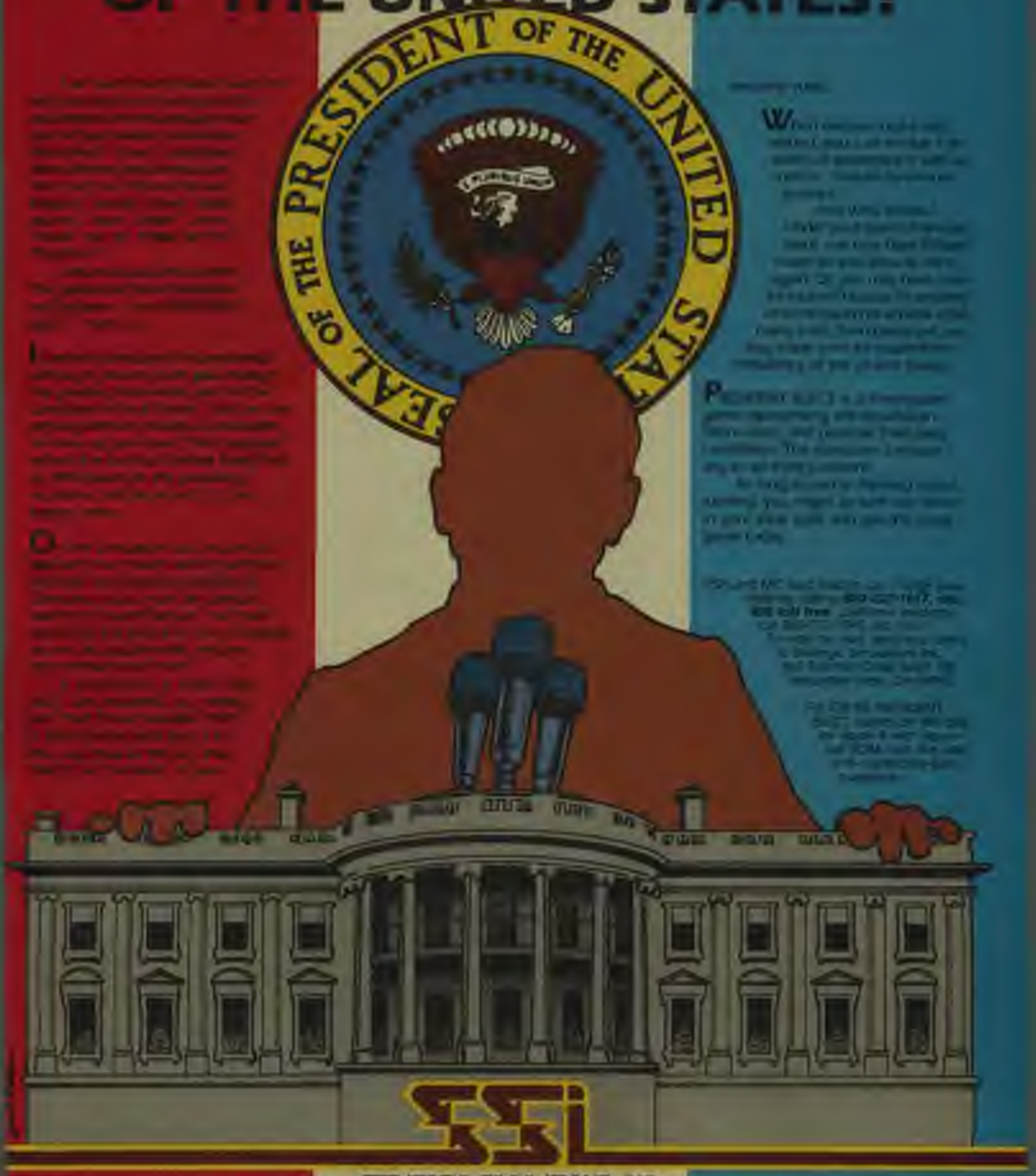


David H. Ahl

The Rollercoaster Game Dissected

"Over my dead body you will!" This was the response I got from David Lubar when I suggested running a map of the *Rollercoaster* game with the information as to what is found in each spot.

His reasoning was that the game could be played by someone whether they had a videodisc player or not. The only difference is that a person with a videodisc player and interface would be able to see the motion sequences where other players would merely have them described by the computer program.

My reasoning was that this is the first computer/videodisc game ever published and that if it is going to be part of the entertainment wave of the future, we ought to share as much information about it as possible.

My reasoning prevailed and, thus, you are reading this article. Mr. Lubar was last heard saying, "Mutter, mutter. You're the publisher."

Flash Back

Ever since I saw an experimental videodisc player from Philips/MCA in 1975 and published three articles about videodiscs in March of 1976, I have been enthusiastic about the medium. More recently, I have gotten very excited about the possibilities for computer programs which take advantage of the videodisc. Many educators and people involved in industrial training are working in similar directions. However, my thoughts were more in the area of home entertainment.

In particular, I imagined an adventure-type game based on the movie *Jaws*. I haven't quite worked out the entire scenario, however, I envision a scene where a shark is about to attack and is swimming toward you with his jaws wide open when the screen goes blank and you are asked for a decision. Make the right decision, and the shark would back off, probably in reverse slow motion and you would see it recede into the ocean. Make the wrong decision and, of course, you get eaten and lose the game. Or, you might invoke magic which would transform you to an entirely different time and place. If you did this, you might or might not lose some of the objects you have gained and you might be posed with an entirely different set of problems based on your new location.

I envisioned using portions of the soundtrack with only the computer output visible on the screen. I also saw opportunities for the player to put in his own search coordinates (a frame number) not knowing, of course, what was there beforehand. Based on what he finds in a particular location, he must continue the game from that point. Thus, I envisioned a very open-ended type of game as opposed to the completely structured adventures and other games that exist today.

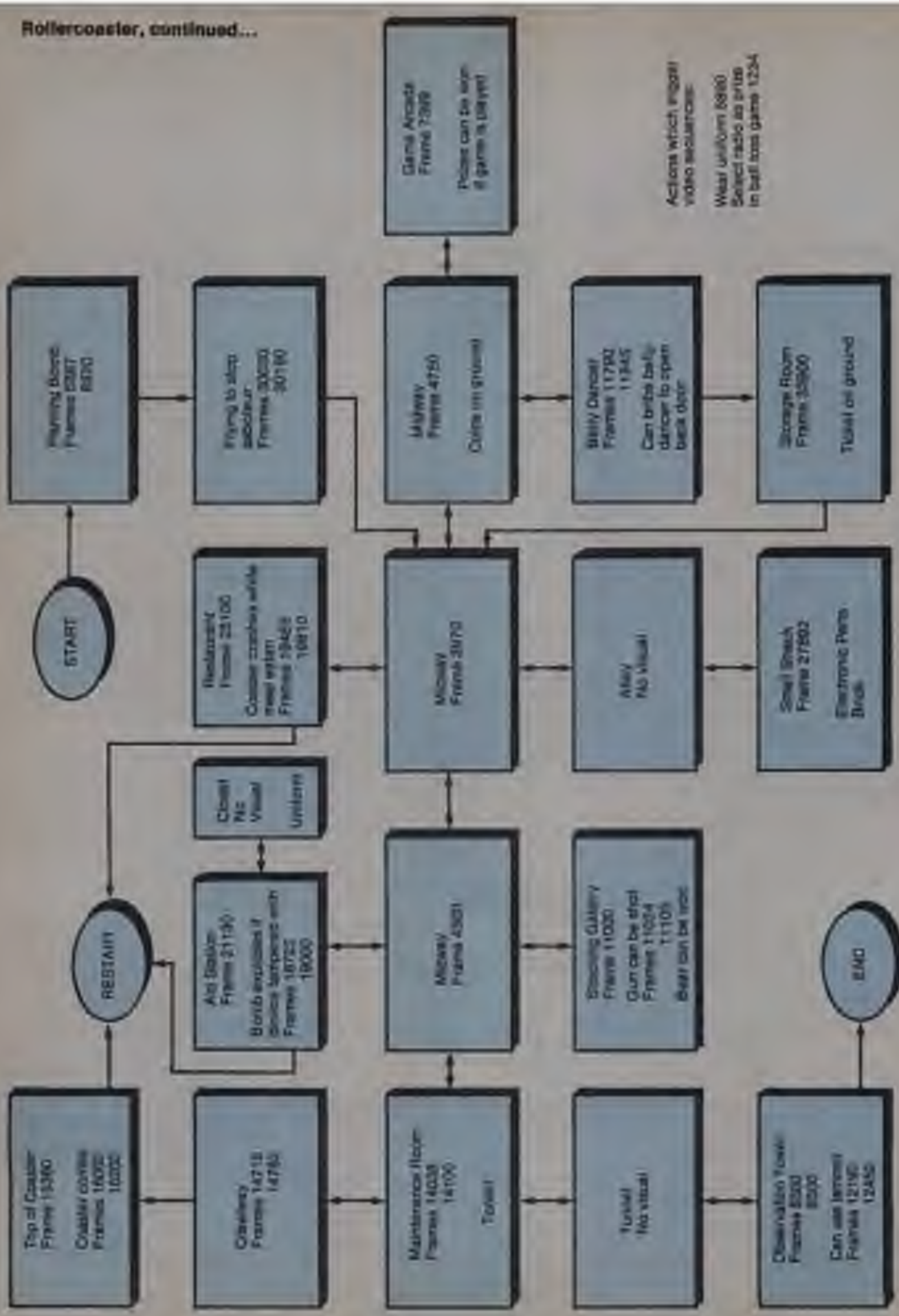
Can it all be done? I think so. We are, of course, starting in a much more structured way. However, I believe that this game will give you some idea of what the capabilities are of marrying the computer with the videodisc.

How the Game Works

After showing the appropriate title graphics, the player is told that a madman has planted a bomb on a rollercoaster. At this point a 10-second scene of the bomb being planted is shown. A message flashes back that you, the player, are being sent to stop the saboteur. At this point a 10-second sequence of a plane landing is shown followed by some additional introductory messages.

After this, you find yourself in a central area of the midway. (See diagram.) Some of the video sequences (both still frames

CIRCLE 147 ON READER SERVICE CARD



Actions which trigger video sequences:

Wear uniform (5860)
Select radio as prize in ball toss game 1234

Game Arcade
Frame 7399
Pellets can be won if game is played

Location Map of Rollercoaster Videodisc/Computer Game

and motion sequences) are activated by going to a new place in the game-playing area. Other video sequences are activated by picking up an object or giving some other command. For example, the command "Wear Uniform" triggers a still frame of the groundkeeper in a uniform.

Still other video sequences are triggered as part of a sequence of events over which a player has no control. For example, if you crawl too far out on the conveyor track, you are shown a scene of the empty track followed by a computer message that says "The sound of the conveyor is getting very loud." This is immediately followed by a scene of the conveyor passing by after knocking you unconscious. This triggers one of the alternate end-of-game routines and you are given the opportunity to play again.

Possible Extensions

The mind boggles with the possible extensions to a videodisc/computer game. For example, the way the game is written now, the bomb explodes if the player tampers with the electronic device in the Aid Station. A possible alternative: by turning the knob on the device you discover that it is an alien time warp machine and that it reverses time for ten seconds. You might see the rollercoaster going backwards or people walking backwards on the midway for the next ten seconds. Used in the adventure, you might have to find a detonator, take it to the Aid Station and explode the bomb, make time go backwards and re-explode the bomb in order to find out on what frequency the detonator works so that you are able to construct a jammer.

Of course, there are many, many possible extensions. One side of the videodisc has over 50,000 individual frames on it and the disc of *Rollercoaster* which we are using for this adventure has over 120 separate motion sequences on the first side. Thus, it should be apparent that we are just scratching the surface with the game as it currently exists. □

Vision of the Future

Tim Onosko

The scene is your living room. You're watching a television program—let's say it's a game show. A policeman is questioning a man suspected of committing a crime. The suspect answers in a barely audible tone, and his words come slowly. The policeman finishes his interrogation, then turns to the camera and asks you a question: Should we believe him?

On a hand-held remote control, you press a button indicating that you doubt the suspect's story. The cop consults you again, this time offering three possibilities:

Do you think the suspect was:

a) lying?

b) concealing important facts?

c) in shock and unable to communicate accurately?

What's going on here? It's just one of the scenarios that has been proposed for the new medium of interactive videodiscs.

An interactive videodisc is one which allows the viewer to determine the order in which it is watched, or is otherwise organized so that it isn't necessarily viewed in a linear, beginning-to-end way. Interactive videodiscs can be powerful teaching tools, new dramatic experiences, or exciting toys.

The idea of a television program you can use rather than only watch isn't new. Two-way cable television offers audiences the opportunity to respond to what they're watching, but these systems usually poll an audience, so a viewer who responds to the show becomes part of a group decision. No personal decisions can be made in an interactive cable system, since everyone watching the program must see the same one.

Other interactive television programs have been (and continue to be) designed and produced for videotape; reels of tape are shuffled back and forth, from segment to segment, to locate the information the viewer wants or needs. But videotape is a linear, "ribbon" medium, and the process of locating an appropriate program segment can take minutes.

All videodiscs are not alike.

Videodisc, because it is a "radial" medium which can be scanned quickly to locate any segment, is the ideal choice for interactive video programs and projects.

First, though, it is important to understand that all videodiscs are not alike. Presently, three, incompatible videodisc systems have been developed and are either in use, or soon will be.

Three Formats

The first videodisc system to be introduced was the *laser-optical* disc system, developed jointly by Philips of the Netherlands, the giant electronics company, and by MCA, the American entertainment conglomerate. Aimed squarely at both the industrial/institutional and consumer markets, the laser-optical disc has been supported by the efforts of IBM, Pioneer and Sony of Japan. Since its introduction, the laser-optical video disc system has acquired the generic name of *LaserVision*.

In the spring of 1981, the *capacitance* videodisc, nicknamed *CED* (for Capacitance Electronic Disc) joined the laser-optical disc in the consumer marketplace. The CED disc is a product of RCA research. Zenith, the American electronics manufacturer, and several Japanese companies, including Hitachi and Toshiba, have fallen in line behind the CED system.

A third videodisc system is called *VHD*, for Video *High Density*, and is scheduled to appear in the U.S. either late this year or during 1982. VHD was developed by Matsushita of Japan. Matsushita has had great success popularizing basic videocassette recorders (VHS format) worldwide, and is hoping to duplicate this success with videodiscs.

All three videodisc formats perform one basic task identically. All play back pre-recorded video programming with good picture reproduction and crisp sound. Beyond that, however, there are major differences among the systems.

The grooves on LaserVision discs, as their name indicates, are read by focusing

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The Omnilink interface from Aurora Systems.

Video-Microcomputer Interface by Allen Communication.

a tiny, flea-powered laser beam into the core of a reflective disc, where information is stored in the form of microscopic "pits" arranged in a spiral. (The length of each pit, as well as the distance between one pit and the next, actually conveys the information.) Since nothing physically comes in contact with the disc, LaserVision discs can be played, speed-up, slowed-down, scanned rapidly, played backwards, or held on any particular still frame, practically indefinitely, without wear.

One side of a LaserVision disc can store one half hour of video programming, or up to 54,000 individual frames of visual material. (Each rotation of the disc, which spins at 1800 RPM, is the equivalent of one television frame.) Another method of coding information, an "extended play" mode yields one hour of video programming per side, but many of the features of the system, including still frame and slow motion, are sacrificed by this information-packing arrangement.

Like a LaserVision extended play disc, the CED disc system is limited in its capabilities, chiefly because CED discs are grooved, like conventional phonograph records. When a CED disc is played, a stylus (actually a microelectronic sensor) tracks the disc, and detects minor changes in the electrical value of capacitance, caused by tiny "bath marks" at the bottom of the groove.

When developing the CED disc system, RCA aimed to make it as inexpensive as possible. The grooves in the discs eliminated the need for a sophisticated tracking system, but also made CED less capable, by design. Because of the grooves, and because each rotation of a CED disc is equal to four television frames, CED cannot produce a still picture. (Theoretically, this can be done, but it would probably require circuitry to digitize a television picture, and enough solid-state memory to hold and display it.)

This makes CED cheap. Players retail at about $500, as compared to the $750 investment required by LaserVision players.

The VHD disc system combines some of the best elements of each system. They are grooveless, and a sensor floating just above the disk surface again measures variances in capacitance. But, while the VHD system is basically as capable as LaserVision, it was designed to compete with the economy of CED, and players will have few more functions than a CED player, without the addition of a VHD "trick box," to be sold at an additional cost.

There have been two generations of consumer players.

Comparison of Formats

While no real videodisc "standard" has emerged, it seems apparent that, using *capability as a basis for judgment*, the LaserVision system is best suited to meet growing information needs in the coming years. When its capabilities are considered and "built into" programs, LaserVision shows distinct advantages, and especially lends itself to interactive applications.

For example:

• LaserVision players can be computer-controlled. Visual material can be intermixed with computer-generated characters and graphics, and can operate under software control.

• Because the LaserVision system incorporates two separate audio channels, these can be used for either stereo sound, bilingual commentary, or alternative information which can be switched from track to track, under either manual or software control.

• Still frame capability gives LaserVision the ability to use large numbers of single frames as a kind of visual database. One side of an optical disc can store 54,000 single *character-generated frames*, the rough equivalent of 3000 to 4000 typeset magazine pages such as the one you're reading now. Photographs and diagrams, of course, can be intermixed with text. (Consider that 10,000 single frames—a staggering amount of visual information—can be included on a disc, leaving 24 minutes for real time video.)

• LaserVision discs can be subdivided into "chapters," which are arbitrary divisions of program material. Using chapter divisions, it's possible to organize information by category, or mix diverse program segments on the same disc. Short films or various activity segments can be "menu" selected by the viewer.

• While the most obvious application of slow motion viewing is to analyze motion, this feature can also be used to compress action, so as to save valuable information space on a disc. Teaching almost any procedure can be reduced to a series of a few dozen still frames that can be "walked through" (with the disc player in slow motion), yielding relatively fluid action, but consuming just a few seconds, rather than minutes, of real time video.

• Most LaserVision disc players can randomly access any frame or chapter.

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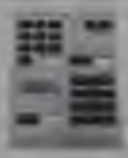

The Pioneer VP-1000.

This is achieved by the viewer keying the number of the frame or chapter into the player, either on its console, or via a remote control keypad. Even though the time required to access a particular program segment can range from two or three seconds to twenty seconds, a smooth, uninterrupted flow of information can be obtained either by using two disc players (with identical discs on each player), or by carefully designing a disc so that a minimum amount of physical space must be traversed when going from segment to segment. In either case, disc access time is distinctly preferable to tape spooling time.

Interactivity

How interactive should an interactive videodisc be?

The best answer might be the three levels of interactivity that have been defined by a major, publicly-funded disc project, the Nebraska Design/Production Group in Lincoln, NE. Part of Nebraska's educational television system, this group began in 1978 with a grant from the Corporation for Public Broadcasting to investigate the new videodisc medium. It produces experimental interactive discs, is fully equipped for post-production assembly of discs, consults to producers entering the medium, and acts as a clearing house for technical and design information.

These are their definitions:

Level One videodiscs are discs designed to be used on a consumer videodisc player with the basic functions (still frame, slow, fast, scan, two audio channels, frame and chapter number search) used *manually*. This allows for menu selection, simple viewer options and branching, analytical sequences, single frame storage, etc. An important function of a Level One disc is that it can be coded so that these consumer players can be told to stop on a single frame to offer the viewer options or further instructions. (The two presently available disc players, manufactured by Magnavox and Pioneer, as well as almost all industrial disc players, will respond to these hidden codes.)

Level One interactivity is the type of interactive disc which will probably be the most widely available to the general public, since no additional hardware is required to use the discs.

Level Two videodiscs are discs which are designed to be used with "industrial" videodisc players. These discs have all of the features of Level One, but are also

Several off-the-shelf interfaces between videodisc players and the Apple II microcomputer are currently available.

encoded with short, prerecorded computer programs. These programs are *dumped* off the videodisc and into a rudimentary computer inside an industrial player. This type of player is offered by DiscoVision Associates (a corporation jointly-owned by MCA and IBM), and is built around a Fairchild F-8 microprocessor with approximately 1K bytes of memory. These computer programs are meant to "manage" the disc, and make very simple responses practical.

Here's an example of the advantage of these "smart" discs and players: Let's say three viewing options are offered in a Level One program. Each of these directs the viewer to a specific frame or chapter. To respond to this prompt, he will need to enter manually either the chapter number (one or two digits) or the frame number (up to five digits) on a control panel. Under internal program control, a Level Two program can offer options that need only a single keystroke in response, since the chapter and frame directives are defined in the computer program.

Level Three programs incorporate all the features of Levels One and Two, and use an intelligent videodisc player interfaced with a microcomputer. In this way, larger management programs can be used, and computer-generated graphics and text can be intermixed with the videodisc visuals. In some schemes, the on-screen video can be switched between the computer-generated material and the disc video. In others, the computer video can be mixed and superimposed with video on the disc.

Particular to Level Three, is the ability to gather and store (on magnetic floppy disk) viewer responses and data on how viewers select options. This way, a group of viewers can be polled, or the designer of an educational program can ascertain that students have viewed and understood its content.

These are convenient definitions of interactivity, but aren't necessarily exclusive. Discs designed only for frame storage, for example, can be used as visual databases in a Level Three system configuration, yet even these discs can be used by manually accessing the material they contain.

It is possible, then, to design an interactive videodisc that works on all levels, differently. Even though consumers will not achieve the same interactive experience that the users of computer-driven Level Three systems will get, a disc can reach a much wider audience, and none of the visual content will be lost.

Consumer vs. Industrial Players

How are "consumer" and "industrial" players defined?

There have been two generations of consumer players. Both were designed to offer limited access to the functions of the disc medium. The first of these was

the Magnavox Magnavision disc player. Even though some experimenters have interfaced the Magnavox player with microcomputers, it is the most primitive of the LaserVision systems. Though all of the manipulative features—still frame, fast and slow motion, scan, etc.—are available, these features can only be operated from a group of keys on the front panel of the player.

The Pioneer VP-1000 player belongs to the second generation of consumer machines. Its design incorporates two badly-needed features: a hand-held remote control and the ability to call randomly any frame or chapter by entering a number on the player console or the remote. As a result, interactive programming is now easier to design for consumer use. The idea of using the disc for consumer-oriented single frame applications also becomes practical.

The Pioneer VP-1000 is sold as an industrial-quality player by DiscoVision Associates, which calls the machine its model 7810. DiscoVision began selling it in response to the needs of industrial clients for cheap, yet capable machines.

(The Pioneer, Magnavox and 7810 are priced in the $700 to $800 range.)

Three different players are marketed by DiscoVision Associates. Each is designated by the model number 7820. The 7820-1 is the original industrial player. It accepts programs about 18 in length loaded off the videodisc, and its longest access time in locating a frame or chapter is about 5 seconds. (Worst access time in the model 7810 and Pioneer VP-1000 is about 20 seconds.) The 7820-2 is faster, can randomly access segments in about 2.5 to 3 seconds, and its design improves upon the original by providing "handshaking"—a response from the disc player that the commands of an external computer have been received and executed—through its computer interface.

The model 7820-3 disc player is a further refinement on the original. It improves access time (albeit slightly) and adds a necessary computer instruction to its vocabulary. (The new instruction, "Branch on Fail," insures that the disc player doesn't "get lost" if it doesn't find the frame number or chapter number requested in a program. This could happen, for instance, when a disc is improperly replicated or mastered, and frame numbers are lost or garbled.)

Sony of Japan has recently begun manufacturing LaserVision-type discs and players. Sony's LDP-1000 is their first, and is an industrial-style machine. Unlike the DiscoVision players, though, the LDP-1000 uses an internal Z-80 microprocessor (on-disc programs, presumably, must be written in Z-80 code) and is oriented around a standard RS-232 serial interface. The Sony player is built to be basically compatible with other LaserVision discs. In other words, it will play them, though it won't recognize some codes that are commonly used, like chapter and frame numbers. Sony, at this time, has not announced plans for a consumer disc player.

Several off-the-shelf interfaces between videodisc players and the Apple II microcomputer are currently available. One is Omnicon, distributed by Aurora Systems, Madison, WI. The Omnicon board contains all the hardware to control the Pioneer VP-1000 (and DiscoVision 7810), and can switch between computer and disc video under software control. It retails for $250, and includes machine-code and Basic software, documentation, and the required cables.

Another board is offered by Allen Communications, Boulder, CO. This one interfaces the Apple to five different disc players, all those previously mentioned, except the Magnavox player. The board retails for $575, including software for interfacing to one of the machines. Additional software packages (for other players) are available for $50 each, and the board allows interfacing peripherals to the disc player and computer via its own RS-232 port. Allen Communications produces interactive discs, and consults to those who wish to design their own. The company is also active in refining and simplifying the "authoring" systems required in creating an interactive disc and computer program.

The picture produced by a videodisc exceeds the quality of other audio-visual media which have been available to educators in the past.

Other companies have developed their own hardware for computer/disc interface, too.

WICAT Incorporated, Orem, UT, designs and manufactures their own minicomputer system (around the Motorola 68000 microprocessor), and has long been active in computer-driven videodisc research. The Nebraska Videodisc Design/Production Group has fabricated its own computer interfaces, one of which is built around a TRS-80 microcomputer. The Interactive Television Company, Arlington, VA, has created several systems for videodisc applications such as data management, electronic libraries, geographic mapping and interactive movie viewing systems.

It is known, too, that Commodore International is hunting for a simple interface between its inexpensive VIC-20 microcomputer and consumer videodisc players.

Applications

It's one thing to invent hardware and dream up new systems, but what do you do with them?

Much of the basic work on interactive videodisc was done, not surprisingly, by educators. In Utah, a state with so much videodisc research that is has been nicknamed "videodisc valley," the University of Utah at Salt Lake, Utah State University, and Brigham Young University have all pursued projects that stem from their development of computer-aided instruction (CAI) programs.

The goal of all of these projects was to arrive at automated teaching systems which might displace (or at least enhance) many of the traditional classroom environments. The proponents of CAI often state that people learn better when they learn at their own pace. Another generally-held tenet, used particularly in support of interactive videodisc, is that the higher the fidelity of the automated image, the stronger the transfer of learning. Fidelity is an apt term, since, the picture produced by a videodisc exceeds the quality of other audio-visual media which have been available to educators in the past.

A look at the way in which interactive discs will filter down to consumers can be seen in two discs produced for Optical Programming Associates (OPA), a consortium of MCA, Philips and Pioneer, set up to demonstrate the possibilities of the LaserVision system.

"How to Watch Pro Football," is the rather prosaic title of the first interactive disc produced by the National Football League for OPA. The NFL has long used motion picture film and analytic movie projectors to teach players and coaches from "game films," and this approach is carried through to their videodisc. One chapter uses the two audio channels for alternate descriptions of the same football play. Another chapter is a collection of single frames of the pages of an NFL playbook. Another is a game called "Freeze Where," which teaches the necessity of anticipating what kind of play will be run. There are also quizzes on the disc, using one audio channel for the questions and the other for answers.

The OPA football disc isn't for everyone. It is a tough, technical discussion of football, suited for the most serious of fans and students of the game. But it does demonstrate how very complicated topics can be organized for interactive viewing.

A very different approach makes the "First National Kidisc" (OPA's second

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program even more fascinating. "Kidisc" is a collection of 22 games and activities for children, and is probably the most impressive program yet developed for the medium. Rather than asking for responses, this disc invites a child to play with it.

Each of the chapters demands that the viewer use it in a different way. Detailed instructions for making 11 paper airplanes are shown as groups of sequential still frames. Key phrases and the alphabet in manual language (sign language) are learned by watching a signer in slow motion. Two target games help develop a child's eye-hand co-ordination, and several chapters are collections of single frames—a flag and dinosaur quiz, and other chapters include puzzles and games.

Yet "Kidisc" is free from any confusing instructions. Its approach is simple, but elegant.

More concentration is required to use an experimental catalog published by Sears, Roebuck and Company. Sears, which is always looking for alternatives to its printed catalogs, took many of the sections of its Summer 1981 catalog, and organized it on an interactive disc. The disc was used as a market test in stores, and was given to Pioneer disc player owners for evaluation.

Naturally, much of the Sears disc is single frames, each of which describes a product that Sears sells. In addition to 5000 of these frames, however, the designers of the disc chose to include 12 real-time motion sequences to demonstrate certain products. One such chapter is a women's fashion show. Others demonstrate wireless telephones, toy airplanes, and backyard barbeque cookers. The organization of the Sears disc requires attentive viewing, since so many of the actual catalog frames make references, back and forth, to other frames. Some of these references necessitate a great deal of keypunching to get to where you want to go on the disc. Five thousand single frames can be a staggering amount of information.

Even more impressive is a visual database called "Patsearch," a project of Pergamon, the British publishing company, and Online Computer Systems, Germantown, MD. "Patsearch" is a visual record of 700,000 U.S. patents which is accessed by a computer dial-up. The host computer, in turn, controls a videodisc player. A series of videodiscs contains the corresponding illustrations for each of these patents. The discs, as well as the computer database, are periodically updated to keep the system current.

Computer-control of disc players is also the heart of a unique, game-like simulator designed by Perceptronics, Woodland Hills, CA. The concept of using a computer game to train military personnel isn't a new one, but Perceptronics' "Tank/Gunnery Trainer," goes one step further.

It uses realistic film segments, stored on videodisc, as well as computer graphics. The scenes on the videodisc depict perspective views from inside a tank. When the operator moves or turns the tank, the video responds appropriately. When a tank is fired upon (with computer-generated shells), a direct hit yields the realistically gruesome results.

The trainer was created under a U.S. Department of Defense contract, and offers distinct advantages. Training a soldier in a real tank, firing real shells, is expensive—the trainer slashes those costs. More important, though, the trainer is designed to be a competitive, fun activity, and, in fact, has been installed in Army post dayrooms, to stimulate play among servicemen. (To add "bells and whistles" to the game aspects, Perceptronics has even incorporated the electronic voice of "crusty Sgt. McCoy," a southern-accented Army NCO who barks at players in a gruff, salty manner.)

The most unique and fascinating interactive disc project may be the creation of "vicarious travel experiences," the work of Massachusetts Institute of Technology's Architecture Machine Group.

One of the MIT travel systems is a "movie map," or visual tour, of Aspen, CO. Aspen was chosen because of its relatively small size and grid-like street layout. Thousands of feet of motion picture footage, and thousands of individual frames were shot of the city's streets and buildings. Viewing the "movie map," you can drive down a street, turn corners, stop, or enter a public building. It also gives the viewer the opportunity to see short films about aspects of life in the city, or even fly over Aspen via a computer graphic simulation.

"Kidisc" is free from any confusing instructions. Its approach is simple, but elegant.

What's Ahead?

Naturally, these are just a few of the applications of interactive videodisc. Most industry watchers agree that the number of these projects will only increase during the coming months and years.

Optical Programming Associates will continue to create new disc programs aimed at the consumer. The most of these are an aerobic dance disc, and "Master Cooking," an instructional cooking disc incorporating a still frame recipe file, and other interactive elements, presided over by chef Pierre Franey and food critic Craig Claiborne.

Special effects master Douglas Trumbull ("Close Encounters," "2001," and "Silent Running") is presently consulting with MCA Videodisc on a series of interactive programs, though, like Trumbull's other projects, these remain under wraps for the time being.

In the future we may see more releases similar to the ambitious production, a tour of the National Gallery of Art, which features thousands of single frames, including virtually every piece in the Gallery's extensive painting collection. It is presently available from Videodisc Publishing, NY.

Online Computer Systems hopes to enter the home with the concept of its visual databases, via a system called "Discover II." "Discover" will permit a home user to dial a computer database which will give a videodisc tour of American colleges, technical schools and universities, helping high school students select colleges and careers. Online hopes to have the visual portion of the system—corresponding videodisc—available through school and public libraries, and plans to have the system operational (with data on schools in ten states available) during 1982.

The more distant future presents even greater potential for videodisc. At present, "sound over stills" is under development. This new disc encoding technique would make dozens of hours of sound, as well as thousands of single frames, available on one disc. This would be accomplished by digitally encoding audio data within one television frame, and using an inexpensive "black box" to convert the frame back into sound. Using this technique, a hundred-hour college course, for example, could be packaged on just a few disc sides.

One inevitable question arises: Will it be possible to record on a videodisc? The answer, at least for now, is no, but practically every manufacturer of videodisc hardware has a disc recorder under development. Most of these designs use a slightly more powerful laser to write information on a special disc. Matsushita of Japan has already shown a working prototype of such a recorder, though it can only record still frames at present. Since the digital data storage capacity of a videodisc is so great (reportedly a theoretical 20 gigabits), this is one area of research which will surely continue. (Some of the thinking in this direction imagines a disc as a gigantic Write Once, Read Only Memory, A WORDM?)

The real future of videodisc can't be predicted, though. Perhaps VHD (or another system not yet developed) will challenge the superiority of today's Laser-Vision system. And there are still solid-state devices, like bubble memories, that may make discs totally obsolete.

For now, the videodisc is a true wonder, but one which is waiting for our imaginations to catch up with its capabilities. □

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Videodiscs in the Classroom:

An Interactive Economics Course

Kent T. Kehrberg and Richard A. Pollack

Perhaps the most [illegible] need for the combination of videodisc and computer is education. And while others have been mentioning it, the Minnesota Educational Computing Consortium has been implementing the technology in classrooms across the state. Here the project director describes the development of an economics course using Apple and videodisc players.—ERS

The Special Products Division of the Minnesota Educational Computing Consortium (MECC) is charged with the task of researching and developing new uses for computers in education. With a grant from the Rockefeller Family Fund, we embarked on a project to develop a high school economics unit to be delivered by a microcomputer and videodisc player. This article describes our project, specifically the materials we developed and the process we used to develop them.

Declining enrollments and corresponding reductions in funds have meant changes in many school districts. In the past a school could offer a great variety of courses, including those taken by only a few students. Now, tightened school budgets make it impractical to provide this variety in the traditional manner.

Small rural schools have been particularly affected. Yet, should students be deprived of an enriched education because they live in a sparsely populated area or attend a small school? Perhaps technology has a solution to this problem.

Kent T. Kehrberg and Richard A. Pollack, Minnesota Educational Computing Consortium, 2520 Broadway Drive, St. Paul, MN 55113

The videodisc adds tremendous potential to traditional computer-assisted instruction.

Application of Technology

The purpose of our project is to apply the evolving technologies of the microcomputer and the videodisc player to educational problems caused by declining enrollments. A course frequently eliminated because of reduced enrollments is economics, which is often taught as an elective in the social studies area. Although an important course, economics is, unfortunately, one which attracts few students and one which few social studies teachers are well trained to teach. Therefore, economics seemed a good subject area in which to develop courseware making use of new computer technologies.

Keeping notes in the student manual provides a reference for the student and evidence of progress for the teacher.

We began by defining an economics course in terms of five units. The first unit, a general introduction, teaches students such concepts as resources, wants and needs, and scarcity. These ideas are taught during 11 student sessions, each of which covers one or two concepts and takes approximately 20 minutes of the student's time. The remaining four units will also consist of ten to fifteen sessions. The second unit is currently being developed with the other three to follow.

Three types of media are used in each session. A booklet introduces the lesson and directs the student to use the other pieces of equipment. At the same time, it provides space for note taking and record keeping. A microcomputer contributes tutorial, drill and practice dimensions to the lesson. And a videodisc player presents information, shows examples, and develops concepts which involve graphics or motion.

One of our objectives was to keep the cost of the project as low as possible. We chose an Apple II computer with a single disk drive. Although not as inexpensive as some cassette-based microcomputers, several thousand Apples were already being used in Minnesota schools. The Pioneer VP1000 LaserDisc system was also chosen for its low cost and because of the availability of an interface board (Available from Blue Lakes Sales, 3240 University Ave.,

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Madison, WI) which allows it to be controlled by the Apple II.

The videodisc adds tremendous potential to traditional pieces of media equipment: slide, filmstrip and movie projectors, as well as audio and videotape players. One side of a videodisc has space for 54,000 frames; this is comparable to the number of frames on a 16mm movie film. Each videodisc frame, however, has an identifying number so it can be directly accessed. Single frames can be displayed like slides, and motion sequences can be presented by having the videodisc pass forward or backward over successive frames. Varying the speed of the player provides slow or fast action. When played at normal speed, a videodisc shows a half hour of motion material.

Student Interaction

A student begins a session by opening the appropriate lesson booklet. The printed material lists the lesson objectives, provides a few paragraphs of background material, and then directs the student to turn on the computer.

The computer displays additional text material and some questions to test the student's understanding. Then, at appropriate times, video material is presented from the videodisc player. The video material may be stills or motion sequences. It may present information, give examples, or provide a visual reference for test items.

The computer occasionally directs the student to make notes or to write answers to questions in the booklet. In this way the booklet serves as a reference for the student in reviewing the lesson and provides tangible evidence of the student's work for the teacher to review. Each session ends in the booklet where the student is directed to turn off the equipment.

Teachers may be as involved in the student's learning activities as they desire. The teacher can review a student's work after each session or wait until he completes the unit. In this manner the student can study economics under the direction of a classroom teacher who may actually spend most of his time teaching a larger class in another social studies area.

The Development Process

Designing courses that involve several different media is a challenging juggling act. When role should the computer play? When should video material be shown? How can the author convey the structure of the lesson content to computer programmers and video directors?

We solved this problem in two ways. First, each lesson was systematically laid out on paper without regard to the use of media. The various lesson components were then examined in light of the available technologies. If a picture could enhance a concept, then the videodisc was applied. When motion played a role in defining a concept, the videodisc was used again. Also, when information could be delivered efficiently through a short video interaction, the television was used. Finally, lists or definitions were printed in the student's booklet.

The second part of the juggling problem was solved by using color-coded sheets of paper. Material for the student booklet was written on green paper. Individual frame sheets for computer coding were written on white paper. Pink was used for television scripts.

By placing the sheets in the proper sequence, a person could read through the entire lesson prior to its production. When the lesson was approved, the white sheets could be given to the computer programmer and the pink sheets to the video director.

Producing the Videodisc

Although the typical lesson requires 20 minutes of student time, only two or three minutes of video material is used. This video material is divided into segments which are interspersed throughout the lesson time while work in the student booklet takes up the remainder.

The costs of producing video material vary with the quality desired. To the microcomputer programmer who is accustomed to creating new programs quickly by typing out a few lines of code, the costs of video production seem high. (Commercial costs range from $1000 to $3000 per minute of material.) We were able to reduce these costs in a variety of ways.

First, using a service called Encyclovideo, which cross-references existing film segments, we were able to locate material from films available through Encyclopaedia Britannica. The rights for short one or two-minute segments were secured and we then added our own audio track.

Also, rather than using commercial studios to produce new video sequences, we were fortunate in being able to work with the Osseo Public School District in Osseo, MN. Their well-equipped facilities allowed us to produce high quality segments at costs that were lower than those associated with commercial productions. The end product was a 3/4" videotape containing new video material along with modified 16MM film, slides, and graphic artwork. The videotape was the equivalent of a half-hour of material for the videodisc.

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Discs in the Classroom, continued...

Post-Production

Producing a videodisc is done in three stages: preparing a premaster videotape, mastering a disc, and making replicates of the disc. Premastering is taking the assortment of source materials (slides, film, graphic art and videotape) and carefully editing them onto a one-inch helical videotape. Single slides must be recorded on single frames of tape, and all titles and captions must be added. Special encoding is required to allow access to individual videodisc frames. The preparation of this premaster tape is done by a post-production facility. We used the services of the Nebraska Videodisc Design/Production Group at the University of Nebraska.

Videodisc production is not the expensive component in computer and videodisc courseware development.

The premastered tape is then sent to a videodisc manufacturer. The process of making a videodisc is called mastering. The 3M Company in St. Paul, MN, facilitated the production of our master videodisc from the premastered tape. From this glass plate master, videodisc replications were made for use on the videodisc player.

Production Costs

Videodisc production costs (premastering and mastering) depend on the complexity and amount of material that is integrated into the disc. Our disc included slides, title frames, and two audio tracks as well as motion sequences. The cost for pre-mastering and mastering was $6,000. Replication of the master disc was inexpensive. In small quantities, copies can be made for fifteen to twenty dollars each.

Videodisc production is not the expensive component in computer and videodisc courseware development. The major expenses lie in the development of the courseware with its computer and video material.

Videotape-based systems could, at times, be used to reduce the cost of using a videodisc system. In fact, we used a tape-based system as our development system. The setup is similar to the videodisc, but the videotape player replaces the videodisc equipment. However, the videodisc does have several advantages over the videotape, including lower cost hardware, clear single frame display, fast access time, reverse motion, and two separate audio channels, as well as durability. These features counter-balance the additional cost of videodisc production.

The Future

A two and one-half week economics unit has been developed for use with computers and videodisc technologies. This unit is one-fifth of a total, stand alone, self-instructional high school economics course. Initial reactions from students and teachers are favorable and suggest that the use of microcomputer and videodisc technology will play a significant role in the future of instruction. A more formal evaluation of this first economics unit is underway. Meanwhile, with support from the Minnesota State Department of Education, we are beginning to design and develop the second unit. As the units are completed, they will be made available for use in schools throughout the country.

We believe that our project will demonstrate the viability of these developing technologies. Most important, the project will demonstrate the feasibility of providing learning opportunities in circumstances where they do not now exist. We hope to be able to maintain and expand learning opportunities where they may be in the process of being phased out and, thereby, improve the comprehensiveness and quality of educational programs. This is especially important to the school district faced with a reduction in the course and program options available to the students.

Finally, we hope that the project will show how available, low-cost technology can be used to deliver information in an interesting and even exciting fashion. In addition to demonstrating the viability of the computer-videodisc concept, the project will generate important new information about the design and development tasks required when working with this type of instructional delivery system. □

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V is for Videodisc

Charlie Kellner

Charlie Kellner works for Apple Computer, Inc. and was one of the developers of Apple Pilot and SuperPilot. Here he gives a brief introduction to the capabilities of SuperPilot as they relate to videodisc technology in what one appears. An in-depth evaluation of SuperPilot is planned for an upcoming issue.

Q: What talks to a videodisc, has 27 colors, and flies?
A: Apple SuperPilot!

Hi. Welcome to the future. I'm Charlie Kellner, and I'll be your guide for a brief tour of Apple's remarkable new educational system, called SuperPilot.

Let's start with a quick review. Pilot is an instructional language similar to Basic. The letters stand for "Programmed Inquiry for Learning Or Teaching." Apple Pilot is an extended version of Pilot for the Apple II, with built-in graphics, high-resolution character sets, and sound effects.

When Apple Pilot appeared a year and a half ago, it answered many questions. It also raised many new ones. The most frequently asked was, "How can I control a videodisc player with Pilot?" The answer is SuperPilot.

What is SuperPilot?

Technically speaking, SuperPilot is a "superset" of Apple Pilot. In other words, any lesson that will run in Apple Pilot will also run in SuperPilot.

Apple SuperPilot has many additional commands and features which have been specially designed to enhance the educational process. The actual design of the SuperPilot system is a direct result of the tremendous response Apple received from Pilot authors across the nation. In fact, most of its new capabilities were originally suggested by Apple Pilot users.

Mixed high-resolution text and graphics are standard in both Apple Pilot and SuperPilot; however, SuperPilot can print the text in 27 colors, on 27 colors of background, in single or double size fonts. It can also animate blocks of custom-drawn characters (remember "Maxwell"?) at up to thirty frames per second. It can control a printer, keep student records, and generally do most anything in order of magnitude faster than Apple Pilot. Like the man said, "Try it—you'll believe a program can fly!" But seriously, folks...

Just imagine, though, having a child's favorite cartoon characters tell him why 2 and 2 doesn't equal 22.

The V: Command

Perhaps the single most powerful new command is V:. With this command, you can add materials from videodisc or videotape sources to any SuperPilot lesson. For instance, it's obvious that a practical demonstration of life-saving techniques is much more effective than a lengthy discussion. Just imagine, though, having a child's favorite cartoon characters tell him why 2 and 2 doesn't equal 22. The possibilities are endless.

With a random-access videodisc player, for example, you might start out with the SuperPilot command "V:INIT." To display a picture located on frame 25037, you could say: "V:FIND(25037);VIDEO." To play an entire movie from frame 1200 to frame 15000, the command would be "V:PLAY(1200,15000)," and so on. The actual command words may vary slightly from one videodisc or videotape machine to another, but the functions will be essentially the same.

The first thing you need in order to use this capability (besides an Apple II) is a video source. Most modern disc and tape players have remote control capability; in fact, an increasing number of them are designed for computer control. The Apple (like most personal computers) usually requires a special interface card to control the player. What kind of card you need to use depends on which unit you want to control, so before you invest in video equipment, be sure that a suitable interface is available!

The other thing you need is a special control program to allow SuperPilot to talk to the hardware. This will very likely be available from the same people who supplied you with the interface card. If you have a Pascal language system, on the other hand, you can write your own!

How Does SuperPilot Control the Videodisc?

The SuperPilot system is written in Apple Pascal 1.1 (a structured programming language for the Apple II). Each lesson disk-

Charlie Kellner, Apple Computer, Inc., 10260 Bandley Dr., Cupertino, CA 95014.

time contains a library of Pascal subroutines which are used by the SuperPilot interpreter as it runs your lessons. Library unit 8, named "VCONTROL," contains just one procedure, called "VCOMMAND." As you might suspect, this is the procedure which controls the videodisc. Whenever a V command is encountered, SuperPilot calls this procedure, and simply does whatever it tells it to.

A complete description of how to write a VCONTROL subroutine is beyond the scope of this article. Suffice it to say that you can use any combination of Pascal and 6502 assembly language, up to 1K total (just remember, a picture is worth 1,024 words). All the information you need is supplied with the system.

Why Use a Videodisc?

Videodisc technology brings tremendous new capabilities to the classroom. It is no exaggeration to say that a single videodisc contains more information than any computer program ever written. In terms of storage alone, each side of the disc can hold up to 54,000 frames, with both pictures and stereo sound. In computer terms, that's more than three billion bits of data!

A videodisc player is much more than just a high-technology slide projector.

A videodisc player is much more than just a high-technology slide projector, though. Not only can any single frame be displayed at random, but any sequence of frames can be shown, either forwards or backwards, at any speed up to 30 frames a second. It can find any individual frame in just a few seconds and hold it all day without any loss of picture quality.

Still, the most exciting thing about the videodisc is not what it does, but what you can do with it. Under computer control, each and every one of those 54,000 frames becomes a resource in a portable "library" of visual materials. It's not inconceivable that one side of a single disc, properly organized, could hold an entire curriculum's worth of reference material, which could be used interactively by a wide variety of instructional programs.

By itself, the videodisc will have an unprecedented effect on the educational system. Used in conjunction with the personal computer, its potential is limited only by the imagination. □

The First National Kidisc— TV Becomes a Plaything

Now you don't have to worry about letting your children watch the tube. This interactive videodisc can provide hours of educational fun.

John Blizek

THE FIRST TIME you work with the LaserVision videodisc player, you will probably discover, as we did, that it is a communication tool with truly exciting potential. We also found, however, that the software that was available was not designed to exploit this potential. We saw a glaring need for an approach to programming that made use of the interactivity possible between the viewer and the program.

Our feeling was that children would be particularly responsive to an interactive disc. This belief was confirmed by a young nephew of Lin Oliver, one of our clients at MCA Videodisc. The young boy sought out from the DiscoVision library feature films with numerous car crashes, explosions, and the like. By step-framing, slowing, freezing, and reversing these scenes he was creating an interactive situation from the only material that was available to him.

Our production team consisted of producer Bruce Seth Green, co-producer James Ritter and myself, director of photography H. J. Brown, art director Betty Green, and educational consultant Ann Brown. We submitted our proposal, in treatment form, to Optical Programming Associates, which is responsible for creating programming designed specifically to make maximum use of the features of the LaserVision system.

John Blizek is a video artist, film producer and a member of B. Green Co. He was co-producer and director of the Kidisc, the first videodisc especially for children, which is the subject of this article. B. Green Co. retains copyright on the material and it is used here with permission. The company also retains rights to the photographs, which are also used with permission.

Since our show would be the first of its kind, we had to establish our own set of rules. What came of our many early brainstorming sessions would be revised and expanded and eventually would become the first truly interactive disc program for the home user—*The First National Kidisc*.

IN DESIGNING our program, we had four basic requirements:

1. It had to utilize all of the optical videodisc functions—forward and reverse modes, slow motion, step-frame still-frame, dual audio channels, and chapter stops.

2. It had to play as a cohesive program, even though it would contain nearly 30 individual modules.

3. It had to be an entertaining and "human" program rather than a cold, sophisticated information storage system.

4. The sequences had to have a high repeatability value. We felt one or two viewings should not be sufficient to exhaust the information available in a particular sequence.

Our first outline was called *18 Things To Do On A Rainy Day*, and consisted mostly of craft activities. Although these did utilize the various disc functions, we realized that, with a few exceptions, the show would work equally well on linear videotape. Expanding our ideas further, we developed our first "breakthrough" segment—*101 Jokes and Riddles*.

This segment was oriented exclusively to the LaserVision videodisc. With a question on one frame and an answer on the following frame, we found that we could present 101 pairs of riddles in less than nine seconds of actual disc time; yet to read all 101 in the step-frame mode could take nearly half an hour. What we did, in effect, was encode information by compressing it. Incomprehensible at the normal speed of 24 fps, it could be decoded or expanded by using the step-frame viewing mode.

The encyclopedia concept of single-frame events led to three other segments—visual puzzles, a flag identification game, and a dinosaur name game. In single frames, following real time demonstrations on how to make a secret decoder and a waterglass xylophone, we presented 13 messages to decode and the music for ten songs, respectively. In both cases one-half second of screen time could be expanded into hours of play value.

We then extended single-framing from animation into the realm of live-action photography. The first segment of this type was *A Trip to the Zoo*. By single-framing a 16mm motion picture camera, we created a sequence lasting less than a minute that contained over 40 animals, each preceded by an identification sign. By using the step- and still-frame modes, a child can view a slide show with five to ten views of each animal. Then we suggest to the child that he view the sequences in reverse and make a game out of guessing each animal before he gets back to the identification sign.

We then began to experiment with vicarious travel. We took our cameras on an airplane ride over Catalina Island and parts of Santa Monica. We found that the feeling of flight worked best when the camera angle was straight ahead. Pairing

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Table of Contents for The First National Kidisc

it straight down, however, was interesting in the step and still-frame modes since each frame was significantly different and the terrain and structures formed constantly changing patterns. At roughly one frame per second, the entire flight—from takeoff to landing—took one minute.

Another vicarious trip was a tour of Universal Studios. Depending on the particular attraction, either separate, unrelated frames or sequences of time-related frames were clicked off at varying rates.

We then added *Athletes in Motion*, in which a child can study the movement of the human body. The child now has control of the slow motion and freeze-framing that previously were the domain of the television sports director.

At this point, we modified two segments to take advantage of the disc's information compression potential. A demonstration of how to fold an Origami crane originally took three minutes in real time, no matter how ruthlessly we cut it. We then shot the demonstration at 8 fps, cutting the time by one-third, yet still retaining all of the necessary information. Since the machine's slow motion mode is infinitely variable, the viewer can easily restore the sequence to "real time."

In *Paper Flying Machines*, we pushed paper-folding to its compressible limit. A frame was clicked off only when it was absolutely essential to a clear demonstration of the folding process. Our original real-time version took two and one-half minutes to show the folding of three airplanes. In one minute, shooting only the essential frames, the revised version included 12 paper airplanes.

We also created two video games based on the optical videodisc's ability to stop instantly and hold a clear, frozen frame. In one case, to make the highest score the viewer is asked to freeze the picture when the moving concentric circles of a target reach the bull's eye. The second game utilizes two rectangles that move quickly across a colorful field of vertical bars. Freezing the disc when the rectangles occupy the same bar scores the highest number of points. In both games, negative points penalize the player for overshooting the target. (The games can be made easier by playing the disc in slow motion.)

We used the disc's two-channel audio capability in a section demonstrating *Pig Latin*. On one channel, a girl gives an on-camera explanation of how to speak Pig Latin—in Pig Latin. The other channel carries a voice-over translation. In another case, we teach two dances with music and instruction on one channel and music alone on the second. Once children have learned the dance, they can turn off the instruction channel and dance to the music and picture only.

To achieve our goal of a cohesive blending of segments and an entertaining "human" presentation, we employed several devices. First, we introduced two principal characters—a magician and a dance instructor—who appear in various segments. Second, a spinning videodisc in black limbo appears between segments as a consistent bridging device. Third, each segment is preceded by a title sequence, and last, music cues segue throughout.

THE FOLLOWING POINTS have come from our production experience with *The First National Kidisc* and may benefit your interactive video production.

1. Compressing information can be a useful technique. When appropriate, utilize the encyclopedia concept of single-frame events, especially when a lot of graphic information must be presented. Live-action photography can be compressed by filming at speeds less than 24 fps. This is particularly appropriate for demonstrations or processes. Determine how much visual information is essential to the viewer, presented as single frames, to arrive at your shooting speed.

Working on one of the animation segments for The First National Kidisc *are (from left to right) James Ritter, Betty Green, and Bruce Green. Nearly one-third of the disc is composed of animated segments.*

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CIRCLE 152 ON READER SERVICE CARD

COLOR-80

Pictured above is Jenny Brown following a paper-folding demonstration from the film-editing bench which allows for frame-by-frame access so Jenny can move along at her own speed.

2. The static shutter speed of motion picture cameras is a problem when you want sharp, single frames and the camera or subject is in motion. Variable shutter cameras can solve this problem.

3. The audio signals cut off when the LaserVision disc is played at speeds other than normal play. Therefore audio information can be related to compressed time segments only when played at normal speed.

4. The audio quality of a LaserVision videodisc is very good. Take care in original recording, transfers, and re-recording. If your program is on film, use your mixed mag track when transferring to disc.

5. To avoid losing frames, single-frame sequences must be shot on film. They can then be transferred to videotape if you so desire. (That has some advantages, as discussed below.)

6. Assembling A and B rolls on videotape is very time-consuming and costly, and is likely to result in lost frames. The last point is significant only when edits occur within, at the beginning, or at the end of single-frame sequences. It is advisable at least to go to an answer print before transferring to videotape so video editing is eliminated. Conformed 35mm camera original can be transferred directly to tape since A and B rolls need not be made.

7. Timing and color correction can be a problem in compressed time sequences when you are dealing with very short shots. Forty frames is about the minimum reaction time for laboratory timing corrections. Therefore color correcting in video where changes can be made faster, is very useful, and is one reason for eventually transferring to tape.

8. We included a "warning" countdown device preceding single-frame sequences so the viewer could stop very close to the first frame of the sequence. These countdowns are similar to SMPTE leader.

9. Each frame is numbered, and the LaserDisc players can display these frame numbers over the picture. These frame numbers are not known until the disc is mastered. Therefore if you want to make reference to these numbers within the program, you must go to a second master disc. The frame numbers can be inserted into "blanks" that you must design into your program graphics.

The First National Kidisc does not have a "menu" or "table of contents" at the beginning of the disc itself. A list of chapters is printed on the album cover, and the information leaflet that comes with the disc describes the content of each one. When viewers wish to see only one or two specific segments (chapters), they can use the disc player's search function to locate what they want by chapter number.

10. The LaserVision system allows self-paced viewing. How clearly you've presented your material to the viewer should no longer be judged in a "real time" viewing. Density is the key to maximizing the LaserVision system features.

It is clear that a new approach to programming will be developed for the LaserVision videodisc system. It's fascinating for us to contribute to that new approach. It is also clear that much more is yet to come. □

Kidisc Available

By the time you read this, The Kidisc described here should be available from your local videodisc dealer or program distribution. It will probably be priced around $20, and contains 27 minutes of programming when played in real time.

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CIRCLE 109 ON READER SERVICE CARD

Shopping for Video Discs

David H. Ahl

We set out to buy some Laser Vision video discs with mixed results

Being the first one on your block to own the latest technological marvel may bring some brightness into your life but it is likely to be accompanied by an equal amount of frustration. Such was the case when I acquired a Pioneer VP-1000 Laser Scan video disc player. It has all the bells and whistles that one could ask for: chapter search, frame search, freeze frame, reverse and forward slow motion, jump forward and reverse, and all of this possible from across the room by means of an infra-red remote control or by control from a computer.

"Boy, is this going to be fun," I thought. In my mind I could see adventure games based on movies such as *Jaws* where the shark would be coming at you with its jaws wide open, the movie would halt and you would have to make a decision. Make the right decision and the sequence would run backwards, perhaps in slow motion, and the shark would back away. Or, you could evoke magic which would transform you to an entirely different time and place. Make the wrong decision, of course, and you get eaten.

With such visions dancing in my head, I set out to get some laser scan video discs. The press release from the Laser-Vision Association boasts that nearly 140 titles are currently available from seven sources: Columbia Pictures, Magnetic Video, MCA, Paramount, and others.

Saturday Night Fever from Paramount Pictures was available in only one of the six stores we visited on our videodisc shopping spree.

The Muppet Movie was recently released by Magnetic Video. It was not available at the time that article was written, however, it should be in retail stores by October or November.

Macy's and Bamberger's are a large, New York based department store chain. They do a big business in electronic appliances and even have their own private label TV sets. They carry both the Magnavision and the Pioneer video disc players. Making my way to the TV department in the Morristown store, I asked the middle aged woman about video discs. She responded, "Just a minute, I'll see what we have in the back." I pointed out to her that the glass cabinet immediately behind her contained what looked like a pile of video discs. "Gee, I don't know about that," she said but unlocked the cabinet and took out its wares. She also, quite obligingly, sent a young sales girl to the back to bring out the additional discs. I said I was particularly interested in space adventure movies such as *Star Trek* or *Alien*, but that any adventure movies would do.

Unfortunately, the main titles that were in stock included *Smokey and the Bandit*, *The Jerk*, and *1941*. Kind of slim pickings.

I then set out for Livingston Mall, where several retailers were selling either the Magnavision or U.S. Pioneer players. My first stop was Sam Gordon's, a large appliance dealer with outlets all over northern New Jersey. I wandered into the store and hung around the Magnavision player for awhile. When it was apparent that no one was going to come my way, I went to the back and asked the salesman whether any laser vision discs were in stock. "Yes, I think we have some in the back," he replied. It was as though I had inquired about x-rated video cassettes. He returned a few minutes later with a battered record box containing eight or ten video discs. Again, there were only three or four titles including many of *Smokey and the Bandit* and several of

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CIRCLE 141 ON READER SERVICE CARD

The Jerk. All the titles were ones that were originally furnished to stores with the Magnavox players nearly a year ago. I asked if more titles were due in and got the same response as I did at Bamberger's, "I don't know. The home office does the buying." I thanked him and went on to my next stop.

My third stop was Sam Goody's, a large retailer of records, tapes and audio equipment. Goody's was featuring the Pioneer player but, like the other two shops, it was not running nor was anyone around who seemed to know very much about it. However, nearby were six record bins of video discs. Four of the bins had discs in the VHD (RCA Selectavision) format whereas two of the bins contained laser vision discs. Unfortunately, most of what was in the bins were the disc separator cards with the titles emblazoned on them and very few discs. Inevitably, *Smokey and the Bandit*, *The Jerk*, *1941* and *Saturday Night Fever* were in stock and about seven additional titles, none of which were in the space or adventure genre.

So far, three stores and all I had seen were the same handful of MCA titles that were distributed with the original Magnavox players nearly a year ago. Just two titles from Paramount, and none from Magnetic Video, Columbia, or any of the others who were supposedly producing laser vision discs. "Ah, well," thought I, "tomorrow is another day."

A few dozen phone calls indicated that some of the video-only shops had a better selection of video discs than department stores and other consumer electronics retailers. Hence, my next stop was Video Shack on Route 46 in Parsippany. Upon entering I was immediately greeted by three young salesmen all offering their help. A four-tier display rack of laser scan video discs was immediately to the left of the entrance. I told one salesman I was interested in space adventure titles and he immediately pointed out *Star Trek-The Motion Picture*, however, that was the only one in stock. Unquestionably, they had a larger array of titles than my previous stops although most of them were still from MCA. Titles included: *The Incredible Shrinking Woman*, *Grease*, *Jaws II*, *Abba*, and the all-too-familiar, *The Jerk*.

I asked whether they expected any titles in from Magnetic Video such as *The Alien* and *The Muppet Movie*, the salesman told me that "No, there would be no titles forthcoming from Magnetic Video as the company was owned by MGM, who was a major backer of the RCA CED video-disc format and, therefore, would not be issuing any laser scan titles." I knew this not to be the case and questioned the other salesman and the owner. They concurred, that indeed Magnetic Video would not be issuing any laser scan titles

but that maybe someone else would do so and that I ought to wait six months and then go disc shopping. I asked further about other companies making laser scan titles and was assured that the only people in the market now or for the forseeable future were MCA, Columbia, and Paramount (I'm sure the folks at Pioneer Artists, Magnetic Video, and Optical Programming Associates (OPA) would not be pleased to hear that news). I thanked them for their help and set out in my car for the shopping center jungle in Paramus.

The First National Kidisc, produced by Optical Programming Associates, is a widely-acclaimed "interactive" disk. Unfortunately, we did not find it widely available at the retail level.

My first stop in shopping mall jungle was Colonial Magnavox in Bergen Mall. Upon entering the store I was delighted to see four or five video discs to the left of the entrance along with a broad array of video tapes. However I then noticed in the back of the store an entire wall of over 50 titles of video discs. While most of the titles were from the MCA catalog, a few Paramount and OPA most notably *Kidisc* and *How To Watch Pro-football* were also represented. Like my previous stop, the shopkeeper knew nothing about the entry of Magnetic Video into the field and was only vaguely aware that Columbia was about to release several titles. Unfortunately, this excellent selection of discs had one major drawback: prices were about $5 per disc higher than any place else I visited. Nevertheless, I shelled out $29.95 for *Buck Rogers In The 25th Century* and went on my way.

My next stop was about a mile east on Route 4 at the Video Shack, part of a five-store New York-based chain. The entry to the store is like a small theater lobby; to the left is a miniature theater with large stuffed animals looking up at a mocked-up video screen. The main part of the store is open and roomy and lined from floor to ceiling on three sides with the largest collection of video tapes and discs I've ever seen in one place. One corner was devoted to laser scan video discs and virtually every MCA title as well as a good cross section of the Paramount and OPA catalogs were in stock. The young salesman immediately came over and offered his assistance and proved exceptionally knowledgeable about existing titles, ones about to go out of print, and new titles and labels entering the field. He told me that he expected Magnetic Video titles in about a month and that a concert series from Pioneer Artists would also be forthcoming. I was impressed by the cleanliness of the store, the knowledge of the salesman and the discounted prices (about 18% off retail). I bought *Roller Coaster*, a movie with plenty of action to integrate into an adventure game, for $25.50. Video Shack, incidentally, carries no hardware; only media (and/or software).

Crossing over to the other side of Route 4 on one of the most complicated U-turns I've ever seen, I made for my next stop, Theatervision. A heavy user of radio commercials, Theatervision is both a hardware and media dealer. The store was a hodge podge of cameras, TV sets and, in the back, a room set aside for large screen and projection TV sets. A magazine-type rack contained about 25 titles each of CED and LV video discs. After getting a demonstration of projection TV sets and deciding that $3,000+ was a bit more than my budget could stand, I settled for *The Great Waldo Pepper* for the lowest price yet, $24.95. Only MCA discs were in stock. The salesman "expected others soon," but couldn't tell me what or when.

What are my conclusions from this shopping spree? The first one is that clearly there is a much greater selection of discs to be found at video-oriented stores than at department stores and audio stores. For the very best selection, a video-media only outlet is probably the best bet. Another advantage to shopping at video-oriented outlets is that their prices tend to be somewhat lower than full-line stores. Another conclusion: don't believe everything you see in advertisements or a catalog. Just like the computer field, manufacturers are prone to announce products before they are available at the retail level. On the other hand, sales people are not necessarily the best source of information either. The more you can find out about what is going on in the field, the better off you are. In other words, become an informed consumer in any way you can: through magazines, shows, advertising, and by shopping around.

Coming in a future issue of *Creative Computing*: reviews of a representative sampling of video discs with an eye toward making them the basis of a computer game as well as, of course, their entertainment value. □

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How Will the New Tax Law Affect Computer Owners?

Vernon K. Jacobs

Should you buy your first (or next) computer this year or next? Should you lease or buy? Are there any other areas of the new tax law that might affect those who own or are thinking of owning a computer?

There are at least 109 specific provisions in the "Economic Recovery Tax Act of 1981," and it will be months (perhaps years) before the impact of all the provisions is evaluated. It's almost certain that we will have another tax bill early in 1982 to correct the inevitable technical errors and flaws in this hastily drafted and complex set of tax law changes. Nevertheless, here is a brief summary of some of the provisions of the new tax law that should be of specific concern to computer owners and lessees.

Full Write Off For Small Computers

One of the provisions of the new tax law permits businesses to deduct the first $5,000 of business equipment acquired in 1982 and 1983, the first $7,500 of purchases in 1984 and 1985 and the first $10,000 of purchases after 1985. This means that many small computers could be fully expensed in the year acquired. No investment credit would be allowed on such purchases but the immediate write off would usually be better.

If the cost of the computer exceeds the deductible amount, the excess would be eligible for the new depreciation method. This full write off provision is not available for investors. It is only available if the equipment is to be used in a trade or business.

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New Depreciation Rules

If you purchased a computer in 1981, the 100% write off won't be available, but the new method of depreciation (called the "Asset Cost Recovery System") does apply to 1981 equipment purchases.

Under the new method, computers will be depreciated over a five-year period using specific rates for each of the five years. (If computers can be classed as research and development equipment, they can be depreciated over a three-year period.)

For five-year class equipment purchased in 1981 through 1984, the first year's depreciation will be 15% of the cost. The second year's depreciation will be 22% of the cost and the rate will be 21% in each of the next three years. The entire cost will be deducted over the five-year period.

By contrast, the prior law permitted a computer owner to write off up to 40% of the cost in the first year if the equipment was placed in service before July first. An additional 24% of the cost would be written off in the second year, 14.4% in the third year and 10.8% in the fourth and fifth years. This assumes a five year life, which has been typical for computer owners. Consequently, owners of larger and more expensive computers won't fare as well under the new law as under the old, but owners of personal computers will be better off – assuming no other equipment purchases in the year.

If the tax deductions are not available because of other tax deductions or business losses, computer owners will be able to elect to write the equipment off over a 12-year or a 25-year period using a straight line method of depreciation. However, the choice of the slower method is mandatory for each year's purchases. I.e. you can't change your mind after a year or two.

The main reason to use a slow method of depreciation is to avoid the possible loss of deductions during a prolonged start up period due to the existing time limit on offsetting losses of one year against profits of future years. The new law provides substantial relief in this area, which may make the slower depreciation method unnecessary. Previously, business losses could be carried forward for seven years, but the new law extends this to 15 years, retroactive to 1976.

Investment Tax Credit

Computer buyers will realize a small increase in the amount of available investment tax credit for purchasing a computer. Under current law, equipment with a five-year useful life is eligible for 2/3 of the full 10% tax credit. Equipment with a five-year life will now be qualified to claim the full 10% tax credit for equipment that is depreciated over a period of five or more years.

If the equipment will have a three-year useful life (autos, trucks and certain R & D equipment), the tax credit will be 6% of the cost of the property rather than 10%. These new tax credit rules took effect in 1981, and include property that was acquired before the law was passed on August 13, 1981.

There was no specific change relative to claiming the tax credit on the full cost of a system that included both hardware and software. However, if the tax credit is claimed on the software because the price is combined with the hardware, then the buyer must depreciate the software with the hardware. If the software is purchased separately, and is licensed rather than purchased, then the full software cost can be deducted in the year of acquisition.

Defining Leases

Taxpayers and the IRS have been arguing for years about whether a lease is really a lease or just a method of financing an equipment purchase. The new tax law attempts to simplify some of the complex rules that have cropped up in this area. Basically, the parties must agree that the transaction is a lease and the lessee must not acquire ownership of the property at any time during the lease. The lessor must be a corporation and must have an investment of at least 10% that is "at risk" in the investment. Generally, the property must be new property. □

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CIRCLE 158 ON READER SERVICE CARD

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MECC NEWS

The Minnesota Educational Computing Consortium (MECC), which provides support services for educational computing for 30 college campuses and 433 school districts in the state, has signed an agreement that is expected to lead to the purchase of approximately 750 personal computer systems from Atari, Inc., over the next year.

The agreement specifies Atari 400 computers with Atari Basic cartridges, Atari 810 disk drives and joystick controllers. At retail, each system would be priced at approximately $1,300.

As part of the agreement, MECC will also convert about 75 of its educational software programs (kindergarten through 12th grade) for use on Atari computers. The programs and accompanying courseware will be available from MECC.

It is expected that Atari versions of the MECC software will be available from Creative Computing Software, which currently distributes the programs for the Apple.

Atari Software Acquisition Center

Independent software developer works on converting his software, originally designed to work on another manufacturer's computer, to a format usable on Atari Home Computers.

The first Atari Regional Software Acquisition Center has opened its doors in Sunnyvale, CA.

The center is designed to provide a place where qualified software developers can work with Atari equipment, have access to technical reference materials and be able to work with a staff of trained people who can answer their questions about Atari computers.

The 4,000 square-foot center houses the administration and duplication facilities for the Atari Program Exchange (APX), which makes software written by users of Atari computers available through a quarterly catalog. More than 57 different programs are now offered through the catalog. In addition, it houses a facility for the conversion of programs written for other computers to a format that will work on Atari computers.

Corrections

We've received a few corrections for "The Computer Tutor," from the October issue.

In Listing 1:

```
160 OPEN#7: "CS1", INTERNAL, OUT-
PUT, FIXED 192
690 CALL HCHAR (L2,2+I,T)
500 I=I-1
860 L1$=SEG$(L$(L2),J,1)
```

In Listing 2:

```
105 OPEN#7: "CS1", INTERNAL,
INPUT, FIXED 192
430 Y=POS(T$,".",W)
620 IF S$=STR(0)
THEN 640
```

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DSK Keyboard for the Apple

Patrick Niesink

It seems that more and more people, particularly computer owners, are becoming aware of the utter cruelty of the keyboard arrangement, commonly referred to as QWERTY, currently in use on most typewriters and computers. A superior arrangement, the Dvorak Simplified Keyboard, which was developed by August Dvorak in 1936, minimizes finger distances travelled and thus greatly improves typing speed and accuracy.

When I bought my typewriter, I surrendered to QWERTY, balking at the thought of breaking off and resoldering the key slugs. However, when I purchased my Apple, I saw an ideal opportunity to reap the benefits of DSK. To convert the Apple to a DSK computer, we need to change the way both the computer and its user interpret the keyboard.

To make the computer believe that you are typing on a DSK keyboard, you need to supply it with a list of ASCII code values known as a "translate table," and since the 6502 chip has no translate instruction, you will also need a short machine language translating program. The translate table tells the computer which character you want to type (DSK keyboard) when supplied with a character typed on the QWERTY keyboard. For example, when you press the "Q" key on the DSK arrangement, you are actually pressing the "X" key. The entry in the translate table which corresponds to the "X" is the ASCII code for a "Q."

Since you will want to make this table as small as possible, you can omit the keys which are not rearranged and compensate by making the translating program a bit more complex. Now you must decide which characters to relocate and which to leave alone. Clearly, you cannot tamper with the control codes, since if you did, the next time you pressed the backspace or forward arrow keys, you would get a nasty surprise. It might seem like a better idea to move CTRL-B along with the "B" key to avoid confusion. For example, if control codes are not relocated, CTRL-C becomes CTRL-J, thus making your Basic manual somewhat obsolete. However, you can always write short notes in your manuals with the new control codes.

Mr. Dvorak's suggested layout for numeric keys seems more of a hindrance than an aid, so I have not altered the numbers (or their shifted characters) in my implementation. This leaves the letters A-Z and the colon, semicolon, slash, question mark, period, comma, hyphen, asterisk, less than, greater than, plus sign, and equal sign. In the ASCII code table, the asterisk, comma, hyphen, period, slash and plus sign occur directly before the numbers and the others are nicely sandwiched between the numbers and the letters. Thus, if you include the numbers in the translation table, you may have wasted ten bytes, but the translating program becomes less complex.

Patrick Niesink, 708 Lindsay St., Winnipeg, Manitoba, Canada R3N 1H3.

Figure 1. The Apple DSK Keyboard.

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```
$3A0: * TRANSLATED TO -
$3A1: + TRANSLATED TO 1
$3A2: , TRANSLATED TO U
$3A3: - TRANSLATED TO *
$3A4: . TRANSLATED TO V
$3A5: / TRANSLATED TO Z
$3A6: 0 TRANSLATED TO 8
$3A7: 1 TRANSLATED TO 4
$3A8: 2 TRANSLATED TO J
$3A9: 3 TRANSLATED TO 9
$3AA: 4 TRANSLATED TO *
$3AB: 5 TRANSLATED TO >
$3AC: 6 TRANSLATED TO A
$3AD: 7 TRANSLATED TO 7
$3AE: 8 TRANSLATED TO O
$3AF: 9 TRANSLATED TO 7
$3B0: : TRANSLATED TO 1
$3B1: ; TRANSLATED TO [illegible]
$3B2: < TRANSLATED TO [illegible]
$3B3: = TRANSLATED TO |
$3B4: > TRANSLATED TO @
$3B5: ? TRANSLATED TO A
$3B6: @ TRANSLATED TO 0
$3B7: A TRANSLATED TO J
$3B8: B TRANSLATED TO .
$3B9: C TRANSLATED TO .J
$3BA: D TRANSLATED TO E
$3BB: E TRANSLATED TO .
$3BC: F TRANSLATED TO H
$3BD: G TRANSLATED TO 1
$3BE: H TRANSLATED TO O
$3BF: I TRANSLATED TO .
$3C0: J TRANSLATED TO U
$3C1: K TRANSLATED TO I
$3C2: L TRANSLATED TO W
$3C3: M TRANSLATED TO A
$3C4: N TRANSLATED TO E
$3C5: O TRANSLATED TO P
$3C6: P TRANSLATED TO L
$3C7: Q TRANSLATED TO >
$3C8: R TRANSLATED TO F
$3C9: S TRANSLATED TO O
$3CA: T TRANSLATED TO Y
$3CB: U TRANSLATED TO .
$3CC: V TRANSLATED TO E
$3CD: W TRANSLATED TO 1
$3CE: X TRANSLATED TO U
$3CF: Y TRANSLATED TO F
$3D0: Z TRANSLATED TO =
```

Figure 2. Contents of Translation Table.

Now all that remains is to decide where on the keyboard to put these 38 characters. Clearly, you can't "double up" characters (one being the shift of the other) on a key such as the QWERTY "Q" key, since shifting the key will not produce a different code. Dvorak's key layout puts four non-letter keys in the places formerly occupied by "Q," "W," "E," and "Z." The comma and the period I have placed as suggested, but I have left less than and greater than where they were. In the suggested place of the slash, I have substituted the question mark, the Basic abbreviation for PRINT. The suggested semicolon-colon key is the equal sign on my computer, since it is also used very frequently in Basic programs.

The arithmetic keys I have placed in the upper right corner, in an order which seems the most logical from a mathematical point of view. Thus simple arithmetic can be performed entirely with the top row and leftmost three keys of the second row. This leaves only the semicolon and the colon. These I have placed above the "Z" and "S" keys, since they were the only places left.

The Translating Program

Now you're ready to write the translating program. The first thing it has to do is call the Apple's KEYIN routine, at location $FD1B. This subroutine returns the ASCII code for the typed character in the Accumulator. Next, you must save the A and X registers in temporary storage locations. I have chosen locations 8 and 9, as they are not used by either Basic, the monitor, or DOS 3.2.

Now you have to make sure that the typed character is one of the relocated ones. Subtracting the value $AA (which is ASCII for "*" with its high bit set) serves two functions: first, if this operation sets the N flag, the character is either a control character or a shifted numeric key; thus you don't want to change it. If the N flag is not set, you need only check that the code is not greater than $DA, which is a "Z."

Now that the Apple understands DSK, all you have to do is change the key caps on the keyboard.

The accumulator now contains a modified ASCII code: 0 for an asterisk, 1 for a plus sign, 2 for a comma, and so on. This means that "Z" has a value of $31, so all you have to do is compare the accumulator to $31. This time if N is set, the character should not be changed. To leave the character unchanged, merely re-load it from location 8 and return. If the N flag was set this time, the character must be translated. This is accomplished by using the pre-indexed mode of the "load accumulator" instruction.

First, transfer the current value of the accumulator into the indexing register X. Then, giving the start address of the translation table (mine is at $3A5), load the DSK counterpart of the typed character into the accumulator. What this particular form of LDA does is add the current value of the X register to the specified address, and use the result as the address of the desired byte. Remember that the table starts at *, that is, location $A5 has the ASCII code for the DSK character which replaces the "*" on the QWERTY keyboard.

Now the accumulator contains the translated ASCII value. All you have to do is store this value in location 8, then act as if you don't want to change it, that is, reload the accumulator and X register and return to whatever program called the translation program. Simple, wasn't it!

Implementation

The next problem lies in implementation. The translation table and program can be saved either on tape through the monitor, or, if you have a disk drive, in a binary file. Then, each time you power up, you will have to load in the table program, and set the monitor KSW switch (bytes $38 and $39 if you don't have a disk drive) to the address of the translating program, $3D6 in my implementation.

If you have a disk drive, it's a bit more involved. Not only will you have to set the KSW of DOS, which is 5205 and 5206 bytes past the HIMEM set by DOS 3.2, but you will have to protect resets and Basic IN#0 commands from putting you back in QWERTY.

This can be done in many ways, but the simplest is to zap out the section of DOS 3.2 which resets the KSW switch. The only disadvantage of this is that it invalidates the Basic IN# command and the CTRL-K command of the monitor. If this really bothers you, there are other ways of protecting the DSK, such as wedging a routine before the DOS RESET routine which plugs your translation program into the DOS KSW.

All you have to do, then, is write a Basic program which loads in the binary file, sets the DOS KSW, and clears out the KSW-resetting routine (which runs from 4686 through 4703 bytes past the HIMEM set by DOS). Then store this program as the "hello" program on your disk. This program will only work if it is run before any program which changes HIMEM.

Listing 1. "HELLO" program for disk.

```
10  PRINT "DO YOU WANT THE DSK BACKUP?"
20  PRINT "(ENTER Y OR N)";
30  GET A$: IF A$ = "Y" THEN 50
40  IF A$ = "N" OR A$ = "Y" THEN  PRINT "N": PRINT "OK.": GOTO 190
50  REM ALLOW FOR BOTH KEYBOARDS (N OR X, U OR V)
60  IF A$ < "N" AND A$ > "U" THEN 20
70  PRINT "U"
80  PRINT  CHR$ (4);"BLOAD DSK"
90 HT = PEEK (3195) + 256 * PEEK (3196): REM HIMEM
100  POKE 5205 + HT,219: POKE 5206 + HT,31: REM SET KSW
110  FOR K = HT + 4686 TO HT + 4703
120  POKE K,234: REM NOP INSTEAD OF 'RESET' BYTE; PREVENTS DOS AND DSK
130  NEXT
140  PRINT "DSK KEYBOARD TRANSLATION INSTALLED."
150  END
```

```
0300- A9 8A 20
0302- A4 D6 D0 A0 01 B0 B1 B2 B3 B4
0304- B5 B6 B7 B8 B9 BA C0 C1 C2
0306- BF B0 B8 C0 C1 B6 C4 C5
0308- BF D2 C9 C4 C2 B6 B4 C8
030A- C8 C2 B2 CC BF D0 C9 B9
030C- C7 C8 AC B1 C8 B0
030E-

0350- C0 18 F0          A5 A0 69 1C
0352- 85 A0             STA $A0
0354- 85 C9             STA $C9
0356- A9 A0             LDA #$A0
0358- 85 C8             STA $C8
035A- A0 00             LDY #$00
035C- C7 31             CMP ($31)
035E- F0 05             BEQ $0365
0360- A0                TAY
0361- B0 A5 C5          LDA ($C5),Y
0363- 85 C8             STA $C8
0365- A5 C8             LDA $C8
0367- 4A 09             LDX #$09
0369- 60                RTS
```

Listing 2. Translating table and program.

Now that the Apple understands DSK, all you have to do is exchange the key caps on the keyboard. Placing a pointed instrument underneath a key near the edge, and your finger on the opposite side of the key, lift straight up, applying equal pressure on both sides of the key. If this is the first time you've ever removed the caps, they may be rather stiff. The removal of the fine cap should provide enough room to get your finger underneath the rest, thus eliminating the need for the pointed instrument. When you are done, some of the keys will be incorrectly labelled; you can cover them with masking tape and re-label them if you have trouble remembering which keys are which. The whole operation takes about five minutes.

Learning to Type

Now that you have a DSK keyboard, all you have to do is learn to type on it. The first week or so, you will probably find yourself typing keywords as if you still had QWERTY. After a while, though, you will be typing faster than ever. If you have special software which can only be run from a disk boot, you will have to revert to QWERTY every time you want to use it (unless you can figure out a way to get the program onto a regular disk).

If you want to use the Applesoft Chain program, you will have to relocate the translation table and program. Also, if you are an experienced DSK typist, you will have trouble finding keys on a regular keyboard (as if you'd want to). Nevertheless, these drawbacks are minimal when compared to the savings in tedium, wasted time, and sore fingers achieved by using a modern, efficient Dvorak Simplified Keyboard. □

Big Numbers and Small Computers

Mark Zimmermann

Numbers are fascinating entities. In some ways, a number is pure, abstract thought, unsullied by "reality." Consider the decimal number "17": does it exist in nature? Sure, there are collections of things that contain seventeen objects; you may have seventeen pennies in your pocket, or walk up seventeen flights of stairs. But those pennies aren't "17," any more than they are Abraham Lincoln. The number "17" goes far beyond any specific embodiment of it.

Seventeen has properties independent of whether one is considering pennies, or stairs, or stars. In counting upwards, 17 follows 16 and precedes 18. Seventeen is a "prime," that is, it has no factors except itself and 1 among the positive integers. It is possible to construct a seventeen-sided regular polygon using only a compass and a straightedge, just as it's possible to make an equilateral triangle or pentagon. Seventeen is very special, in lots of ways; so are other numbers.

The positive integers 1, 2, 3, . . . are sometimes called "natural numbers," perhaps because at first sight they seem somehow obvious or commonplace. These natural numbers, however, soon lead to subtle and extraordinary results. Notice, for instance, the limitlessness of the series of integers: for any number you care to name, I can find a larger number. We are immediately faced with the mystery of "infinity"—yet we ourselves are finite creatures, on a finite planet in a finite galaxy. (Perhaps the universe is finite too—we don't know.)

Even staying well short of infinity, the natural numbers overwhelm us. Pick a random decimal number a thousand digits long. If every star in the observable universe has a hundred planets, and every planet has a trillion aliens, and every alien is guessing a trillion numbers per second, the odds are very, very long against anybody guessing your number within the age of the universe.

The most important use of Bignum may be to extend one's reach to larger integers, so that new theorems or conjectures may be grasped.

Big numbers form a vast, unexplored territory. It's a territory into which almost anybody with the inclination can venture, a land full of never-before-seen sights and discoveries, waiting to be found. In the exploration of large numbers, to quote IBM, "a small computer can make a big difference." A home computer can spend your journeys and take much of the arithmetical "grunge" away; a machine is also less likely to make a mistake!

I've written a program in Basic, called Bignum, which is an aid in handling big numbers. Bignum imitates a pocket calculator, but with a difference: it can add, subtract, multiply, divide, and raise to a power integers of up to 1024 decimal digits! (The length limitation of 1024 digits can be lifted if you have enough memory and can dimension arrays of more than 256 elements in your computer.) My implementation of Bignum occupies most of the available storage space of an 8K Commodore PET. I haven't used any PET-specific "tricks" in the program, so it should be adaptable with little or no modification to other types of machines.

This article will first discuss a variety of problems in number theory which I've began to use Bignum to investigate. I'll next describe in some detail the actual Bignum program, and give instructions for its use. Finally, I will mention some possible extensions and modifications to the program which some readers may be interested in pursuing. A listing of Bignum accompanies this article; I apologize for the lack of comments (and spaces) within the listing, but they had to be removed in order to fit the program into the limited memory of the PET.

Mark Zimmermann, 9401 Woodland Drive, Silver Spring, MD 20910

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Topics to Explore with Bignum

In this very finite article, I can only begin to touch upon a few of the subjects which Bignum can help you explore. One of the most difficult things to do is to invent new, interesting, and important questions to ask—questions of which no one else has thought.

Frequently the ability to "experiment" with numbers can lead one to formulate a good question; probably the majority of classic mathematical theorems grew out of such experimentation with small numbers. The most important use of Bignum may be to extend one's reach to larger integers in this sort of play, so that new theorems or conjectures may be grasped.

One specific topic for which I have frequently used Bignum is the factoring of large numbers into a product of smaller integers. As mentioned above, occasional numbers (such as 17) cannot be broken down into smaller factors; such numbers are called primes.

Prime numbers become rarer as one moves into the realm of big integers, mainly because the bigger a number is, the more smaller numbers there are that may divide into it evenly. The chance of a random big integer being a prime is about one in 2.3 times the number of decimal digits in the number; for example, a thousand-digit number has about one chance in 2300 of being a prime.

A number can be tested for primality simply by trying all smaller integers and seeing whether any of them divide the number being tested. That's not very efficient, however! First of all, it is unnecessary to try any divisors which are greater than the square root of the target, since if the target has a factor greater than its square root, it must also have a factor smaller than the square root.

Second, it's not even necessary to try all of the numbers from two through the square root; once 2 has been tried and found to fail, there is no way for 4, 6, 8, or any other multiple of 2 to succeed in dividing the target number. Similarly, if 3 doesn't work, no multiple of 3 can, etc. To be really efficient, we need only try the prime numbers (2, 3, 5, 7, 11, 13, 17, . . .) smaller than the square root of our target; if none of them divide it, then the target is prime.

Trying all those potential factors is not an easy task. Even the largest, fastest computers would take an impossibly long time to factor a number a few hundred digits long, using the best known tricks to speed the process. What hope is there for a small machine?

Fermat Test

If one does not demand to see the explicit factors of a number, N, but simply asks the question, "Is N prime?" then there is hope of getting an answer. Consider the number A^{N-1}, the result of multiplying A*A*A*...*A with the number A occurring N-1 times in the product. A beautiful theorem, stated by Pierre de Fermat around 1640 and proved by Leonhard Euler about a century later, says that if N is prime, then N must leave a remainder of 1 when divided into A^{N-1} for any value of A not a multiple of N. Conversely, if the remainder left after division by N is not 1, then we know that N is not a prime (though we don't know what the factors of N are).

For example, suppose we want to test the number 15 for primality. We could choose A = 2 and calculate $A^{N-1} = 2^{14} = 16384$; then dividing 16384 by 15, we get 1092, with a remainder of 4. Since the remainder was not 1, we know that 15 is not a prime.

This Fermat test for primality is not quite complete: if we come out with a remainder not equal to 1, we know that our number N is not a prime, but if the remainder is 1, then N may be a prime—but it's not quite certain. There are numbers (fairly rare compared to the primes) which for many choices of A give a remainder of 1 in Fermat's test. Techniques exist to catch these exceptional numbers, but they're too complicated and I don't understand them well enough to attempt to explain them here. In the vast majority of cases, if the Fermat test answers "Maybe" to the question "Is N prime?" then the real answer is "Yes." References 1 and 2 give more details.

This Fermat test may not sound very practical; after all, isn't A^{N-1} a huge number itself, much larger than N, and won't it take a long time to compute it? Yes—but it doesn't matter. We don't want

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to know A^{N-1} itself; we only want to know the remainder left after division by N. So, as A^{N-1} is being calculated, we can keep it (relatively) small by dividing by N and keeping only the remainder as we go along. The final result will be the same.

To calculate A^{N-1} also does not require N-1 multiplications: by repeatedly squaring, multiplying, and squaring again, we can save time. For example, to compute A^{17} requires only five multiplications, as follows: first square A yielding A^2; then square that result (which gives A^4), square again (giving A^8), square once more (giving A^{16}), and finally multiply by A again.

Bignum uses these tricks when computing the function X^Y (modulo Z), the remainder left after dividing X^Y by the number Z. It is quite efficient, and automatic.

Given this convenient test for primality of a big number, a variety of interesting questions can be attacked. The Fermat numbers F_n are defined by the equation

$$F_n = 2^{2^n} + 1$$

where the exponents must be evaluated from the top down. Thus, $F_0 = 3$, $F_1 = 5$, $F_2 = 17$, $F_3 = 257$, and $F_4 = 65537$. These Fermat numbers are all primes, and it turns out to be possible to construct, using only a compass and a straightedge, regular polygons with F_n sides, if F_n is a prime, and not otherwise.

Strangely enough, for n ranging from 5 through 16 (at least), F_n are not prime (Reference 2), and it is not known whether there are any more primes among the higher F_n. All of the Fermat numbers, whether prime or not, pass the A^{N-1} test for A = 2 and for A = 3, but there is a sure test for the primality of F_n: F_n is prime if and only if $3^{F_n - 1/2}$ leaves a remainder of $F_n - 1$ when divided by F_n (Reference 2).

Mersenne Numbers

Another set of interesting and mathematically important numbers are the "Mersenne numbers" defined by

$$M_n = 2^n - 1$$

for prime values of n. (For n not a prime, M_n is never prime and is a bit less useful.) The first few Mersenne numbers are $M_2 = 3$, $M_3 = 7$, $M_5 = 31$, and $M_7 = 127$, all of which are primes; M_{11}, however, is divisible by 23.

The Greeks called a number "perfect" if it was equal to the sum of its divisors (excluding itself), like 6 = 1 + 2 + 3, or 28 = 1 + 2 + 4 + 7 + 14. All even perfect numbers have the form $M_n 2^{n-1}$, for M_n prime. So, to find a perfect number, it is essential to have a test for the primality of M_n.

E. A. Lucas devised such a test in the late 1800's; it is described in References 1 and 2. Using it, and a rather large machine, L. Nickel and C. Noll found that M_{2281} is prime; it is 6533 decimal digits long, and is the largest prime yet found. (Reference 3).

Rep-Unit Numbers

Somewhat less interesting, except to base-ten chauvinists perhaps, are the "rep-unit" numbers defined by

$$R_n = (10^n - 1)/9;$$

they are called rep-unit numbers because they consist of strings of ones. Thus, $R_2 = 11$, $R_3 = 111$, $R_4 = 1111$, etc. For a rep-unit number to be prime, n must have a prime subscript; among the rep-units less than R_{1000}, the only primes are R_2, R_{19}, R_{23}, and R_{317} (Reference 4).

Other Applications

Besides determining prime numbers, another important application of large integer arithmetic is in the field of cryptography, the coding and decoding of messages. There are many mathematical operations which can be used to scramble the bits of a message. Useful operations for codemaking are ones which are easy to perform but hard to un-do (unless one knows the secret).

A prime example (pun intended) of such an encoding operation is our familiar function X^Y (mod Z): by using integers a few hundred digits long, it is possible to make a crypto-system that is apparently unbreakable, as far as mathematicians can tell today (References 5, 6, 7). Bignum is well-suited to investigating these new ideas in cryptography.

Another important application of large integer arithmetic is in the field of cryptography.

Finally, even if one has a problem involving non-integral numbers, Bignum may be able to help. By mentally placing a "decimal point" somewhere within the integers that the program is handling, one can do high-precision arithmetic, accurate to hundreds of decimal places.

For example, put the decimal point 100 places into the numbers. Addition and subtraction proceed as usual; after multiplication, one must divide by 10^{100} to renormalize the result, and after division, one multiplies by 10^{100}. This scaling of results can also be done before performing the operations. Thus, to compute the value of 355/113 to a hundred decimals, divide $355 * 10^{100}$ by 113 and mentally place a decimal point a hundred digits into the result.

Program Description

The program Bignum for handling arithmetic with large integers uses algorithms taken from Reference 1, Donald E. Knuth's, *Art of Computer Programming*, Volume 2; see in particular Chapter 4, section 4.3.1. The program avoids conversions into and out of base 10 by effectively working in base 10^4, that is, by breaking large decimal numbers up into four-digit chunks. The value of each chunk is an integer within the range 0 to 9999, and is stored as one element in an integer array. The Basic floating-point arithmetic which is used to perform operations on these chunks must be perfectly accurate to eight decimal places, so that it can correctly execute operations such as 9999 * 9999. If your Basic interpreter sometimes keeps fewer than eight significant decimal figures, you may want to work in base 10^3 or 10^2. Aside from changing the value of the Basic variable B to your new base, you will probably need to modify some of the input/output sections of the program as it is given in Listing 1.

To a user, Bignum seems much like a pocket calculator, specifically a Hewlett-Packard model HP-35. It has a stack of four numbers, named X, Y, Z, and T, and a memory register separate from the stack, named M. Numbers are input into the X register from the keyboard; from there, they can be pushed up into the stack, rolled down, stored into and recalled from memory, and operated upon.

Commands such as arithmetic operations are taken from the keyboard and stored in a command string, C$, where they are executed on a strictly left-to-right, reverse-Polish-notation basis. This simplifies the "parsing" part of the Bignum program (lines 1000 through 2999) which performs the commands for the user. If one prefers to use another scheme (such as an "algebraic" system with pending operations and parentheses), the parser can be modified without affecting any of the computational subroutines.

Because Bignum occupies so much of the available memory space of the small computer on which I developed it, there are no comments or spaces in Listing 1. The remainder of this section, therefore, combines documentation for the program and information for the user, and should be read in conjunction with the listing.

Comments By Line Number

Line 100 of Bignum dimensions the arrays used by the program: X%, Y%, Z%, T%, W%, and M%. Each array is allocated 256 elements, subscripts numbered 0 through 255, since that is the maximum allowable on my machine. An

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element of an integer array can take on a value between −32767 and +32767, though Bignum uses only numbers between 0 and 9999. Arrays X%, Y%, Z%, and T% are used for the X, Y, Z, and T stack, array M% is the special memory which may be exchanged with the X register, and array W% is an auxiliary register, used for temporary storage within the program and not available to the user. Line 100 also defines B = 10000, the base used for the computations.

Line 500 gets a command string from the keyboard and places it in the string variable C$. Variable C is a pointer into C$ used by the parser; in line 1000 of Bignum, the pointer is incremented, and if it has reached the end of the command string, the program loops back to line 500 for more command inputs. Otherwise, execution proceeds into lines 1040 through 2999 where commands are recognized and performed.

The current single-character command is taken from C$ and placed in A$ by line 1040. That line also begins the monotonous task of recognizing the command, carried out by IF statements in lines 1040 through 1180. At most a single one of the IF statements will be satisfied; after a command has been executed, or if it is not among the legitimate commands available, line 2999 loops back to line 1000 where the next character in the command string is removed.

The individual commands included in Bignum are summarized in Table 1. They are all reasonably easy to remember, and after using the program for a short time you'll probably find that the commands become quite natural. Below, I will describe each command and tell what it does, how, and why.

First, however, it is useful to know the format in which Bignum stores numbers in its arrays. As mentioned above, a decimal number is broken up into four-digit pieces, each piece a positive integer between 0 and 9999, inclusive. For each of the X, Y, Z, T, and M registers, a variable exists which holds the sign of the contents of the corresponding register. In Basic notation, SX = SGN(X), SY = SGN(Y), and so forth for SZ, TS, and SM. (Note that the sign of the T register is stored in TS; the letter-combination ST is a reserved word in PET Basic.)

Each sign variable takes on only the values +1, 0, or −1, depending on whether the contents of the register are positive, zero, or negative. The four-digit pieces of the big numbers are stored in the arrays with least significant parts in the lowest numbered array elements and with most significant parts in higher numbered slots. The index of the most significant array element in use is stored in variables NX, NY, NZ, NT, and NM. For example, if the X register contains the number 1234567890, then SX = 1, X%(0) = 7890, X%(1) = 3456, X%(2) = 12, and NX = 2. The value of NX is thus just INT(LOG10(X)/4), where LOG10 means a logarithm to the base ten.

Command	Definition
D	Display the contents of the X register.
E	Enter a number from the X register, pushing up the stack: Z→T, Y→Z, X→Y.
I	Input a number from the keyboard into the X register; stack not affected, old value of X destroyed.
C	Clear the X register, leaving zero; rest of stack unaffected.
+	Y+X→X, Z→Y, T→Z.
−	Y−X→X, Z→Y, T→Z.
Y	display contents of stack; equivalent to command string DRDRDRDR.
R	Roll down stack: X→temp, Y→X, Z→Y, T→Z, temp→T.
S	Swap X and Y registers: X→temp, Y→X, temp→Y.
M	Memory interchange between M and X: X→temp, M→X, temp→M
N	Negate X: −X→X.
*	Y*X→X, Z→Y, T→Z.
/	Y/X→temp, Y−X*INT(temp)→Y, INT(temp)→X.
T	Ten's power: input desired power of 10 from keyboard into the X register, old value of X destroyed, stack not moved.
Q	Quick look at contents of X, Y, Z, T, and M (only the most significant digits).
↑	X^Y (mod Z) → X, other values in stack except Z destroyed; M also destroyed. For X^Y, set Z to zero before execution.
6	Input 6 into the X register, destroying present contents of X and not otherwise affecting stack. Also works for 1 through 9.

Table 1.

With the above background information about how numbers are stored internally, the remainder of the Bignum parser is easy to read and to understand. After extracting the current command and placing it in A$, line 1040 checks for a D, which means "Display the contents of X." If the command is D, subroutine lines 4000 through 4100 format the contents of the array X% as a string and print it, including the sign from SX. Program execution then returns to the line following 1040, all the subsequent IF tests fail, and at line 2999 we loop back to line 1000, where parsing continues.

If the command in A$ is E for "Enter," line 1060 detects it and calls subroutine 7000. "Enter" acts just like the "Enter" key on the Hewlett-Packard calculators: the contents of the Z register are copied into T, the contents of Y move into Z, and the contents of X are duplicated in Y. In other words, the "stack" is pushed up; the old value of T is lost.

The command I for "Input" is caught by line 1080 of the parser, which prints a prompting request for the X register and then calls a subroutine beginning at line 5000. That subroutine clears out the X register (using subroutine 8000) and accepts a string X$ from the keyboard. That string is then properly formatted as a positive integer and placed in the X% array by lines 5800 and 5840.

Two important things to note: (1) the "Input" command does *not* push up the stack automatically, unlike the usual HP-35 mode of operation (if you want automatic stack-lifting, insert a GOSUB7000 at

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the beginning of line 5000; I prefer to control the process manually); and (2) "Input" expects to see a *positive*, unsigned integer (to input a negative number, follow the "Input" by a "Negate X" command, discussed below). The Commodore PET doesn't like to input strings longer than one or two lines (40 or 80 characters) from the keyboard, so if I need to input a very large number by hand, I break it up into parts of length 25 or 30 characters, enter the parts (from left to right), and after each part is entered, multiply it by 10^{25} or 10^{30}, so that it is ready to have the next part added to it. This procedure avoids all input difficulties and makes mistakes less common and easier to correct.

Line 1100 of the parser detects the C command, which "Clears X" by calling subroutine 8000, and does not otherwise affect the stack.

Line 1120 takes care of the first arithmetic operation, addition, symbolized by the + command. It calls subroutine 11000, which does addition just as one does it with pencil and paper, by adding corresponding elements of the X% and Y% arrays, including "carries" from one element to the next if the sum is greater than 9999. The special cases of X = 0, or Y = 0, are handled in lines 11000 and 11040; otherwise, the signs of the numbers being added are compared in line 11060.

If both signs are the same, the result has that sign too, and lines 14000 through 14080 do the addition and jump to lines 13000-13080 where the stack is dropped down before returning to the parser. If the contents of the X and the Y registers have opposite signs, lines 11080 through 11140 determine the correct sign for the sum; if the sum is nonzero, it is calculated by subtraction in lines 15000 through 15120.

To multiply two numbers, each 100 decimal digits long, to give a 200 digit product takes about 20 seconds.

The result of all this complicated work is that the sum of the contents of X and Y ends up in X, and the rest of the stack is dropped down: the former Z is put into Y, the former T into Z, and the T register keeps its value.

Subtraction is symbolized by - and is performed in the parser by line 1140, which simply changes the sign of the X register and calls the addition subroutine (beginning at line 11000). The result of the subtraction is Y - X, placed in the X register, and the stack drops just as it did for +.

The useful ? or "print stack" command is managed by line 1160 of the parser. (The ? mnemonic is suggested by the use of ? as an abbreviation for "PRINT" in many versions of Basic.) Since the goal is to print the whole contents of the stack, a series of alternating "Display X" and "Roll down the stack" commands does the job; after four of these pairs, the stack is back as it was initially and the contents of X, Y, Z, and T have been displayed. The parser does all this simply by replacing the ? command with the string DRDRDRDR, resetting the command-string pointer, and relying on the "Display" and "Roll down the stack" commands. As a convenience for the user, the caption STACK: is also printed out.

The R command mentioned in the previous paragraph, which asks to "Roll down the stack," is caught in parser line 1180 and executed in very straightforward fashion by subroutine 20000. R transfers the contents of T to Z, of Z to Y, of Y to X, and of X back up to T. No information is lost.

Line 1200 recognizes the S command, which "Swaps X and Y." It is done in a

subroutine occupying lines 6000 through 6060; the same "Swap" subroutine is used by other operations (such as addition, line 11000) when appropriate. The result of an S command is to interchange the contents of the X and Y registers; the rest of the numbers in the stack and in memory are left unchanged.

Line 1220 executes M for "Memory interchange with X." It calls a subroutine occupying lines 16000 through 16060, which interchanges the contents of X and M, the separate memory register in the machine. By using an interchange-type operation, the need for distinct "store in memory" and "recall from memory" commands is eliminated and some space is saved.

The extremely simple "N" or "Negate X" command is recognized and executed within line 1240 of the parser; all that is necessary is to set $X = -X$, that is, to change the sign of the contents of the X register.

Line 1260 does multiplication, the * operation. It calls subroutine 12000, wherein the proper sign of the result is determined and the actual multiplication is performed in much the same manner as one does it with pencil and paper. After multiplying, the properly-signed result X * Y is left in the X register and the rest of the stack is dropped down, just as it is after addition or subtraction.

Division is detected in line 1280, which looks for the / command and calls subroutine 17000 if it finds it. This subroutine is the most complicated in the Bignum program, but all of its details are taken almost literally from Knuth's book (Reference 1). After checking for zeroes in numerator or denominator, the subroutine scales both numbers in the division process by multiplying each by a constant, in order to simplify later work; the scaling factor is stored in the simple variable D. Lines 17300 through 17860 perform the division with the "classical" division algorithm which is used for manual, pencil and paper long division by humans, slightly modified for the machine.

The result of this / operation consists of two numbers: an integer quotient and a remainder. The operation leaves the X register containing that quotient: in Basic notation, X contains INT(Y/X). The remainder left by the division, however, is frequently very useful for number theory investigations, so instead of throwing it away, it is placed in the Y register: in Basic, Y then contains Y - X*INT(Y/X). The stack does not, therefore, drop down after division, unlike the behavior of a pocket calculator.

One final remark: if either of the numbers being divided is negative, the remainder is not guaranteed to be correct; Bignum only promises to divide positive integers correctly. Negative dividends or divisors may be handled correctly, but I haven't checked it out completely, since I've never needed to use them in my work.

Returning to the parser, line 1300 senses the T command, for "power of ten." Upon receiving a T, the X register is cleared and the desired power of 10 is input from the keyboard and placed in X. All of this is done within line 1300; as in the "Input" command, T does not raise the stack.

The Q command, for "quick look at registers," is recognized by parser line 1340 and performed by subroutine 21000. It prints out the most-significant chunk of the X, Y, Z, T, and M registers, along with the corresponding power of ten, to allow a quick look at the contents of all registers without disturbing them.

A powerful command, ?, calculates X^Y (mod Z), that is, the remainder left when the number X^Y is divided by Z; it is caught by parser line 1360 and handled in a subroutine beginning at line 25000. That subroutine uses the binary decomposition algorithm (repeatedly squaring and multiplying) described earlier in this article and in Reference 1. Most of the work is done by a sequence of subroutine calls to the multiplication and division routines. The ? command, therefore, is like a "macro" in that it invokes a sequence of more fundamental commands. It unfortunately uses most of the stack during its work; only the value in the Z register is preserved unchanged. The contents of X are replaced by the results of the computation X^Y (mod Z), and Y, T, and M contain partial results from the course of the calculations. If only the result X^Y is desired, the number in Z should be set to zero before beginning the execution of the ? command.

The final feature recognized by the parser, line 1180, is the presence of a positive integer, 1, 2, 3, . . . , 9. If an integer is found, it is put into the X register, just as though it had been input with an "I" command. I have frequently found the ability to put in a small integer valuable when writing a long command string, and the process only takes up the single line in the parser.

That's all there is to Bignum.

Improvements and Enhancements

The version of Bignum given in Listing 1 is actually the second major revision of the program. My first efforts lacked the ? command and included some specialized stack-manipulation and input/output features which I never used much. I have tested Bignum extensively, and have shared it with a number of friends. None of us has yet observed any mathematical

errors committed by the program. I would appreciate it if any reader who finds a bug in the program would bring it to my attention.

If more memory is available, or if one is willing to sacrifice some of the features in the present version, there are several obvious modifications which should be considered. At present, command strings are simply read left-to-right and thrown away after they are used. A valuable ability to add would be looping or branching within command strings, so that more extensive programs could be written.

Another enhancement of the Basic-language Bignum program could be to include machine language modules to speed up the workings of the arithmetic operations. The Basic program is very portable and can be easily used on a variety of computers, but its speed is only fair.

In general, on the Commodore PET, a multiplication of two random numbers of *m* and *n* hundred digits takes approximately 20*mn* seconds; that is, to multiply two numbers, each 100 decimal digits long, to give a 200 digit product takes about 20 seconds. That's not intolerable, but machine-language could speed it up by a factor of 10 to 100. Mike Lorsder of Glendale, CA has developed some 6502 machine-language programs on the Apple II which multiply large numbers and raise them to powers; possibly that approach would be useful to take with Bignum.

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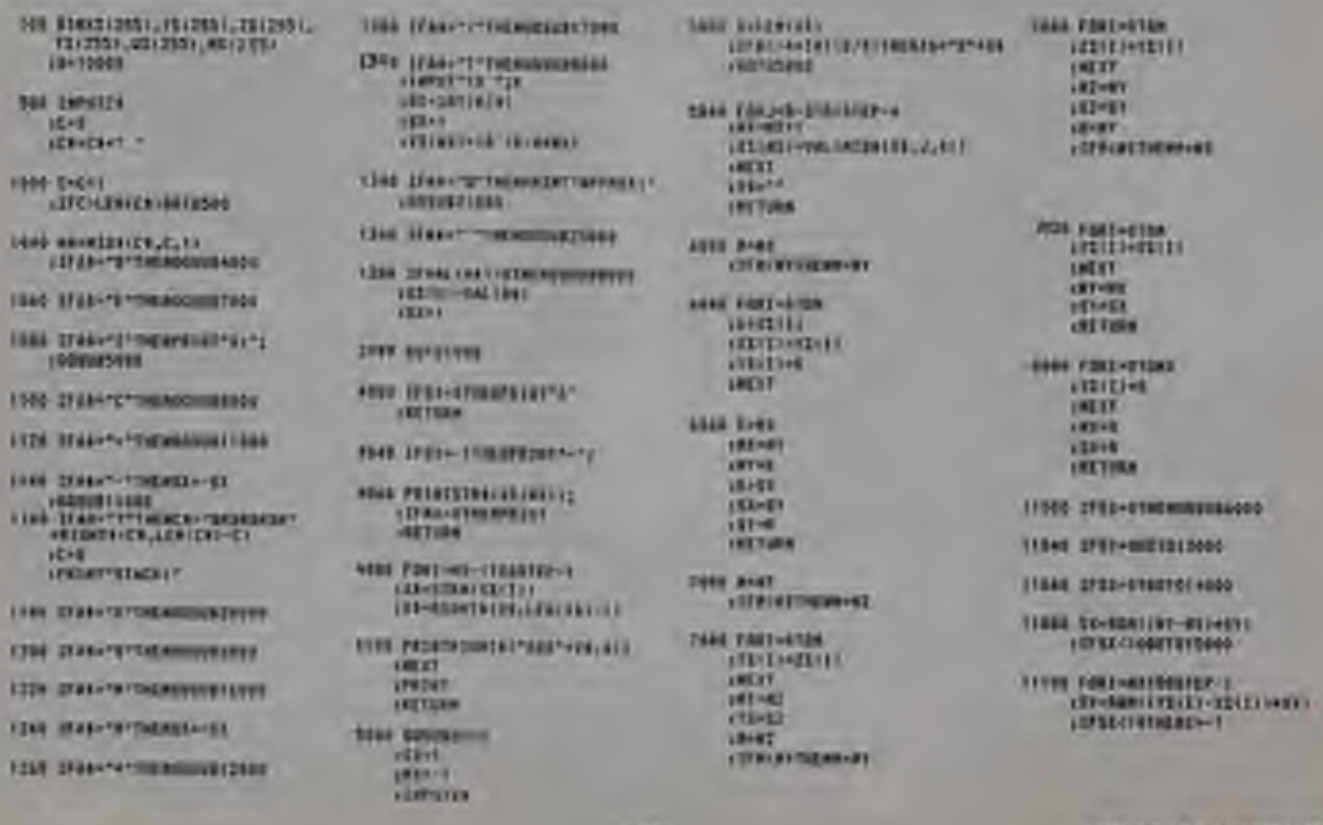
In the final analysis, however, what may be needed is not more computing power but more mathematical insight. Many of the references cited at the end of this article (especially References 1, 2, and 8) contain good, introductory-level statements of fundamental, unsolved problems, which Bignum or an extension of it could be used to investigate. The small computer revolution will really have an impact on mathematics if somebody, inspired by Bignum or similar programs, takes a step forward and makes a discovery in number theory.

It may take years, and it may only happen if young people become excited enough by their home computers to become mathematicians, but I think that, in the long run, small machines will make a big difference to the progress of mathematics.

Acknowledgement

I thank Charles A. McCarthy for his help in obtaining the printout of Listing 1, which was done using his Cheapprint program.

Listing 1.



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MX-80 [illegible] *graphics characters.*

PRM-27080	*List $614*	$489.95

MX-80FT [illegible] *tractor feed added.*

PRM-27082	*List $741*	$550.95

MX-100 [illegible] *tractor feed & adjustable tractor feed, 31 & 66 char. in CPI.*

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ARL ASIO, APIO - S.S.M.

Parallel & serial interface for your Apple (see Byte pg 11)

IOI-2050K	*Pair & Set kit*	$139.95
IOI-2050A	*Pair & Set A & T*	$189.95
IOI-2052K	*Serial kit*	$89.95
IOI-2052A	*Serial A & T*	$99.95
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Modems

CAT MODEMS - Novation

CAT [illegible] *baud acoustic answer/originate*

IOM-5200A	*List $169.95*	$149.95

D-CAT [illegible] *baud direct connect, answer/originate*

IOM-5201A	*List $199.95*	$169.95

AUTO-CAT [illegible] *baud answer/originate, direct connect*

IOM-5220A	*List $299.95*	$229.95

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VIEWPOINT - ADDS

Detachable keyboard, serial RS232, video, [illegible] baud, [illegible] page, 80 by 24 line, auxiliary serial port, 64 [illegible]

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TELEVIDEO 950

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1 Drive ...	$234.95 each
2 Drives	$224.95 each
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Jade Part Number MSM-[illegible]

END-000213	Fan & power cord's	$74.95

Stewart F. Rush

It is the year 1991. You have just landed on the Northwest Moon (mission Survival).

INITIAL STATUS
ELAPSED TIME: 0 MINUTES
POWER UNITS: 200 UNITS
OXYGEN REMAINING: 180 MINUTES
PRESENT LOCATION STATUS: YOU ARE AT MARE SERENITATIS. LONG, DEEP SHADOWS FROM DISTANT MOUNTAINS AND CRATERS CAST THEMSELVES ACROSS THE BARREN LANDSCAPE.

Game Description

This game is patterned after the new Basics Adventure programs and their many derivatives. It requires luck, skill, and persistence and the object is survival.

The scene takes place somewhere on the surface of the moon and the player must upon the mission explore the surroundings, avoid potential hazards, and gather resources which may be needed.

It is a race against time. Many explorations are required before the total situation is revealed, and the resources and life-threatening situations discovered. Only then, can the process of determining the optimum set of moves and actions begin.

After the player succeeds in surviving, it becomes a challenge to generate survival situations which result in the minimum elapsed time.

As with Adventure, the computer accepts directional commands NORTH, SOUTH, EAST, WEST, UP, and DOWN. Other commands consist of an action verb followed by a noun. Verbs include USE, GET, TRY, and INVENTORY.

Stewart F. Rush, 1182 Pennsylvania Place, San Jose, CA 95116

Table 1

MsP 1 = location to go to if direction is NORTH
MsP 2 = location to go to if direction is SOUTH
MsP 3 = location to go to if direction is EAST
MsP 4 = location to go to if direction is WEST
MsP 5 = location to go to if direction is UP
MsP 6 = location to go to if direction is DOWN
MsP 7 = printer so line prints fine on TS copier
MsP 8 = printer so line prints fine on TS copier

Table 2

P = The current location
B = The previous location (P for the previous location)
T = The current elapsed time
T2 = The amount of oxygen remaining in the oxygen tank
P1 = The amount of power remaining in the power cells
P2 = The amount of power remaining in the power pack
V = The number of times in the current cavern
L = The number of items being carried
F0 = Flag: oxygen in use
F1 = Flag: Mirror broken
F2 = Flag: Sextant used
F3 = Flag: Illuminator on
F4 = Flag: Health deteriorated
F5 = Flag: Oxygen expired in cavern

I'm sorry, the program gave only the first three characters of a command on your name. In addition, the directional commands can be entered as single letters, e.g., N, S, W, E, U, D.

The following are some sample keyboard entries:

GET ILLUM	(get the illuminator)
N	(go north)
USE GOLD KEY	(use the key)

Program Description

The program, by design, is relatively small and requires no additional peripheral devices such as disk drives to store textual and descriptive information. Thus it may be adapted for use on relatively small

computer tutor

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CIRCLE 346 ON READER SERVICE CARD

computers runs "Convertare"). In the author's case, the program is implemented on a home brew, S-100 bus system with 48K of RAM.

The program is directed by a move matrix M. There is one vector for each location P in the game. Table 1 lists the significance of each vector in the matrix M.

If the vector element (1-6) contains a value of "0," then the move requested in that direction is invalid. If the vector element contains a "99," then the game is terminated.

The T$ vector contains the textual description of all of the various locations. As an example, the first three elements in the vector contain the description for location 1 in the M matrix. Looking at the line 9001, the seventh and eighth data items correspond to M(1,7) which has a value of 1, and M(1,8) which has a value of 3.

Table 2 lists the variables used in the program.

Table 3 lists each of the objects used in the program which are contained in the B vector. Normally the vector element in B, for a given object, contains either the P location of that item, or a value of 99 indicating that the player is carrying that item.

B(1)	- An electronic key.
B(2)	- Sealant.
B(3)	- An oxygen module.
B(4)	- An illuminator.
B(5)	- A robot.
B(6)	- A deactivator.
B(7)	- A nuclear bomb.
B(8)	- A transporter unit.
B(9)	- Dilithium crystals.
B(10)	- A computer message.
B(11)	- A power unit.
B(12)	- A mirror.
B(13)	- A coded badge.
B(14)	- A power pack.

Table 3.

Locations 1-18, and 38 normally require oxygen. All other locations are within the space station or the space craft. Locations 1-21, and 38 require a power unit or pack. All other locations are within the space station.

Changing the Complexity of the Game

Normally, the program permits the player to carry four items. One way the difficulty can be increased is by permitting only three items to be carried. In this case, a longer survival time results, and the following statements must be updated:

```
350 LET T2=275
360 LET P1=320
370 LET P2=75
730 IF T1>485 THEN 2960
740 IF T1>390 THEN 3840
2270 IF C>2 THEN 2390
```

Reducing Program Size

The following are suggested to reduce the size of the program for computers which cannot accommodate the program as shown in the listing.

1. Eliminate the printed instructions, statements 90-120, and 5020 to 5230.

2. Eliminate the REM or remark statements.

3. Eliminate the use of verb or action word synonyms, statements 1340, 1360, 1370, 1390, 1400, etc. Also refer to statements 4660 through 4800 for use of synonyms.

4. Following the full program listing is a partial program listing which replaces statements 7500 through 9042. These employ shortened location descriptions and require the following program modifications:

```
10 DIM T$(40,60)
130 FOR I=1 TO 60
500 LET M(2,8)=M(2,7)+1
3760 LET M(2,8)=M(2,7)
```

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Conclusion

This program, unlike other Adventures, contains no random events. The emphasis is on determining optimum move scenarios, resulting in minimum times and resource use. Each location described corresponds to an actual moon location taken from a *National Geographic* map of the moon.

The author wishes you many happy hours of exploration. As a benchmark, the author's best survival time is 365 minutes, with a four-item carry limit. Here's to your survival! □

Listing 1.

```
10 DIM IN$(6,6)
20 DIM M$(2,8)
30 DIM D$(6)
40 DIM [illegible]
50 DIM [illegible]
60 DIM ****************************************************
70 REM ** INITIALIZE/DEF FNS ** MOVE MATRICES
80 DIM ****************************************************
90 PRINT "WELCOME TO THE GAME OF SURVIVAL - MOON"
100 PRINT "FOR HELP INSTRUCTIONS"
110 INPUT D$
120 IF D$="Y" THEN GOSUB 8000
130 FOR I=1 TO 5
140 READ T$(I)
150 NEXT I
160 FOR I=1 TO 5
170 FOR J=1 TO 6
180 READ M$(I,J)
190 NEXT J
200 NEXT I
210 DIM ****************************************************
220 REM ** INITIALIZE OTHER PROGRAM VARIABLES
230 REM **
240 REM **  P  = CURRENT POSITION        C  = NO. OF ITEMS CARRIED
250 REM **  T1 = CURRENT ELAPSED TIME    P4 = ILLUMINATOR ON FLAG
260 REM **  T2 = SUPPER REMAINING        F1 = METEOR SHOWER FLAG
270 REM **  F2 = DUNGEON IN USE FLAG     F3 = OPEN DOOR FLAG
280 REM **  R  = RIDDLE IN COMP ROOM     F7 = ROOM DESIGNATED FLAG
290 REM **  P1 = PWR IN POWER UNIT       F8 = CURRENT REGION IN STATION
300 REM **  P2 = PWR IN POWER PACK
310 REM ****************************************************
320 LET P=1
330 LET C=0
340 LET T1=0
350 LET T2=180
360 LET P1=250
370 LET P2=50
380 LET P=0
390 LET R=1
400 LET T1=T1
410 LET T2=T2
420 LET P1=P1
430 LET P2=P2
440 LET P=P
450 LET R=R
```

```
510 REM ****************************************************
520 REM ** DISPLAY CURRENT STATUS AND LOCATION INFO
530 DIM ****************************************************
540 PRINT "ELAPSED TIME: ";T1;" MINUTES"
550 IF P1<>0 THEN PRINT "POWER UNIT: ";P1;" UNITS"
560 IF P2<>0 THEN PRINT "POWER PACK: ";P2;" UNITS"
570 LET T1=T1+1
580 IF P1<>0 & P1<5 THEN LET P1=P1-1
590 IF P2<>0 & P2<5 THEN LET P2=P2-1
600 IF P1=0 & P2=0 THEN GOSUB
610 IF T1=T2 THEN GOSUB 5000
620 IF T1>T2 THEN GOSUB 5000
630 IF R=1 THEN LET T2=T2-5
640 IF T2<0 THEN LET T2=0
650 IF P=1 THEN GOSUB 8000
660 IF P=2 THEN GOSUB 8000
670 IF P=3 THEN GOSUB 8000
680 IF P=4 THEN GOSUB 8000
690 IF P=5 THEN GOSUB 8000
700 IF P=6 THEN GOSUB 8000
710 IF P=7 THEN GOSUB 8000
720 IF P=8 THEN GOSUB 8000
730 IF P=9 THEN PRINT "DUNGEON DIMENSIONS: ";T1;"MINUTES"
740 PRINT "PRESENT LOCATION STATUS: YOU ARE"
750 FOR I=1 TO MID$(M$,P,1) TO MID$(M$,P,1)
760 PRINT T$(I)
770 NEXT I
780 PRINT "**"
790 REM ****************************************************
800 DIM ** DISPLAY ANY OBJECTS PRESENT
810 REM ****************************************************
820 IF P=1 THEN 1000
830 FOR I=1 TO 25
840 IF D$(I)=0 THEN 860
850 GOSUB 4510
860 PRINT "THERE IS ";D$;" HERE."
870 NEXT I
```

Conversion to Other Basics

Conversion will be required in the manipulation of the definition and manipulation of the string variables T$, C$, B$ and D$, depending on the manufacturer's Basic. The variables have the following string lengths: T$, M$, C$, A$, B$, IN (elements), and D$, 1. Refer to statements 10, 40, 50, 1000, 2370, 3000, 4490-4640. For example, the following, or equivalent, would reference the 17th character from the left of the string B$, for a length of 3:

```
LET C$=STR$(B$(J+1,J))
```

Suggested changes to convert "Survival" to TRS-80 Level II and Disk Basic:

```
10 CLEAR 4000 : DIM T$(47)
40 REM * OMIT THIS LINE *
50 REM * OMIT THIS LINE *
60 CLS : PRINT"WELCOME TO THE GAME OF SURVIVAL. MOON"
110 INPUT"INSTRUCTIONS (Y OR N)"; D$: IF D$="Y" THEN GOSUB 8000
840 CLS : PRINT"ELAPSED TIME: ";T1;" MINUTES"
890 IF P1<>0 AND P1<5 THEN P1=P1-1
900 IF P2<>0 AND P2<5 THEN P2=P2-1
910 IF P1=0 AND P2=0 THEN GOSUB 8000
920 IF T1=T2 THEN GOSUB 5000
930 IF T1>T2 THEN GOSUB 5000
940 IF R=1 THEN T2=T2-5
950 IF T2<0 THEN T2=0
960 IF P=1 THEN GOSUB 8000
970 IF P=2 THEN GOSUB 8000
980 IF P=3 THEN GOSUB 8000
990 IF P=4 THEN GOSUB 8000
1000 IF P=5 THEN GOSUB 8000
1010 IF P=6 THEN GOSUB 8000
1020 IF P=7 THEN GOSUB 8000
1030 IF P=8 THEN GOSUB 8000
1040 IF P=9 THEN GOSUB 8000
1050 IF P=10 THEN PRINT "DUNGEON DIMENSIONS: ";T1;"MINUTES"
1060 PRINT"PRESENT LOCATION STATUS: YOU ARE"
1070 FOR I=1 TO MID$(M$,P,1) TO MID$(M$,P,1)
1080 PRINT T$(I)
1090 NEXT I
1100 PRINT"**"
4490 REM ** DISPLAY ANY OBJECTS PRESENT
4500 IF P=1 THEN 1000
4510 FOR I=1 TO 25
4520 IF D$(I)=0 THEN 4560
4530 GOSUB 4610
4540 PRINT"THERE IS ";D$;" HERE."
4550 NEXT I
```

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CIRCLE 187 ON READER SERVICE CARD

```
1000 GOTO 2000
1010 REM ****************************************************
1020 REM ** READ AND PROCESS KEYBOARD RESPONSE
1030 REM ****************************************************
1040 INPUT A$
1050 LET I=0
1060 IF LEN(A$)=1 GOTO 1020
1070 IF A$="N" THEN LET I=1
1080 IF A$="E" THEN LET I=2
1090 IF A$="S" THEN LET I=3
1100 IF A$="W" THEN LET I=4
1110 IF A$="U" THEN LET I=5
1120 IF A$="D" THEN LET I=6
1130 IF A$="I" THEN 4000
1140 IF I=0 THEN 1270
1150 IF POS(I,I)=0 THEN 1270
1160 IF POS(I,I)>99 THEN 2040
1170 LET O=POS(I,I)
1180 IF P=12 THEN 1060
1190 IF P=13 THEN 1380
1200 IF P=27 THEN 1313
1210 IF P=13 THEN 1420
1220 IF P=29 THEN 1470
1230 LET R=P
1240 LET P=O
1250 IF P=25 THEN LET Y=Y+1
1260 GOTO 630
1270 PRINT "YOU CANNOT GO IN THAT DIRECTION!"
1280 GOTO 1040
1290 REM ****************************************************
1300 REM ** PROCESS 2 OR MORE CHARACTER COMMANDS
1310 REM ****************************************************
1320 LET B=0
1330 IF C$="LOC" THEN 630
1340 IF C$="GET" THEN 630
1350 IF C$="DRO" THEN 2190
1360 IF C$="TAK" THEN 2190
1370 IF C$="USE" THEN 2190
1380 IF C$="SHO" THEN 2380
1390 IF C$="LEA" THEN 2380
1400 IF C$="FOO" THEN 2380
1410 IF C$="INV" THEN 2380
1420 IF C$="QUE" THEN 4200
1430 IF C$="HEL" THEN 4200
1440 IF C$="FIX" THEN 1730
1450 IF C$="EAT" THEN 2860
1460 IF C$="DRI" THEN 1610
1470 IF C$="FUE" THEN 4610
1480 IF C$="REA" THEN 4250
1490 IF C$="DEA" THEN 2890
1500 IF C$="BLA" THEN 4610
1510 IF C$="[illegible]" THEN 1640
1520 IF C$="[illegible]" THEN 1640
1530 IF C$="[illegible]" THEN [illegible]
1540 IF C$="[illegible]" THEN [illegible]
1550 IF C$="[illegible]" THEN [illegible]
1560 IF C$="[illegible]" THEN [illegible]
1570 PRINT "INVALID COMMAND!"
1580 GOTO 1040
1590 PRINT "I CANNOT PROCESS YOUR REQUEST!"
1600 GOTO 1040
1610 PRINT "ENTER LOCATION"
1620 INPUT P
1630 GOTO 630
1640 [illegible]
1650 [illegible]
1660 GOTO 1070
1670 REM ****************************************************
1680 REM ** PROCESS ENTRY TO HANGER FROM AIR LOCK
1690 REM ****************************************************
1700 IF R<>39 THEN 2900
1710 GOTO 840
1720 REM ****************************************************
1730 REM ** PROCESS TRANSFER COMMAND
1740 REM ****************************************************
1750 IF P<>36 THEN 1800
1760 IF B$(1)=Y$ THEN 1990
1770 LET P=B$(1)
1780 PRINT "REPAIRING IN PROGRESS."
1790 GOTO 630
1800 IF P=B$(1) THEN 1990
1810 LET P=36
1820 GOTO 1780
1830 REM ****************************************************
1840 REM ** PROCESS DIE COMMAND
1850 REM ****************************************************
1860 IF P=18 THEN 1930
1870 LET B$(1)=P
1880 GOTO 940
1890 REM ****************************************************
1900 REM ** DROP ILLUMINATOR IF AT OVERLOOK
1910 REM ****************************************************
1920 IF B$(1)=P THEN 990
1930 LET B$(1)=18
1940 PRINT "YOU DROPPED YOUR ILLUMINATOR! YOUR
1950 PRINT "CANNOT RETRIEVE IT."
1960 GOTO 950
1970 REM ****************************************************
1980 REM ** PROCESS ROBOT
1990 REM ****************************************************
2000 IF B$(2)=P THEN LET B$(2)=0
2010 IF B$(3)=P THEN LET B$(3)=0
2020 IF B$(4)=P THEN LET B$(4)=0
2030 IF B$(5)=P THEN LET B$(5)=0
2040 IF B$(6)=P THEN LET B$(6)=0
2050 IF B$(7)=P THEN LET B$(7)=0
2060 IF B$(8)=P THEN 2090
2070 LET B$(8)=25
2080 GOTO 1010
2090 IF B$(9)=P THEN 2120
2100 LET B$(9)=25
2110 GOTO 1010
2120 REM ****************************************************
2130 REM ** PROCESS GET OR TAKE COMMAND
2140 REM ****************************************************
2150 GOSUB 4590
2200 IF I=0 THEN 2050
2210 IF I=8 THEN 2240
2220 PRINT "I DON'T RECOGNIZE ";B$(B,J+1);"."
2230 GOTO 1040
2240 PRINT "WHAT ITEM?"
2250 GOTO 1040
2260 IF C$[1,1]=P THEN 2270
2270 IF C>3 THEN 2300
2280 IF I=0 THEN 2410
2290 IF I=10 THEN 2440
2300 IF I=13 THEN 2440
2310 IF I=14 THEN 2490
2320 LET C=C+1
2330 B$(1)=P
2340 IF I=3 THEN LET P=1
2350 PRINT "OK."
2360 GOTO 1040
2370 PRINT "THERE IS NO ";B$(B,J+1);" HERE!"
2380 GOTO 1040
2390 PRINT "YOU CAN'T CARRY ANY MORE!"
2400 GOTO 1040
2410 PRINT "YOU CAN'T CARRY A BEAST!"
2420 GOTO 1040
2430 PRINT "YOU CAN'T GET THE MESSAGE. IT'S"
2440 PRINT "ON THE TERMINAL SCREEN."
2450 GOTO 1040
2460 IF B$(1)=99 THEN 2520
2470 B$(1)=99
2480 GOTO 2320
2490 IF B$(1)=99 THEN 2580
2500 B$(1)=99
2510 GOTO 2320
2520 PRINT "YOU CAN'T HAVE MORE THAN ONE"
2530 PRINT "POWER SUPPLY."
2540 GOTO 1040
2550 REM ****************************************************
2560 REM ** PROCESS DROP OR LEAVE COMMAND
2570 REM ****************************************************
2580 GOSUB 4590
2590 IF I=0 THEN 2620
2600 IF I=8 THEN 2640
2610 GOTO 2220
2620 IF B$(1)=99 THEN 2660
2630 LET B$(1)=0
2640 B$(1)=P
2650 IF I=1 THEN LET P=36
2660 IF I=2 THEN B$(2)=P
2670 IF I=3 THEN B$(3)=P
2680 GOTO 2030
2690 PRINT "YOU DON'T HAVE ";B$(B,J+1);"!"
2700 GOTO 1040
2710 IF P=22 THEN 2830
2720 IF P=18 THEN 2870
2730 IF P=1 THEN 2810
2740 GOTO 2300
2750 REM ****************************************************
2760 REM ** PROCESS INVENTORY COMMAND
2770 REM ****************************************************
2780 FOR I=1 TO 14
2790 IF B$(I)=99 THEN 2820
2800 GOSUB 4610
2810 PRINT "YOU HAVE ";B$(I);"."
2820 NEXT I
2830 GOTO 1040
2840 REM ****************************************************
2850 REM ** PROGRAM TERMINATION PROCESSING
2860 REM ****************************************************
```

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CIRCLE 137 ON READER SERVICE CARD

```
2876 PRINT "YOU HAVE NO POWER ON POWER PACK."
2880 PRINT "YOU HAVE FREZEN TO DEATH."
2890 GOTO 2980
2900 PRINT "OXYGEN REQUIRED HERE. NONE AVAILABLE."
2910 GOTO 2980
2920 PRINT "A NUCLIAR DETONATION HAS JUST OCCURRED."
2930 GOTO 2980
2940 PRINT "YOU HAVE FALLEN TO  YOUR  DEATH."
2950 GOTO 2980
2960 PRINT "YOU HOPE BEEN ZAPPED BY THE LASER."
2970 GOTO 2980
2980 PRINT "THE PROBE BASE HAS JUST BEEN DESTROYED"
2990 PRINT "BY A LARGE ASTEROID."
3000 PRINT "YOU HAVE FAILED TO SURVIVE."
3010 PRINT "DO YOU WISH TO TRY AGAIN?"
3020 INPUT QA
3030 IF QA="Y" THEN 50
3040 GOTO 3090
3050 REM ***********************************************
3060 REM ** PROJECT METEOR SHOWER
3070 REM ***********************************************
3080 IF MOP.I>=12 THEN 1230
3090 IF P2=1 THEN 1230
3100 PRINT "THERE IS A METEOR SHOWER. YOUR SPACE"
3110 PRINT "SUIT HAS DEVELOPED A LEAK!"
3120 GOSUB 4890
3130 IF I<>2 THEN 2980
3140 PRINT "YOUR SUIT IS NOW SEALED."
3150 LET P2=1
3160 GOTO 1230
3170 REM ***********************************************
3180 REM ** PROCESS LOADED GUNS
3190 REM ***********************************************
3200 IF MOP.I>=12 THEN 1230
3210 IF P3=1 THEN 1230
3220 PRINT "THE GUNS IS LOADED!"
3230 GOSUB 4890
3240 IF I<>3 THEN 3260
3250 PRINT "YOU ARE IN THE GUNS AND LOCK."
3260 LET P3=1
3270 GOTO 1230
3280 PRINT "YOUR ATTEMPT FAILS."
3290 REM ***********************************************
3300 REM ** PROCESS DARK SPACEPLANE SHAFT
3310 REM ***********************************************
3320 IF MOP.I>=12 THEN 1230
3330 IF P4=1 THEN 1230
3340 PRINT "IT IS DANGEROUS TO PROCEED ON THE DARK!"
3350 GOSUB 4890
3360 IF I>14 THEN 3440
3370 PRINT "THE SHAFT IS NOW ILLUMINATED."
3380 LET P4=1
3390 GOTO 1230
3400 REM ***********************************************
3410 REM ** PROCESS SHAFT WITH THE ILLUMINATION
3420 REM ***********************************************
3430 IF O1>=1.99 THEN 2960
3440 GOTO 1230
3450 REM ***********************************************
3460 REM ** PROCESS LASER BEAM
3470 REM ***********************************************
3480 IF MOP.I>=12 THEN 1230
3490 IF P5=1 THEN 1230
3500 PRINT "FUSE TO A LASER BEAM WERE. PASSAGE NOT"
3510 PRINT "POSSIBLE WITH BEAM PRESENT."
3520 GOSUB 4890
3530 IF I>=12 THEN 2952
3540 PRINT "THE BEAM IS NOW REFLECTED."
3550 LET P5=1
3560 GOTO 1230
3570 REM ***********************************************
3580 REM ** PROCESS BLOWN SEAL IN SPACE STATION
3590 REM ***********************************************
3600 IF P6=1 THEN 830
3610 IF P4=1 THEN 850
3620 LET P6=1
3630 PRINT "YOU HAVE JUST BLOWN OUR SEAL IN"
3640 PRINT "SPACE STATION."
3650 GOTO 890
3660 REM ***********************************************
3670 REM ** POWER REQUIRED FITTING
3680 REM ***********************************************
3690 IF P=12 THEN 2876
3700 IF P=1 THEN 2876
3710 GOTO 730
3720 REM ***********************************************
3730 REM ** EXPOSE REACTIVITY
3740 REM ***********************************************
3750 IF P=1 THEN 780
3760 LET O1=O1+
3770 LET M12,B1=M12,7)
3780 LET M(16,B1)=M(16,7)
3790 LET M(16,B1)=2
3800 LET P=1
3810 GOTO 740
3820 REM ***********************************************
3830 REM ** DETONATE BOMB
3840 REM ***********************************************
3850 IF P=4 THEN 2970
3860 GOTO 740
3870 REM ***********************************************
3880 REM ** DESTRUCTIVE BOMB
3890 REM ***********************************************
3900 IF O1>=1.95 THEN 1230
3910 IF O1>=1.99 THEN 2980
3920 LET Y=Y+1
3930 PRINT "BOMB IS NOW REACTIVATED."
3940 GOTO 1890
3950 PRINT "YOU HAVE DETONATED TO DO IT WITHIN"
3960 GOTO 1890
3970 PRINT "THERE IS NOTHING TO DO IT FOR"
3980 GOTO 1890
3990 PRINT "YOU CAN'T DO IT FROM HERE!"
4000 GOTO 1890
4010 REM ***********************************************
4020 REM ** FUEL ROCKET
4030 REM ***********************************************
4040 IF P=1 THEN 3980
4050 IF O1>=1.99 THEN 3940
4060 LET O1=O1+.96
4070 PRINT "FUEL IS NOW LOADED."
4080 GOTO 1890
4090 REM ***********************************************
4100 REM ** BLASTOFF PROCESSING
4110 REM ***********************************************
4120 IF P=1 THEN 4180
4130 IF O1>=1.98 THEN 4190
4140 IF P=1 THEN 4190
4150 PRINT "REPAIRS NOC YET COMPLETE."
4160 GOTO 1890
4170 PRINT "CONGRATULATIONS. YOU HAVE JUST BLASTED"
4180 PRINT "OFF AND ARE ON YOUR WAY TO EARTH."
4190 PRINT "YOUR  ESCAPE TIME"; T1; "MINUTES."
4200 GOTO 2890
4210 PRINT "YOUTHE SPACE CRAFT HAS NO FUEL!"
4220 GOTO 1890
4230 REM ***********************************************
4240 REM ** COMPUTER WORKOUT PROCESSING
4250 REM ***********************************************
4260 IF P=50 THEN 5980
4270 GOSUB 4340
4280 IF P=18 THEN 4360
4290 IF P=8 THEN 4420
4300 PRINT "HOME DO-ACTIVATION (ALATER SOMEWHERE ELSE"
4310 PRINT "OF SPACE STATION. ON MOON'S SURFACE."
4320 GOTO 4340
4330 IF P=1 THEN 4410
4340 PRINT "LOCAL FUEL SOURCE: SILICIUM CRYSTAL."
4350 GOTO 4360
4360 PRINT "SILICIUM FOUND IN SOFT SURFACES."
4370 IF P=1 THEN PRINT "SPACECRAFT REPAIRS COMPLETED."
4380 GOTO 1890
4390 REM ***********************************************
4400 REM ** SUBROUTINE TO DESCRIBE ITEMS AT LOCATION
4410 REM ***********************************************
4420 IF I> 1 THEN LET B1="AN ELECTRONIC KEY"
4430 IF I> 2 THEN LET B1="SEALANT"
4440 IF I> 3 THEN LET B1="A DECODER MODULE"
4450 IF I> 4 THEN LET B1="AN ILLUMINATOR"
4460 IF I> 5 THEN LET B1="A ROBOT"
4470 IF I> 6 THEN LET B1="A REACTIVATOR"
4480 IF I> 7 THEN LET B1="A MOBILAR BOMB"
4490 IF I> 8 THEN LET B1="A TRANSFORMER UNIT"
4500 IF I> 9 THEN LET B1="SILICIUM CRYSTALS"
4510 IF I> 10 THEN LET B1="A COMPUTER MESSAGE"
4520 IF I> 11 THEN LET B1="A POWER UNIT"
4530 IF I> 12 THEN LET B1="A MIRROR"
4540 IF I> 13 THEN LET B1="A SHORT RADIO"
4550 IF I> 14 THEN LET B1="A POWER PACK"
4560 RETURN
4570 REM ***********************************************
4580 REM ** SUBROUTINE TO CONVERT AN ITEM TO A NUMERIC VALUE
4590 REM ***********************************************
4600 REM LOT TO GENERATE
4610 IF A$="A" THEN 4690
```

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3	DATE	Time between dates
4	DAYYEAR	Day of year a particular date falls on
5	LEASERT	Interest rate on lease
6	BREAKEVN	Breakeven analysis
7	DEPRSL	Straightline depreciation
8	DEPRSY	Sum of the digits depreciation
9	DEPRDB	Declining balance depreciation
10	DEPRSDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
12	CHECK2	Prints PEDS checks along with daily register
13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	INVLTMON	Computes time needed for money to double, triple etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARBY	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REDWITH	Equal withdrawals from investment to leave 0 over
24	SINKFDR	Sample discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for loans
26	APPLUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	ERNEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-or what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPERF	Value of perfect information
43	VALADPF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUET	Single server queuing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	PQOOQ	Fixed quantity economic order quantity model

NAME	DESCRIPTION
53	PQEOQWSH	As above but with shortages permitted
54	PQEOQBPS	As above but with quantity price breaks
55	QUEUECB	Cost-benefit waiting line analysis
56	NCFANAL	Net cash flow analysis for simple investment
57	PROFIND	Profitability index of a project
58	CAP1	Cap. Asset Pr. Model analysis of project
59	WACC	Weighted average cost of capital
60	COMPBAL	True rate on loan with compensating bal. required
61	DISCVAL	True rate on discounted loan
62	MERGAVAL	Merger analysis computations
63	FINRAT	Financial ratios for a firm
64	NPV	Net present value of project
65	PRICELAS	Lagrange price index
66	PRICEPA	Paasche price index
67	SEASPC	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
70	FORPRP	Future price estimation with inflation
71	MAILPAC	Mailing list system
72	LETWRT	Letter writing system more was MAILPAC
73	SORT3	Sorts list of names
74	LABEL3	Shipping label maker
75	LABEL2	Name label maker
76	INSBUS	NOPE business bookkeeping system
77	TIMECLOK	Computes weekly total hours from timeclock (y/n)
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generates invoice on screen and print on printer
80	INVNTO	In memory inventory control system
81	TELLER	Computerized employee checking
82	TIMEANP	Time per analysis
83	ASSIGN	Rate of assignment algorithm for optimal job assign
84	ACCTREC	In memory accounts receivable system-storage-on
85	TURNPRV	Computes 3 methods of depreciation of loans
86	PAYREQ	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPREF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	EXHELCOR	Types exercise including return address
92	AUTOCKP	Automobile expense analysis
93	INSPLE	Insurance policy file
94	PAYROLL3	In memory payroll system
95	DILATVAL	Dilution analysis
96	LOANAFF3	Loan amount a borrower can afford
97	REPYTRCH	Rent/lease price for similar property
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CIRCLE 138 ON READER SERVICE CARD

```
4610 NEXT J
4620 I=-1
4630 RETURN
4640 LET C$(A,B)=C$(A,J+1,B)
4650 LET I=0
4660 IF C$="E" THEN LET I=1
4670 IF C$="NE" THEN LET I=2
4680 IF C$="SE" THEN LET I=3
4690 IF C$="S" THEN LET I=4
4700 IF C$="SW" THEN LET I=5
4710 IF C$="W" THEN LET I=6
4720 IF C$="NW" THEN LET I=7
4730 IF C$="U" THEN LET I=8
4740 IF C$="D" THEN LET I=9
4750 IF C$="NU" THEN LET I=10
4760 IF C$="ND" THEN LET I=11
4770 IF C$="SU" THEN LET I=12
4780 IF C$="SD" THEN LET I=13
4790 IF C$="WU" THEN LET I=14
4800 IF C$="WD" THEN LET I=15
4810 IF C$="NWU" THEN LET I=16
4820 IF C$="NWD" THEN LET I=17
4830 IF C$="SWU" THEN LET I=18
4840 IF C$="SWD" THEN LET I=19
4850 RETURN
4860 REM ***********************************************************
4870 REM ** SUBROUTINE TO PROCESS ENT COMMAND
4880 REM ***********************************************************
4890 INPUT B$
4900 LET C$=B$
4910 IF C$="ENT" THEN 4950
4920 IF C$="USE" THEN 4950
4930 I=-1
4940 RETURN
4950 GOSUB 5990
4960 IF I<1 THEN 5150
4970 IF RL(I)=99 THEN RETURN
4980 PRINT "YOU DON'T HAVE ";STR$(B,J+1);"!"
4990 GOTO 4930
5000 PRINT "YOU'RE ATTEMPT FAILS!"
5010 GOTO 4930
5020 REM ***********************************************************
5030 REM ** PRINT INSTRUCTIONS
5040 REM ***********************************************************
5050 PRINT "YOU HAVE BEEN DRAWN LONGER BY THE  "
5060 PRINT "EARTH'S MOONS. YOU HAVE LIMITED"
5070 PRINT "SUPPLIES AND TIME IN WHICH TO "
5080 PRINT "SURVIVE. TO TRAVEL, YOU MAY   "
5090 PRINT "ENTER DIRECTIONS SUCH AS NORTH"
5100 PRINT "OR N; AS WELL AS S, E, W AND  "
5110 PRINT "U, AND D FOR UPWARD AND DOWNWARD. YOU  "
5120 PRINT "WILL ENCOUNTER VARIOUS ITEMS  "
5130 PRINT "AND SITUATIONS DURING YOUR    "
5140 PRINT "TRAVELS; TO COMMUNICATE, ENTER"
5150 PRINT "COMMANDS (VERBS), FOLLOWED BY "
5160 PRINT "OBJECT NAMES, IF APPLICABLE.  "
5170 PRINT "FOR EXAMPLE, EAT EGG. (EAT.   "
5180 PRINT "USE, AND INVENTORY."
5190 PRINT " "
5200 PRINT "UNLESS YOU HAVE SURVIVED, THE  "
5210 PRINT "OBJECT THEN IS TO ACHIEVE THE "
5220 PRINT "OPTIMUM SURVIVAL TIME. GOOD   "
5230 PRINT "LUCK!!!"
5240 RETURN
5250 REM ***********************************************************
5260 REM ** (EX) LOCATION DESCRIPTIONS
5270 REM ***********************************************************
5280 DATA "AT MAKE ENCOUNTERS."
5290 DATA "ON RIM OF PUSTORNION."
5300 DATA "TOTAL DARKNESS IN 1."
5310 DATA "TAKEY DANCE A FLICKER."
5320 DATA "AT PASS IN HARMON HOWL."
5330 DATA "AT SHIFTER MARBLES."
5340 DATA "AT MAKE VAPORUM."
5350 DATA "AT MT. [illegible]."
5360 DATA "FOREIGN ARTIFACTS."
5370 DATA "ON DISARMING AREA."
5380 DATA "IN LAZARO TOMMIGAN."
5390 DATA "AT LAZARO POINTS."
5400 DATA "THE SURFACE IS VERY SOFT HERE."
5410 DATA "AT E. SIDE OF MARS IMPRINT."
5420 DATA "AT THE EDGE OF PLATO CRATER, 1"
5430 DATA "SHORT DRIFT IS SEEN W."
5440 DATA "BEFORE A METAL GATE, 4"
5450 DATA "NEAR BOULE POINT, SHAFT B2."
5460 DATA "N. OF MARS ENCOUNTER."
5470 DATA "THERE IS TOTAL DARKNESS."
5480 DATA "AT SHARP BITE OF A SPACE SHAFT."
5490 DATA "THE SHIP ENTRANCE IS BEFORE YOU."
5500 DATA "AT THE CENTER OF MARS CHASM."
5510 DATA "IN THE AIR LOCK CHAMBER OF THE SHIP."
5520 DATA "IN THE AFT CARGO AND FUEL STORAGE ROOM."
5530 DATA "IN THE ENGINE ROOM OF THE SPACECRAFT."
5540 DATA "IN THE SHIP'S CONTROL ROOM."
5550 DATA "IN AN AIR LOCK CHAMBER."
5560 DATA "INSIDE A VENTILATOR SHAFT. A LEDGE"
5570 DATA "LEADS DOWN INTO A LARGE METAL SHAFT."
5580 DATA "IN A VENTILATOR PASSAGE."
5590 DATA "AT A VENTILATOR OPENING. THROUGH THE"
5600 DATA "OPENING A LIT PASSAGEWAY CAN BE SEEN."
5610 DATA "IN A LIGHTED SPACE STATION CORRIDOR."
5620 DATA "IN THE SPACE STATION INFIRMARY."
5630 DATA "IN THE RECREATION ROOM AND LIBRARY."
5640 DATA "IN THE MESS HALL. ABANDONED FOOD TRAYS"
5650 DATA "ARE STILL ON THE TABLES."
5660 DATA "IN THE STORAGE ROOM AND SUPPLY AREA."
5670 DATA "IN THE SLEEPING QUARTERS."
5680 DATA "IN AN ELEVATOR AT SUBSURFACE LEVEL."
5690 DATA "IN AN ELEVATOR AT SURFACE LEVEL."
5700 DATA "IN THE STATION CONTROL CENTER."
5710 DATA "IN THE TRANSPORTER ROOM."
5720 DATA "IN THE SPACE STATION LABORATORY."
5730 DATA "IN THE HANGAR AREA, THE LAUNCH AREA"
5740 DATA "IN THAT SOUTH OR NORE."
5750 REM **
5760 REM ** MOVEMENT AND TEST PRINTER MATRIX
5770 REM **
5780 DATA 47, 46, 45, 44, 43, 42, 41, 41
5790 DATA 39, 38, 37, 36, 35, 34, 33, 33
5800 DATA 32, 31, 30, 29, 28, 27, 26, 25
5810 DATA 24, 23, 22, 21, 20, 19, 18, 17
5820 DATA 16, 15, 14, 13, 12, 11, 10, 9
5830 DATA 8, 7, 6, 5, 4, 3, 2, 1
5840 DATA 99, 99, 99, 99, 99, 99, 99, 47
5850 DATA 48, 49, 50, 51, 52, 53, 54, 55
5860 DATA 56, 57, 58, 59, 60, 61, 62, 63
5870 DATA 64, 65, 66, 67, 68, 69, 70, 71
5880 DATA 72, 73, 74, 75, 76, 77, 78, 79
5890 DATA 80, 81, 82, 83, 84, 85, 86, 87
5900 DATA 88, 89, 90, 91, 92, 93, 94, 95
5910 DATA 96, 97, 98, 99, 99, 99, 99, 99
5920 DATA 99, 99, 99, 99, 99, 99, 99, 99
5930 DATA 99, 99, 99, 99, 99, 99, 99, 99
5940 DATA 99, 99, 99, 99, 99, 99, 99, 99
5950 DATA 99, 99, 99, 99, 99, 99, 99, 99
5960 DATA 99, 99, 99, 99, 99, 99, 99, 99
5970 DATA 99, 99, 99, 99, 99, 99, 99, 99
5980 DATA 99, 99, 99, 99, 99, 99, 99, 99
5990 DATA 99, 99, 99, 99, 99, 99, 99, 99
6000 DATA 99, 99, 99, 99, 99, 99, 99, 99
6010 DATA 99, 99, 99, 99, 99, 99, 99, 99
6020 DATA 99, 99, 99, 99, 99, 99, 99, 99
6030 DATA 99, 99, 99, 99, 99, 99, 99, 99
6040 DATA 99, 99, 99, 99, 99, 99, 99, 99
6050 DATA 99, 99, 99, 99, 99, 99, 99, 99
6060 DATA 99, 99, 99, 99, 99, 99, 99, 99
6070 DATA 99, 99, 99, 99, 99, 99, 99, 99
6080 DATA 99, 99, 99, 99, 99, 99, 99, 99
6090 DATA 99, 99, 99, 99, 99, 99, 99, 99
6100 DATA 99, 99, 99, 99, 99, 99, 99, 99
6110 DATA 99, 99, 99, 99, 99, 99, 99, 99
6120 DATA 99, 99, 99, 99, 99, 99, 99, 99
6130 DATA 99, 99, 99, 99, 99, 99, 99, 99
6140 DATA 99, 99, 99, 99, 99, 99, 99, 99
6150 DATA 99, 99, 99, 99, 99, 99, 99, 99
6160 DATA 99, 99, 99, 99, 99, 99, 99, 99
6170 DATA 99, 99, 99, 99, 99, 99, 99, 99
6180 DATA 99, 99, 99, 99, 99, 99, 99, 99
6190 DATA 99, 99, 99, 99, 99, 99, 99, 99
6200 DATA 99, 99, 99, 99, 99, 99, 99, 99
6210 END
```

Listing 2. Option for Shorewood Tour.

```
3050 REM ****************************************************
3060 REM ** TEXT LOCATION DESCRIPTIONS - SHORTENED FORM
3070 REM ****************************************************
3080 DATA "AT MAIN SEMAPHORE."
3090 DATA "ON RIM OF PERIGRINUS."
3100 DATA "TOTAL DARKNESS TO E."
3110 DATA "TWOUT-BAGGY & PLEASING."
3120 DATA "AT PASS ON BIRMUS MTNS."
3130 DATA "AT CRATER MAKILUS."
3140 DATA "AT PARK VAPORUM."
3150 DATA "AT MT. [illegible]."
3160 DATA "INSIDE ARCHITEXTILE."
3170 DATA "IN CHANGING ROOM."
3180 DATA "IN LARGE AUDITORIUM."
3190 DATA "AT LARGE MONITOR."
3200 DATA "THE CORRIDOR IS VERY DEPT HERE."
3210 DATA "AT E. SIDE OF PARK CYMBRIUM."
3220 DATA "AT THE BASE OF PLATO CRATER. A"
3230 DATA "SHINY OBJECT IS SEEN W."
3240 DATA "BEFORE A METAL DOOR. A"
3250 DATA "SIGN READS EDMT. SHAFT NO."
3260 DATA "E. OF PARK SEMAPHORIUM."
3270 DATA "THERE IS TOTAL DARKNESS."
3280 DATA "AT CRASH SITE OF A SPACE CRAFT."
3290 DATA "THE LUCIF ENTRANCE IS BEFORE YOU."
3300 DATA "AT THE CENTER OF PLATO CRATER."
3310 DATA "IN THE AIR LOCK CHAMBER OF THE SHIP."
3320 DATA "IN THE AFT CARGO AND FUEL STORAGE ROOM."
3330 DATA "IN THE ENGINE ROOM OF THE SPACECRAFT."
3340 DATA "IN THE SHIP'S CONTROL ROOM."
3350 DATA "IN AN AIR LOCK CHAMBER."
3360 DATA "INSIDE A VENTILATOR SHAFT. A LADDER"
3370 DATA "LEADS DOWN INTO A LARGE METAL SHAFT."
3380 DATA "IN A VENTILATOR PASSAGE."
3390 DATA "AT A VENTILATOR SPINNING. THROUGH THE"
3400 DATA "OPENING A LIT PASSAGEWAY CAN BE SEEN."
3410 DATA "IN A LEMPIRE SPACE STATION CORRIDOR."
3420 DATA "IN THE SPACE STATION CATEWAY."
3430 DATA "IN THE RECREATION ROOM AND LIBRARY."
3440 DATA "IN THE MESS HALL. ABANDONED FOOD TRAYS"
3450 DATA "ARE STILL ON THE TABLES."
3460 DATA "IN THE STORAGE ROOM AND SUPPLY AREA."
3470 DATA "IN THE SLEEPING QUARTERS."
3480 DATA "IN AN ELEVATOR AT SUBSURFACE LEVEL."
3490 DATA "IN AN ELEVATOR AT SURFACE LEVEL."
3500 DATA "IN THE STATION CONTROL CENTER."
3510 DATA "IN THE TRANSPORTER ROOM."
3520 DATA "IN THE SPACE STATION LABORATORY."
3530 DATA "IN THE HANGAR AREA. THE LAUNCH AREA"
3540 DATA "IS JUST SOUTH OF HERE."
3550 REM **
3560 REM ** MOVEMENT AND TEXT POINTER MATRIX FOR SHORTENED TEXT
3570 REM **
3580 DATA 87, 85, 80, 65, 86, 90, 81, 51
3590 DATA 93, 83, 34, 81, 98, 79, 92, 43
3600 DATA 42, 85, 14, 84, 48, 19, 34, 84
3610 DATA 91, 83, 91, 88, 38, 88, 48, 85
3620 DATA 94, 85, 47, 86, 84, 84, 45, 84
3630 DATA 84, 83, 85, 83, 89, 89, 49, 45
3640 DATA 98, 87, 99, 13, 85, 88, 88, 88
3650 DATA 99, 87, 18, 83, 95, 83, 89, 69
3660 DATA 18, 82, 16, 47, 88, 88, 11, 13
3670 DATA 48, 89, 34, 88, 99, 85, 12, 12
3680 DATA 12, 15, 87, 13, 89, 82, 14, 19
3690 DATA 88, 13, 85, 13, 85, 88, 15, 16
3700 DATA 88, 18, 12, 83, 88, 98, 17, 18
3710 DATA 99, 99, 99, 89, 98, 89, 19, 20
3720 DATA 11, 18, 81, 98, 89, 88, 21, 22
3730 DATA 17, 16, 87, 13, 86, 83, 23, 23
3740 DATA 16, 17, 11, 17, 88, 88, 81, 24
3750 DATA 13, 19, 86, 86, 86, 86, 29, 29
3760 DATA 18, 85, 28, 86, 86, 86, 29, 29
3770 DATA 86, 86, 89, 89, 81, 89, 28, 26
3780 DATA 89, 89, 98, 83, 89, 23, 27, 27
3790 DATA 88, 88, 13, 89, 28, 23, 29, 30
3800 DATA 26, 83, 96, 99, 22, 99, 32, 31
3810 DATA 29, 26, 88, 88, 86, 86, 30, 32
3820 DATA 87, 88, 88, 87, 29, 89, 34, 35
3830 DATA 25, 85, 26, 32, 26, 98, 39, 39
3840 DATA 26, 28, 83, 88, 88, 86, 36, 36
3850 DATA 89, 89, 42, 88, 89, 89, 38, 35
3860 DATA 28, 32, 45, 37, 99, 96, 36, 39
3870 DATA 88, 88, 88, 26, 48, 46, 85, 28
3880 DATA 99, 99, 89, 99, 99, 89, 31, 38
3890 DATA 46, 83, 29, 42, 96, 96, 43, 38
3900 DATA 91, 89, 88, 87, 89, 88, 46, 46
3910 DATA 96, 27, 96, 99, 99, 99, 49, 49
3920 DATA 88, 28, 88, 46, 86, 46, 43, 46
3930 DATA 99, 99, 48, 99, 89, 89, 44, 46
3940 DATA 46, 46, 29, 88, 88, 98, 45, 48
3950 DATA 87, 89, 89, 88, 89, 88, 46, 47
3960 DATA 47, 43, 88, 38, 99, 99, 48, 48
3970 DATA 86, 89, 88, 47, 48, 46, 48, 28
3980 DATA 89, 88, 88, 27, 42, 85, 51, 41
3990 DATA 29, 85, 78, 28, 99, 99, 42, 99
```

The Second Annual International Computer Problem Solving Contest

Donald T. Piele

It is time once again to extend an invitation to schools throughout the United States and around the world to participate in the Annual International Computer Problem Solving Contest sponsored by the University of Wisconsin-Parkside. This contest is a team competition for elementary and secondary school students that emphasizes the role of problem solving in computer programming.

It is a timed competition that challenges each team to solve five problems within a two hour time limit. The results are judged locally at each school or contest site with the aid of a set of sample solutions that we provide. Each program must run correctly using the test data supplied in the problem to receive any points. The local contest results that are returned to us will be analyzed further to determine a world wide ranking of the top ten teams.

The contest problems are available free of charge to any school or organization that sends in an application before March 27, 1982. The date of this year's contest has been set for Saturday, April 17, 1982. Here is how you can get involved.

Registration

To become a local contest site, a school or organization should complete the application form shown here. Each local contest should have a contest director and a contest duplicator. The contest director is the person responsible for organizing and running the local contest. The contest duplicator is the one responsible for making the required number of copies of the problems for the local contest. This person should be someone who is not involved in the teaching or coaching of students entered in the contest.

About three weeks before April 17—the day of the contest—we mail one copy of the contest problems. Other than the contest duplicator, no one may see the problems before April 17. On the day of the contest, they are to be delivered to the contest director who may share them with the judges before the contest begins.

All applications should be accompanied by a large (9x12 inch) envelope addressed to the contest duplicator. If the entry is from a school or organization inside the United States, please include four 20-cent stamps. We will provide the postage for entries from outside the United States. Send to:

Dr. D.T. Piele
The University of Wisconsin-Parkside
P.O. Box 2000
Kenosha, WI 53141

Previous Contest Problems

This is the sixth year that we have held a local contest and the second year for the international event. As a result, we now have six Junior and six Senior contest problem sets that we have used. Since this is the first year for the Elementary Division, we do not have any problems at this level. For those who would like to see what kinds of problems have been used before, the problem sets for the last three contests can be found in *Creative Computing* (Sept. 1979, p. 152-153; Feb. 1981, p. 89-92; Oct. 1981, p. 140-148). If you would like to receive the complete set of all twelve problem sets, please send a self-addressed 9x12 envelope with four 20-cent stamps.

John Rumpel
Junior Division
Winner
Redwood Middle
School,
Redwood, CA

Donald T. Piele, Department of Mathematics, The University of Wisconsin-Parkside, Kenosha, WI 53141.

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The University of Wisconsin - Parkside

Second Annual International Computer Problem Solving Contest

April 17, 1982

R U L E S

Divisions:	Senior	SR:	Grades 10-12	(age ≤ 18)
	Junior	JR:	Grades 7-9	(age ≤ 15)
	Elementary	EL:	Grades 4-6	(age ≤ 12)

All students should be classified by grade or grade equivalent. The ages are listed to help assist schools outside North America establish equivalents.

Team Size: A team consists of one, two, or three students.

Computer System: Any computer system or computer language may be used; however, each team may use only one input device (keyboard/terminal). A printer must be available for listing the programs and the sample runs.

Time Limits: Each team has exactly two hours to write five programs and save them to disk or tape. After the two hour period, each team is allowed time to list their programs and sample runs to the printer. No changes in any program are allowed at this time except those changes in the PRINT or INPUT statements that may be necessary to get a hard copy. 15 minutes should be plenty of time for this job.

Grading Procedure: It is the responsibility of each local director to arrange for grading of the local contest. Sample solutions will be provided. Each program may be awarded 20 points. These points are broken down as follows:

1) 15 points for each program that runs correctly. No partial credit is possible here.

2) If it runs correctly, then 1 to 5 additional points may be given for design and ease of reading. No points are given if the program does not run correctly.

General: No outside help is allowed during the contest, including books, programs, or students not on the team. However, questions concerning the operation of the computer system or terminals, may be answered by the those conducting the contest. Any language reference book or pocket guide of commands and statements is also allowed. Time may be taken before the contest to familiarize the contestants with the computer system. Standard programming languages inherent to the processor of the computer should be used.

University of Wisconsin - Parkside

Second Annual International Computer Problem Solving Contest

April 17, 1982

REGISTRATION FORM

Instructions: Please fill out the enclosed form and mail it along with (1) a large 9x12 envelope addressed to the Contest Duplicator. Please affix four 18-cent stamps if you are mailing from within the United States; 2) a postcard addressed to the Contest Director if you wish to have your registration confirmed.

1. School or Organization _____

2. Address _____

3. City,State,Zip (USA) _____

4. City,Country (non-USA) _____

5. Contest Director _____ Ph _____

6. Contest Duplicator _____ Ph _____

7. Contest Problems requested for EL) JR) SR) divisions.

8. We expect to give the contest to approximately ____ EL, ____JR, and ___ SR teams.

As contest duplicator, I agree to keep the contest problems and the sample solutions sent to me confidential until April 17 when I will turn them over to the contest director. I am not involved in any way in the preparation of student teams for the contest.

_____

Contest Duplicator's signature

As contest director, I have read the rules of the contest and agree to follow them. I realize that I am responsible for conducting the local contest, having the results graded or ranked, and returning a completed Results Sheet supplied with the problems.

_____

Contest Director's signature

Sourcebook of Ideas

Many mathematics ideas can be better illustrated with a computer than with a text book.

Consider Baseball cards. If there are 50 cards in a set, how many packs of bubble gum must be purchased to obtain a complete set of players? Many students will guess over 1 million packs yet on average it is only 229.

The formula to solve this problem is not tasty. The computer simulation is. Yet you as a teacher probably don't have time to devise programs to illustrate concepts like this.

Between grades 1 and 12 there are 182 mathematics concepts in which the computer can play an important role. Things like arithmetic practice, X-Y coordinates, proving geometric theorems, probability, compounding and computation of pi by inscribed polygons.

Endorsed by NCTM

The National Council of Teachers of Mathematics has strongly endorsed the use of computers in the classroom. Unfortunately most textbooks have not yet responded to this endorsement and do not include programs or computer teaching techniques. You probably don't have the time to develop all these ideas either. What to do?

For the past six years *Creative Computing* magazine has been running two or three articles per issue written by math teachers. These are classroom proven, tested ideas complete with flowcharts, programs and sample runs.

Teachers have been sending back issues with these explorations for years. However many of these issues are now sold out or in very short supply.

So we took the most popular 134 articles and applications and reprinted them in a giant 224-page book called *Computers in Mathematics: A Sourcebook of Ideas*.

Ready-to-use material

This book contains pragmatic, ready to use, classroom tested ideas on everything from simply binary counting to advanced techniques like multiple regression analysis and differential equations.

The book includes many activities that don't require a computer. And if you're considering expanding your computer facilities, you'll find a section on how to select a computer complete with an invaluable microcomputer comparison chart.

Another section presents over 250 problems, puzzles and programming ideas more than are found in most "problem collection" books.

Computers in Mathematics: A Sourcebook of Ideas is edited by David Ahl, one of the pioneers in computer education and the founder of Creative Computing.

The book is not cheap. It costs $15.95. However if you were to order just half of the back issues from which articles were drawn, they would cost you over $30.

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Some of the problems are not very nice. We are asking how much the $24 the Indians were paid for Manhattan would be worth today had it been deposited in a bank. However, this problem was revised to have a variable interest rate so it would be a challenge to program. Of course, many of the problems are new and have never been in print before.

The student section has 106 pages and includes all 90 problems (with variations), 7 appendixes and a comprehensive bibliography. Cost is $4.95.

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The traveling trophies awarded to the winning Junior and Senior Division teams. The school and team member names are engraved on each trophy.

My Mailbag

One of the truly pleasant experiences associated with conducting the International Programming Contest last year was reading the letters that I received from several of the high ranking teams. Any thoughts that I may have subconsciously harboured that tended to classify exceptional computer programmers as keyboard junkies with tunnel vision were completely dispelled. Here are two letters that I received that told me much about the kinds of young students around the world who are being challenged by computers.

Dear Mr. Fiele,

Thank you for your letter of congratulations regarding my ranking of "third" in the Junior Division of the First International Computer Problem Solving Contest.

This spring I also received a gold medal at the Long Island Math Fair (level 14) and placed first in the Junior Computer Division of the Long Island Science Congress.

Although I am only a 10th grader in high school, I have spent hundreds of hours at my computer mastering computer programming. Only through working at odd jobs have I been able to buy my present system which consists of a 16K Commodore computer, a tractor feed printer, sound box and cassette deck.

Through experimentation, I was able to use my computer to control a robot I constructed by myself. In the future I plan to program EPROM chips and sell computer software.

In school, I conducted informal classes in computer programming for the faculty as well as the students.

My biggest problem with my computer research is financing my experimentation. I would like to know where to write for funds or some type of grant to help me continue my research into the field of computers.

Thank you for your time and trouble.

Craig Cohen
78 Frankel Blvd.
Merrick, Long Island 11566

Dear Dr. Fiele,

I am writing to you on behalf of Karen Eller, Peter Fraser and myself acknowledging the congratulations you sent to us on achieving second placing in the senior division of the First International Computer Problem Solving Contest sponsored by your University.

All three of us were thrilled with the news.

Early last month after receiving the news of our success, our school organized a special assembly at which two representatives of Hewlett Packard presented each of us with an HP 41C programmable calculator. In addition, the nine students from our other three teams which participated in the contest, received an encouragement award in the form of a book presented by the Regional Director of Education. The assembly was televised by our local TV station and excerpts were shown on the evening news.

At present we are all very busy preparing our entries for a State Science Talent Search. Greg Parrott, Nigel Edwards and myself have entered a computer-driven solar tracker. Mark McConnel has done a project on "Velocity Tolerance of a Bar-Code Scanner," and Debbie Eller is working on a Computer Simulation of Mendel's Experiments.

With the end of our academic year drawing ever-closer, Karen Eller and Peter Fraser, who are two academic years ahead of me, are very busy preparing for their final examinations.

Thank you once again for your congratulations, and in particular thank you for the opportunity given to us to participate in the contest.

Bruce M. Edwards
Terang High School
P.O. Box 124
Terang, Victoria 3264
Australia

Solutions To Last Month's Problems

Six problems were presented last month that dealt with the generation and study of prime and related numbers. The problems were called: Prime Factorization, Prime Numbers, The Sieve of Eratosthenes, Random Primes, and Lucky Numbers. Following is a set of solutions. (Page 61)

Program Remarks

Last month, I invited interested readers to find their fastest Basic algorithm for generating the prime numbers between 2 and 1000. The Super Fast Sieve of Eratosthenes listed below is our best effort. The time that it takes this program to generate the 168 prime numbers between 2 and 1000 and print them out on the screen was recorded for a variety of microcomputers.

Microcomputer	Time (Seconds)
TRS-80 Level II	11
Atari	10
TRS-80 Color Computer	10
PET/CBM	9
Apple II (Applesoft)	8
North Star Horizon	5
Microsoft Basic on N.S.	5

Can anyone do better? If so, send it along. I would like to share the news with others in a future article.

Two other programs – Lucky Numbers and Random Primes – could stand a great deal of improvement. As written, they are very slow. There must be faster implementations of the sieve algorithm for generating Lucky and Random Prime Numbers. □

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Problem Solutions

```
10 PRINT "PRIME FACTORIZATION"
20 PRINT
30 PRINT "This program takes an integer N and factors it"
40 PRINT "into its prime factors."
50 PRINT
60       INPUT "Enter an integer ";N
70       PRINT N;"=";
80 I=
90       K=1
100      P=P+1
110      IF K=0 THEN PRINT
120      IF NOT(N/P=INT(N/P)) THEN 160
130 K=
140      PRINT P;
150      N=N/P
160      IF N=1 THEN END
170      PRINT "*";
180 GOTO 90

PRIME FACTORIZATION

This program takes an integer N and factors it
into its prime factors.

Enter an integer  855
 3*3*5*19

Enter an integer  [illegible]
 [illegible] = 2 * 2 * 2 * 7 * 11 * 13

10 PRINT "PRIME NUMBERS - TRADITIONAL"
20 PRINT
30 PRINT "This program generates the prime numbers from "
40 PRINT "2 to 1000 by checking each number for divisors using"
50 PRINT "the numbers."
60 PRINT
70       PRINT 2,3,
80       FOR P=5 TO 1000 STEP 2                    RESPONSIBLE PRIME
90           FOR I=2 TO SQRT(P) STEP 2             TEST FOR ODD DIVISORS
100              R=P/I                             UP TO SQUARE ROOT OF P.
110              IF R=INT(R) THEN 140
120          NEXT I
130          PRINT P;
140      NEXT P
150 END


10 PRINT "PRIME NUMBERS - MODIFIED TRADITIONAL"
20 PRINT "This program generates the prime numbers from"
30 PRINT "2 to 1000 by checking each number for divisors"
40 PRINT "using the previous primes."
50 PRINT
60       DIM A(500)
70       PRINT 2,3,
80       N=21 A(1)=3
90       FOR P=5 TO 1000 STEP 2                    Impossible prime.
100          FOR I=2 TO N+1 STEP 1:IF A(I)>SQRT(P) GOTO 170   Test for prime
110              R=P/A(I)
120              IF R=INT(R) THEN 190              of 2 and test primes.
130          NEXT I
140          PRINT P;
150          N=N+1
160          A(N)=P
170      NEXT P
180 END

PRIME NUMBERS - MODIFIED TRADITIONAL
This program generates the prime numbers from
2 to 1000 by checking each number for divisors
using the previous primes.

 2   3   5   7  11  13  17  19  23  29  31  37
 41  43  47  53  59  61  67  71  73  79  83  89
 97 101 103 107 109 113 127 131 137 139 149 151
157 163 167 173 179 181 191 193 197 199 211 223
227 229 233 239 241 251 257 263 269 271 277 281
283 293 307 311 313 317 331 337 347 349 353 359
367 373 379 383 389 397 401 409 419 421 431 433
439 443 449 457 461 463 467 479 487 491 499 503
509 521 523 541 547 557 563 569 571 577 587 593
599 601 607 613 617 619 631 641 643 647 653 659
661 673 677 683 691 701 709 719 727 733 739 743
751 757 761 769 773 787 797 809 811 821 823 827
829 839 853 857 859 863 877 881 883 887 907 911
919 929 937 941 947 953 967 971 977 983 991 997
```

Survival, continued...

```
10 PRINT "SIEVE OF ERATOSTHENES - STANDARD"
20 PRINT
30 PRINT "This program generates the prime numbers between"
40 PRINT "2 and 1000 by using the Sieve of Eratosthenes."
50 PRINT
60      DIM X(1000)
70      FOR I=1 TO 1000                     'Initialize an array
80          X(I)=1                          'with the numbers from
90      NEXT I                              '1 to 1000.
100 ;
110     P=0
120     PRINT P;
130       IF X(P)=1 THEN 180                'Sieve is complete.
140         FOR I=P+P TO 1000 STEP P        'Delete the multiples
150           X(I)=0                        'of P.
160         NEXT I
170 ;
180     FOR J=P+1 TO 1000                   'Print out primes.
190       IF X(J)=0 THEN P=J : GOTO 120
200     NEXT J
210 END
```

```
10 PRINT "SIEVE OF ERATOSTHENES - SUPER FAST"
20 PRINT
30 PRINT "The program generates the prime numbers between"
40 PRINT "2 and 1000 using a super fast Sieve Method."
50 PRINT
60      DIM N(1000)                         'No initialization needed.
70      PRINT 2;
80        FOR P=3 TO 997 STEP 2
90          IF N(P)=1 THEN 150
100         IF P>31 THEN 140
110           FOR I=P*P TO 997 STEP 2*P
120             N(I)=1                      'Delete multiples of P.
130           NEXT I
140         PRINT P;
150       NEXT P
160 END
```

```
10 PRINT "RANDOM PRIMES"
20 PRINT
30 PRINT "This program generates a set of Random Prime Numbers"
40 PRINT "between 1 and 1000."
50 PRINT
60      DIM X(1000)
70      R=2
80      PRINT R;
90          FOR I=1 TO 1000
100           IF X(I)=1 THEN 180                'Skip the ones deleted;
110           R=INT(RND(1)*R)                   'Pick a random number.
120           IF R<0 THEN X(I)=1                'Delete I not in R
130       NEXT I                                'in the average.
140 ;
150       FOR J=R+1 TO 1000                     'Search for next
160         IF X(J)=0 THEN R=J : GOTO 80        'Random Prime.
170       NEXT J
180 END
```

RANDOM PRIMES

This program generates a set of Random Prime Numbers between 1 and 1000.

2	3	11	13	15	21	23	25	27	31	33	35
51	53	63	67	71	83	84	87	88	100	103	113
121	123	139	143	149	150	153	157	165	171	173	175
195	193	199	203	213	223	224	227	228	240	253	257
273	283	293	304	307	312	317	343	355	365	381	384
393	395	399	392	395	401	422	429	433	437	439	440
455	454	462	468	518	525	547	470	475	476	487	516
523	524	526	563	576	579	580	589	595	601	603	608
613	623	634	638	645	646	657	661	671	679	682	692
718	719	726	726	728	727	734	739	742	745	747	750
760	764	781	789	791	808	813	814	816	832	843	851
859	864	873	874	881	891	897	901	903	905	910	923
928	932	940	947	958	979	982	983	985	991	997	

```
10 PRINT "LUCKY NUMBERS"
20 PRINT
30 PRINT "THIS PROGRAM GENERATES THE LUCKY NUMBERS BETWEEN"
40 PRINT "1 AND 1000."
50 PRINT
60        DIM X(1000)
70        PRINT L;
80        L=0
90        PRINT L;
100       C=0
110       FOR I=1 TO 1000 STEP 2
120          IF X(I)=0 THEN C=C+1                  'COUNT THE TERMS AND
130          IF C/L=INT(C/L) THEN X(I)=1           'DELETE EVERY LTH TERM.
140       NEXT I
150       FOR J=L+2 TO 1000 STEP L                 'SEARCH FOR NEXT
160          IF X(J)=0 THEN L=J : GOTO 90          'LUCKY NUMBER.
170       NEXT J
180 END
```

```
LUCKY NUMBERS

THIS PROGRAM GENERATES THE LUCKY NUMBERS BETWEEN
1 AND 1000.

  1   3   7   9  13  15  21  25  31  33  37  43
  49  51  63  67  69  73  75  79  87  93  99 105
 111 117 127 129 133 135 141 151 159 163 165 171
 189 193 195 201 205 211 219 223 231 235 237 241
 259 261 267 273 283 285 289 297 303 307 319 321
 327 339 349 355 357 361 367 385 391 393 399 409
 415 421 427 429 433 451 463 475 477 483 487 489
 495 511 519 523 529 539 547 561 563 567 573 579
 583 591 601 603 615 619 621 631 637 643 645 651
 655 673 679 685 690 699 717 723 727 739 765 775
 781 795 799 805 811 817 841 855 859 873 883 891
 925 947 973 985 995 999 977 993 925 927 931 933
 937 957 963 975 979 981 987 993 997
```

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Will Fastie

In which Will reveals the minimal secrets of how, where, and why to buy your own.

Welcome to my column. I'm glad to be here.

I'm going to do my best to make this interesting reading every month. I'll try hard to give you quality as well as quantity, and I'll try to keep the information content high. *Creative* and I will welcome your comments, criticisms, and ideas. I'll also be looking for your help, in the form of information. For obvious reasons, I would like to learn anything you know or learn about the IBM Personal Computer and associated matters. I'm going to be most interested in software. I'll be hungry for the earliest possible news about product developments—vendors take note!

About replies: this column is my forum, and I'll try to answer you here, sooner or later. If you really want a direct response from me, please send a stamped, self-addressed envelope along. I promise to do my best to reply, as my time permits. Writing this column only pays the computer bills—I have a real job too!

Since this is an inaugural column, it is only appropriate that we deal with an inaugural subject. I'll tell you where and how to buy the IBM Personal Computer, and why you should (or shouldn't). "Baloonlash," you say? "Why aren't we hearing some heavy technical junk?" you ask. Well, my friends, take a close look at Photo 1. See the IBM Personal Computer sitting on the table next to my inaugural bottle of champagne? You don't? Well see, here's the thing. When I took the picture for this column there was no computer on that table. However, there is now, right this minute, even as you read. Isn't time travel wonderful!

W. H. Fastie, 7110 Sheffield Rd., Baltimore, MD 21212.

The Author's System.

Down to Business

The where and how of buying the Personal Computer are somewhat interrelated. "Where" is who sells them, and "how" is what kind of money they accept. We'll talk about "why" later.

There are, at the moment, four ways you can buy the IBM Personal Computer. The first is through an IBM Product Center. The second is also from IBM, but through the Data Processing Division (DPD) if the quantity you require is sufficiently high. The third is in one of the new Sears Business Systems Centers. The last, but most likely for most of you, is in a Computerland store.

IBM Product Centers

The odds are this won't work for you. It does for me because I happen to live in Baltimore, the location of one of only three Product Centers. The other two are located in Philadelphia and San Francisco. These stores are simply manufacturer's retail outlets, selling only products made by IBM. The stores carry office equipment, like the Selectric typewriters, and small systems. The systems sold before the Personal Computer were the IBM 5120 and the DisplayWriter word processor. The "Datamaster" System 23 was introduced about the same time as the Personal Computer.

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CIRCLE 190 ON READER SERVICE CARD

IBM, continued...

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The Product Centers also carry supplies for the Personal Computer, including diskettes, printer ribbons, and printer paper. Repair service is available at all centers, as well as at service locations in Los Angeles, Seattle, Houston, Dallas, Boston, New York, Chicago, Detroit, and Washington. The product centers will not carry replacement heads for the printer, but will be able to order them. I mention this because the Epson MX80 print head is user-replaceable.

I'm sure it will come as no surprise to learn that IBM will sell the system at list price. No wheelin' and dealin' with IBM, folks. The standard price schedule is shown in Table 1.

IBM DPD

For customers of the Data Processing Division, or those wishing to purchase twenty or more systems, IBM will sell through a sub-organization within DPD. In essence, this means IBM will call on you to sell the machine, and that you can get a discount of from five to fifteen percent for quantities of from 20 to 150 units. The buyer must execute a one year Volume Purchase Agreement (VPA) with IBM and buy at least the minimum configuration, shown in Table 2. An Educational Allowance is available for qualifying educational institutions, provided that a VPA has been executed and that the allowance is greater than the VPA discount percentage.

IBM Service

When you buy your IBM Personal Computer, you get a 90-day warranty. A system which needs repair while under warranty must be delivered to one of IBM's designated service locations or IBM's National Support Center in Greensville, IN. IBM's objective is to repair or replace the unit in one to two days, exclusive of shipping time. IBM will repair or replace at its option; the customer may request repair, but an additional fee is charged.

After the warranty period you're on your own unless you purchase what I like to call computer life insurance. The IBM service agreement costs about 13% of the purchase price of the computer per year. The exact figures for each component are shown in Table 1. One advantage of the service agreement is that IBM will arrange to have the unit picked up for repair and will deliver a replacement unit to the customer. IBM's objective is to deliver the replacement unit within 24 hours of receipt of the malfunctioning unit. Upon customer request, IBM will repair the unit, their objective being one to two days for repair. Pickup and delivery service is available in the service areas mentioned previously, within a 30-mile radius.

Customers outside the service radius can either carry their system to the service location or ship them to the National Support Center. IBM's objective is to ship a replacement unit within 24 hours of receipt, or a repaired unit within two days.

Table 1. IBM Personal Computer Price List.

Component	Price	Maintenance
System Unit, Keyboard, 16K RAM	$1,265.00	$112.00
16K RAM Expansion Kit	90.00	8.00
32K RAM Expansion Board	325.00	40.50
64K RAM Expansion Board	540.00	122.00
Monochrome Display & Printer Adapter	335.00	20.00
IBM Monochrome Display	345.00	66.50
IBM 80 cps Matrix Printer	755.00	179.00
Color/Graphics Monitor Adapter	300.00	41.00
5 1/4" Diskette Drive Adapter	220.00	6.00
5 1/4" Diskette Drive, 160K	570.00	62.00
Asynchronous Communications Adapter	150.00	8.00
Game Control Adapter	55.00	1.50
Printer Cable	55.00	–
Printer Stand	55.00	–
Software		
IBM Personal Computer DOS	$ 40.00	
IBM Personal Computer Pascal Compiler	300.00	
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VisiCalc	200.00	
EasyWriter	175.00	
Peachtree Software		
General Ledger	595.00	
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Microsoft Adventure	30.00	
Advanced Diagnostics Package	155.00	

Note: Maintenance prices shown are for the "Annual Option" and represent the cost of service for a 12 month period. A "Warranty Extension" option is available at about 75% of the prices shown which extends the three month warranty to twelve months and which is only available in the first year of ownership. Service under either option is identical.

Table 2. Data Processing Division VPA Minimum Configuration.

Component	Price	Maintenance
System Unit, Keyboard, 16K RAM	$1,265.00	$112.00
16K RAM Expansion Kit (2 each)	180.00	16.00
Monochrome Display & Printer Adapter	335.00	20.00
IBM Monochrome Display	345.00	66.50
5 1/4" Diskette Adapter	220.00	6.00
5 1/4" Diskette Drive, 160K	570.00	62.00
Asynchronous Communications Adapter	150.00	8.00
IBM Personal Computer DOS	40.00	
Total	$3,105.00	$290.50

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For Example

You have just purchased a mailing list program. Everything is fine until the list has to be sorted by zip code. If the program has that capability, all is well. If not, you have a big problem. If you had just invested a few hours reading *Small Business Computers*, you would have known what functions to look for before buying the program, you would have known how to plan for future needs. That's just one example. Expand this concept into other areas, other programs and systems, and you can see what you get for your investment.

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CIRCLE 290 ON READER SERVICE CARD

Sears Business Systems Center.

Personal Computers sent to IBM for repair must have all non-IBM "devices or features" removed. IBM wants the systems properly shipped, either in the original carton or an equivalent, and they will sell you replacement shipping containers for this purpose.

If you elect not to buy a service agreement and your machine dies, you can obtain "time and materials" service, but only from the National Support Center. Labor, parts, and transportation will be billed. Now I know it's tempting to take a chance—$400 to $600 seems like a lot of money for "life insurance." Take my word for it—if your machine has any serious problems you could easily spend twice the bucks in T&M.

Sears Business Systems Centers

The odds are that this won't work for most of you either, since there are only five stores in existence so far. Sears opened its first two Business Systems Centers this past October 7 in the Chicago suburbs of Arlington Heights and Villa Park, and followed them a week later with two more in Prestonwood and Carush Shopping Mall in Dallas. The fifth store in Boston, was scheduled for mid to late November and should be open now. All five stores carry both Sears and national brands of computer systems, software, typewriters, word processors, printers, copiers, calculators, dictation and communications equipment, and supplies. The IBM Personal Computer is being sold along with the NEC PC-8000, Vector 2600 and 3005 systems, and the WangWriter 5500 word processor. Three Okidata dot matrix printers and two NEC Spinwriters are also available.

Sears is orienting these stores directly toward the small business and professional markets. Even their appearance, as shown in Figure 2, suggests this. Systems may be paid for with cash, on a "Net 30" invoice, on up to a three year installment plan, or with the Sears Credit Card. (This last means Sears isn't completely ignoring the consumer market, even though Atari computers were recently dropped from the catalog and the retail stores.) Sears will also provide service, both under warranty and under their own maintenance programs. They intend to do this work themselves and not use IBM resources such as the National Support Center.

Sears' pricing of the IBM Personal Computer is not available to me as I write this column. However, a Sears spokesman told me that they would not necessarily use the IBM price structure. I assume (hope?) this means that the individual stores are empowered to negotiate price, and not that Sears will charge more.

The Sears Business Systems Centers are a test. If they are successful, Sears plans to open a network of them nationwide. This is a very interesting possibility. Sears can bring several strengths to this new business. Its service network, although new to computer system repair, simply cannot be underestimated and is of enormous importance and value in today's more mature small business computer market. Nonetheless, Sears is the Johnny-come-lately in this business, and they have a tough, uphill battle, as you are about to see.

Computerland

The odds are that this will work for you! Computerland stores are individually owned and operated computer stores in a franchised network. The franchises are sold by Computerland Corporation of San Leandro, CA, which provides many services to its member stores. This network is very large. In October there were between 160 and 170 stores in the United States and another 40 in foreign countries. Computerland Corporation expects to close 1981 with 230 stores (15 openings per month!) and plans to add another 100 by the end of 1982.

I talked with Marion Murphy, the VP of operations, whose excitement about Computerland is contagious even over the telephone. What I learned was very interesting. Computerland gives a great deal of flexibility to the dealer while strongly influencing the overall style and strategy. Individual stores can do just about anything they please. They can carry whatever products they choose. They can refuse to carry products offered by the corporation. They are perfectly free to sell local third-party software. They can purchase outside Computerland Corporation.

However, for an 8% cut of the gross store sales, the corporation provides advantages, the most important of which is that Computerland buys products in volume and ships them to the stores at cost. This gives each dealer the same leverage as the entire network! It also gives the dealers a breadth of product that they otherwise could not afford to offer. This breadth of product includes Apple, Atari, Commodore, Northstar, Cromemco, Dynabyte, Xerox, WangWriter, Vector Graphic, and now IBM. Most stores usually carry at least Apple, Atari, Xerox, and Vector Graphic. About the only thing a store owner is discouraged from doing is mail order business.

Computerland stores accept cash, MasterCard, Visa, and American Express credit cards. Leasing programs are provided nationally and some stores have local leasing and financing arrangements.

One thing the stores must do to retain their franchise is service what they sell, and they must provide this service at the store location. Typical turnaround is one day if the system is under service contract and two to three days if it is not. A "Passport" program has been put into effect that identifies the bearer as a customer of Computerland and allows the customer to obtain the same level and speed of service at any Computerland store. I asked if the repair time objectives were met, and was told that they were typically being exceeded, as many repairs involved either quick adjustment or component swapping. The IBM Personal Computer will be serviced by the stores, although dealers are not discouraged from telling customers about IBM as an alternate service source.

Computerland has a central corporate program to certify new products, including software. A committee reviews suggestions from all sources, including stores. If a new product is approved by the committee, it is stocked and distributed to the stores from San Leandro. I think this is a very strong program because it means that cottage industry products, especially software, can percolate up to Computerland Corporation and out to a much broader audience than might otherwise be possible. This kind of thing can make a big difference during the early life of the IBM systems.

Supplies are certainly no problem for Computerland, but IBM diskettes and ribbons will be carried nonetheless.

I learned some new things during my talk with Computerland. First, Computerland Stores will be getting something called the "spare parts kit" from IBM. I got this

data base

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CIRCLE 149 ON READER SERVICE CARD

information in answer to my question about striking the Epson printer head for customer replacement. Computerland assures the head will be part of this kit, although they couldn't say for sure. One thing is certain—they don't currently have the printer parts on hand because they don't sell Epson printers. (Sounds like heresy to me!) Computerland will also be selling an RF Modulator, which is needed to connect a standard TV set to the Color/Graphics adapter. And here's the next thing I learned: they claim they are quite sure that the one they have been selling all along for the Apple will work on the IBM machine.

There are some things that IBM does not offer that are needed by the consumer market. I had hoped Computerland would fill in this void with more than just the RF Modulator, but alas, no luck. They say they will have joysticks and paddles someday, as soon as they find a source. I didn't ask, but I'm sure they do have cassette recorders and cables. I'll keep you posted on developments in these areas and will publish the specifications for these devices as soon as I have them.

Computerland declined to give me a pricing structure. What they said, however, was that each independent dealer establishes his pricing and is able to negotiate. Careful now—I didn't say they would, just that they could. They could just as easily sell at list, firm.

Where Should I Buy Mine?

Now that you know who sells them, how do you decide how to choose your source? I think the answer is simple: you walk out of your home and go to your nearest computer store that sells the IBM Personal Computer. There is a 95% chance that it will be a Computerland Store.

If you have a choice, choose the least expensive store after you have determined that the store is fit to service your system.

Why Should I Buy One?

There is only one reason to buy a small computer nowadays. It's a reason that was "discovered" when VisiCalc was first published. It's a reason that has been printed between these covers many, many times. You buy a computer because you have found a piece of software that has some value to you and that software just happens to run on the computer you are buying.

Okay, so much for the sermon. Let's get serious about this.

"Why Should I Buy One?" Asked the Small Businessman

Please see above. Yep, that's right—the sermon was for you. If you want a computer system to help you in your business you had better know right up front what you expect it to do for you. You, more than most, must find the software you need and buy the machine to match it. If you can't find the software you need, one of two things is wrong: either what you need really isn't available "off-the-shelf," or you don't know what you need. The latter is more probable—go get yourself some help if you're still serious, but *don't buy that computer yet!*

If you read my evaluation of the IBM Personal Computer in last month's *Creative*, you know I think the machine is the cat's meow. But that doesn't mean a thing to you if you can't get the function you need out of it. Don't be seduced. Just think of $6,000 sitting on the shelf getting dusty. That six grand could mean a lot more to your business in other ways, maybe more than you should risk without knowing what your expected return will be.

Am I saying not to buy the IBM Personal Computer for small businesses? Not at all. If the general accounting software and VisiCalc will be useful, the capacities of the system suit your business, and the new way of doing things will be cost effective, I think it's a fine choice. But if you can't find useful software, look elsewhere. By the way, this situation will improve slowly as a body of software is developed for the machine. It takes a while—you may have to be very patient.

"Why Should I Buy One?" Asked the Big Businessman

The small business is usually after a general purpose computing system, one which can keep the books but also do other things. Larger businesses already have loads of equipment for those purposes. The trend now, and one which will have a lasting influence on the way we work, is the distribution of computing power into the hands of the worker. Just now, however, a single piece of software is focusing much attention on a particular segment of larger organizations: the accounting and financial departments. The software, of course, is VisiCalc.

The IBM Personal Computer is kind of an ultimate VisiCalc machine. Its great memory capacity means that large, complex models can be constructed. I have a rule of thumb which says that the VisiCalc worksheet has about 10,000 cells in a machine with 192K of main memory. That's enough for all but the largest, most demanding applications.

So VisiCalc, coupled with the fact that the IBM Personal Computer is easily integrated into the mainstream of data processing in most organizations, is the reason bigger businesses will buy.

I'd like to interject one comment about the IBM Personal Computer version of VisiCalc. At the time of writing, VisiCalc still has the memory limitation I described in my evaluation article, which is to say that it does not use all available memory if more than 96K of memory is installed. I have not been able to learn when the new version will be available. Besides supporting extended memory, the new release will most likely be bug free and tuned, and may even incorporate a new feature or two. My advice: wait for it, or make sure you don't have to buy it all over again when the new release is made.

"Why Should I Buy One?" Asked the Ordinary, Everyday Consumer

We haven't yet reached the point at which the everyday consumer casually buys a computer. The question would be more appropriate if worded "Now that I've decided to buy a personal computer, which one should I get?" I can't answer that for you without knowing, in too much detail thank you, what you want to do with it. However, let me take a moment

Apple and turned instead to the IBM Personal Computer.

I spent a considerable amount of time looking around at what was available in the market over the last year. I found myself frustrated because I couldn't find a single computer that gave me everything I wanted. Finally, I worked up a configuration of an Apple II that I thought would suit. My "ultimate Apple" priced out at over $12,000, or about $5,000 without the Corvus hard disk and the Malibu Dual Mode 200 printer. How did I come up with a $5,000 Apple? My big problem was my ground rule that the system support word processing, and I knew I could not settle for a display screen size of less than 24 lines of 80 characters. On the other hand, I love computer games and I did not want to sacrifice spiffy graphics. So my Apple found itself full of Videx equipment to stretch the screen display and give the keyboard lower case letters. My second problem was some specific software I wanted that ran in CP/M. Enter, of course, the Microsoft Z80 Softcard.

So why didn't I buy it? Well, if you can accept this, it just didn't *feel* right. I was losing the Apple II under a pile of "subordinate" equipment—Rube Goldberg had nothing on that system. I just couldn't bring myself to start buying toward that end.

Thankfully, I was put out of my misery by the IBM announcement. The reason the Personal Computer is my salvation is that everything I want is there, and it's integrated! I don't have to sacrifice color graphics for a good text display, or vice versa. I don't have to adapt the machine to speak lower case. I won't have to worry about whether software will talk properly to this device or the other. And the best of all, I don't have to buy a huge configuration to get these things—they *come* in every configuration.

Most of you probably know that love hurts. In the case of the IBM Personal Computer, it's worse than that, it's agony. There is virtually no software. No Raster Blaster or Invaders or Dancing Demon or Star Raiders. No checkbook program. No home finance system. No Air Traffic Controller. Yes, the list of software that's missing from this system is endless. That's the price you pay for being on the leading edge. You wait.

I don't think we'll have to wait too long. I think the Personal Computer will sell relatively well in the home market for two reasons. The first is the name and image of IBM. There's a great deal of computer shock out there, and the company whose name is virtually synonymous with the word "computer" is going to overcome some of that. A legendary reputation for reliability won't hurt either. The other reason is that the IBM system holds up pretty well in a head-to-head comparison with the Apple II/II+. The IBM is more expensive, but you do get something for that extra money.

IBM vs Apple II

I came up with a quick comparison for my own purposes that I'd like to pass on. I've included the complete IBM price list in Table 1 so you can do your own configuration studies.

What I considered was an Apple II+ with 48K RAM against an IBM with 32K RAM and the Color/Graphics Adapter. The price of the Apple II is $1,530; the IBM is $1,655. Surprised? The reason I allowed the IBM to have less main memory is because the Color/Graphics adapter has 16K of RAM onboard for the display memory, while the Apple must sacrifice some of its program space for display memory. If the IBM is increased to 48K, its price rises to $1,745. For that $215 you get a better keyboard; upper and lower case; 24 by 80 display capability; a steel, rather than plastic, housing for the system; tremendous memory expandability; and more. To be completely fair, a $55 Game Control Adapter is required to allow connection of joysticks, or game paddles to the IBM. I won't bore you with my (obvious) conclusion.

Thanks for reading. I'll see you next month. □

Harold Novick

m...software legal forum...s

The comments and opinions of the author are given for education purposes only and are not meant to be legal advice. Specific legal questions should be referred to your personal attorney.

Now that Midway Manufacturing Co. has literally shot down every infringer of its coin-operated game "Galaxian," just as a player shoots down the invading aliens, others in the field have joined the fracas to establish their own turf. For example, Atari, Inc. has announced their intentions to the trade, in general, and to numerous software dealers, software houses, and software producers, in particular, that they will take aim against all copiers of their copyrighted games. Their position has been further strengthened as a result of a recent court decision holding that duplication of a ROM storing a copyrighted computer program is a copyright infringement.

As a quick update, in the October, 1981 Software Legal Forum, there was a discussion of the attempts by Midway to protect its "Galaxian" game. Midway was confronted with no less than twenty copied variations of its game being imported into the United States. Midway filed an action in early 1980 before the International Trade Commission to stop these infringers. The action was based on common-law trademark infringement, passing off, imitation of trade dress, and false designation of origin. Five months later, on October 8, 1980, the action was amended to add copyright infringement. After hearing arguments, the Commission issued its order on June 25, 1981 to exclude the "certain coin-operated audio-visual games, kits and components thereof which infringe Midway's attract mode and the first few moments of the play mode before the player takes control of the game...." (In the Matter of Coin-Operated Audio-Visual Games and Components Thereof, United States International Trade Commission Investigation No. 337-TA-87).

The "Galaxian" game has an "attract mode" and a "play mode." The attract mode is a short sequence of images designed to attract potential players to the game and to encourage them to play it. About one-third of the attract mode is a randomly selected, non-repeatable simulated game that ends with the destruction of the rocket base's defense ship. The play mode begins when a player inserts a coin into the game. When a coin is inserted and before the player's controls are activated the screen is first blanked and then the top half is sequentially filled with an attacking array of aliens. As soon as the aliens are in position, the player can control the lateral movement of the defense ship and fire missiles at the array of stationary aliens or a group of aliens that peel off from the group and attack the defense ship.

The interesting legal issues in the Galaxian case arise because Midway did not register any copyright claim to the computer program. Instead, it videotaped the attract mode with a particular one of the simulated games and videotaped an entire game played by a player. Midway then obtained registrations of its claims to copyrights on these "audio-visual works." The infringers probably never saw the copyrighted tapes, and some accused infringers wrote their own computer program and did not copy the Galaxian ROM. Thus, if an infringer never had access to the copyrighted work (the video tapes), how could there be an infringement? What did Midway copyright anyway? Also, if the player constitutes an active participant in the play mode, the player may be a co-author of an original work resulting in the displayed audiovisual presentation. As a co-author, the player is not liable for infringement. The game manufacturer may also not be liable.

The International Trade Commission only discussed some of these points in its decision. A crucial point, however, is that none of the respondents participated in the proceeding. All Midway had to do to win, which it did, was to prove its *prima facie* case. The ITC held that Midway made the dual requisite for copyright infringement of ownership of the copyright in question and copying by the respondents. Thus the Commission held there was copyright infringement.

More specifically, the ITC found that Midway established ownership by showing that:

1. Originality was in the author (Namco Ltd. of Japan);
2. The subject matter was copyrightable;
3. The author had the necessary citizenship so as to permit a claim of copyright;
4. There was a compliance with the statutory formalities (application, fee, deposit of a copy);
5. Midway was a valid copyright claimant as a result of a transfer of rights from the author.

The only questionable contention under the ownership element of infringement appears to be copyrightability of the subject matter. By law (The Copyright Act of 1976 § 410(c)), the certificate of registration constitutes a rebuttable presumption that the copyright is valid. There being no rebutting evidence, the ITC had to find that the subject matter was copyrightable. There is no argument so far. Disagreement arises, however, when one asks what is that subject matter? The certificates of copyright registration (one for the attract mode and one for the play mode) recite that the claim of copyright extends to all audiovisual or cinematographic works. This is not a computer program! This is not a computer video game!

In any event, the Commission recognized the limitations in this proceeding because there was no defense. Thus they specifically said there were some significant issues that were left unresolved. These issues included:

1. Whether an audiovisual work is an "original work of authorship" or whether it is derived from another original work.
2. Whether the videotapes are a fixation of the original work of authorship or whether they are a "photograph" of a fixed copy of the original work.
3. For purposes of determining the proper form of deposit and registration, whether the work was first published in Japan or the United States.

The other half of the copyright infringe-

Harold L. Novick, Patent Attorney, Larson & Taylor, Arlington, VA 22202.

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Legal Forum, continued...

mum proof is a showing that the copyrighted work was copied by the respondents. In the absence of direct evidence of copying (e.g. the respondents admit it, or someone testifies that they witnessed the copying), an inference of copying can be created by proving the respondents had access to the copyrighted work and there is a substantial similarity between the two works. Again, because the respondents did not respond, the ITC held that Midway had won because it had established inference.

The ITC held that respondents had access because the game (not the videotapes) had been displayed at two trade shows and had been available in the marketplace for some time. Then, in a non sequitur, the ITC held that the respondents "had access to the complainant's work." That holding seems to say that the game is copyrightable, which according to numerous court cases it cannot be.

The element of "substantial similarity" was found because "the attract modes of each of the alleged infringing games except Moon Alien are almost identical to the attract mode of complainant's Galaxian game." The ITC applied the ordinary observer test used in fabric design copyright cases: "Would an ordinary observer, who is not attempting to discover disparities, be disposed to overlook them and regard their aesthetic appeal as the same?" The ITC also applied two, two-step applications of the test. They said that 1) the respondents copied the work and that copying constituted appropriation; and 2) there was a substantial similarity between the "general ideas" of the two works and that similarity of general ideas constituted infringement upon analysis of the response of an ordinary reasonable person.

With respect to the Moon Alien game, the ITC also held there was substantial copying, even though it has its own "original works of authorship which are apparently unique." However, the Moon Alien game had enough similar significant aspects so as to constitute the same aesthetic appeal when overlooking the disparities. These are as follows:

1. The rolling star background;
2. The shape and color of the aliens in the simulated game;
3. The formation of the aliens in the simulated game and its placement on the display screen;
4. The movement of the aliens both while in formation and while swooping down in attack; and
5. The scoring table, including the manner in which it is brought into display on the screen, the wording contained, and the flashing score values.

The second aspect of this Forum complements the Galaxian case. A judge in the Northern District of California held that the ROM's of plaintiff can be considered copies of copyrighted computer programs. Therefore, when defendants duplicated the program and only changed some minor items that specifically identified the owner of the program, they infringed the copyright. (*Tandy Corp. v. Personal Micro Computers, Inc.*, 546 PTCJ (9-17-81) A-4 (N.D. Calif. 1981)). The judge specifically disagreed with the Chicago judge in the Data Cash Systems case (the Compuchess case discussed in several earlier Software Legal Forums.) Specifically, the judge said as follows:

> There is no dispute that the court is to initially look to the Copyright Act which was passed by Congress in 1976 and went into effect on January 1, 1978. Looking first to sections 101 and 102 of that Act, 17 U.S.C. §101, §102, the court is convinced that under those provisions (1) a computer program is a "work of authorship" subject to copyright, and (2) that a silicon chip is "tangible medium of expression," within the meaning of the statute, such as to make a program fixed in that forum subject to the copyright laws.

Section 117, as it existed in the 1976 act (117 was amended in 1980), does not mandate a different result. Section 117 was not intended to provide a loophole by which someone could duplicate a computer program fixed on a silicon chip. It did not refer to the unauthorized duplication of a silicon chip upon which a properly copyrighted computer program is imprinted. [A]ny other interpretation would render the theoretical ability to copyright computer programs virtually meaningless.

With these two decisions and the active litigating interest of other software game owners, it seems that all copiers of video games better beware. One can no longer view the play of one copyrighted video game, write his or her own program to closely copy the game, sell the computer program, and expect to get off scot-free. Although it is believed that the legal reasoning may be muddy or even incorrect, it is clear that the legal consequences will favor the game originator.

P.S.: On October 16th, 1981, the Patent Trademark Office announced that it was accepting and granting patents on computer programs that were novel and unobvious according to the guidelines set down by the Court of Customs and Patent Appeals. These guidelines were discussed in earlier Software Legal Forums. Basically, the Patent and Trademark Office is applying the two-step test of *In re Freeman* as modified by the decision in *In re Walter*. The two-step test basically asks whether the computer program is merely solving a mathematical equation. Finally, the Patent and Trademark Office has given up its prior restrictive position. More about this in subsequent Forums. □

Bit Pit

Chas Andres

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CIRCLE 210 ON READER SERVICE CARD

rings...trs-80 strings...trs-8

Stephen B. Gray

As the curtain goes up on the 24th performance of the TRS-80 Follies (where did those three years go so fast?), we see that most of the show is about graphics. Starting with a program that creates a wandering pattern in both B&W and color, goes into a subroutine for storing graphics, shows how to create blank lines between program lines, reviews Sketch-80, and rings down the curtain with pretty patterns created by a four-way random-graphics shtick.

Graphics: Wandering Pixel

Although many of the graphics programs that create symmetrical patterns can be fascinatingly hypnotic, the patterns are usually predictable enough so that eventually you may lose interest in them.

Here's a simple program that lets a pixel (graphics-block picture element) wander completely at random, all over the screen, in Rorschach-like figures you may find even more hypnotic than regular patterns.

```
100 CLS: REM--WANDERING PIXEL--
120 X=RND(126)-1
130 Y=RND(190)-1
140 SET(X,Y)
150 A=RND(4)
160 ON A GOTO 160,170,180,190
170 X=X+1: GOTO 200
180 X=X-1: GOTO 200
190 Y=Y-1
200 IF X<0 THEN X=127: GOTO 130
210 IF X>127 THEN X=0: GOTO 130
220 IF Y<0 THEN Y=47: GOTO 130
230 IF Y>47 THEN Y=0: GOTO 130
240 GOTO 130
```

Lines 160-190 can be made more efficient. Can you see how?

To make this pattern four-way symmetrical, change or add the following lines:

```
110 X=RND(64)-1
120 Y=RND(24)-1

131 SET(X,47-Y)
132 SET(127-X,Y)
133 SET(127-X,47-Y)

200 IF X<0 THEN X=63: GOTO 130
210 IF X>63 THEN X=0: GOTO 130
220 IF Y<0 THEN Y=23: GOTO 130
230 IF Y>23 THEN Y=0: GOTO 130
```

These programs are only a start. See if you can change them so they will:

- Turn off any lighted pixel they meet up with;
- Clear the screen after filling it fairly full, and start over;
- Create a continuous path, without the wraparounds used here (lines 200-230);
- Create a "wandering graphics character" program, using either the solid sixpixel block (code 191) or randomly selecting from among the 63 characters;
- Start the pattern near the center of the graphics area, and/or confine it to a smaller area;
- Change the randomness of the pattern by adding to the ON/GOTO section.

This wandering-pixel program usually creates patterns that are predominately in the center portion of the graphics area. For patterns that are often created around the periphery of the graphics area, change lines 200-230 to

```
200 IF X<0 THEN X=X+128: GOTO 130
210 IF X>127 THEN X=X-128: GOTO 130
220 IF Y<0 THEN Y=Y+48: GOTO 130
230 IF Y>47 THEN Y=Y-48: GOTO 130
```

Can you figure out why the patterns created with these two sets of lines 200-230 are often so different?

CC Changes

Frederick Cunningham of Stamford, CT asks "When you publish a TRS-80 program could you include the necessary changes to run on the Color Computer? A few simple changes of the program in the July issue produced a program that my children have named City."

To run that July 1981 (p. 212) program:

- Change CLS to CLS 0
- Change the graphics-area limits from 128 and 48, to 64 and 32
- Add 165 C=RND(8)
- Change line 230 to SET(J,K,C).

The CLS 0 uses the screen black instead of green, and the added line makes each random rectangle a random color.

Wandering Color-Pixel

For those who are just starting in with the Color Computer, here's the basic Wandering Pixel program in color:

TRS-80 LEVEL II

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This program was originally developed for personal use by an investment specialist. Creative Computing Software now makes this package available for you to analyze your investments and investment decisions. Programs in this package include regression analysis, stock market simulations, market/stock values, risk analysis, time based investments, and tax analysis.

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CS-3401 Cassette (16K) $24.95 CS-3403 Disk (32K) $24.95

This package may be the ultimate in statistical applications for the 16K TRS-80. Attractively packaged in a vinyl binder with a large instruction booklet, Advanced Statistics will provide you with the ability to perform statistical tests never before available on small computers. Its cassette based data file system allows you to store, retrieve, and transform data files for use in several different tests.

1. Tape Manager

Tape Manager, the heart of the statistical file management, allows you to create, edit, and transform data files. Unique to this program are features that allow the user to perform transformations on variables, extract and create subfiles, and selectively copy records. Up to twenty variables and an unlimited number of cases can be processed.

2. Descriptive Statistics

Descriptive Statistics computes the mean, standard deviation, standard error of estimate, variance, skewness, kurtosis, range, median, and quartiles for a variable and constructs a histogram for each value. A T-score scoring option for conversion of raw scores into percentiles is included.

3. Two Variable Statistics

This program calculates descriptive statistics for each variable. It performs a t-test for the difference of means, computing the product-moment correlation coefficient and its associated significance level. In addition, it performs linear regression and computes standard error of estimate for Y.

4. Crosstabulation

This program constructs contingency tables for displaying frequencies, column percentages and cell-wide percentages for each cell. It computes the Chi-square, the level of significance and gamma statistic. Tables as large as 10x10 may be evaluated.

5. Regression-Trend Analysis

This program computes least-squares regression coefficients from one-dimensional data for best fit equations (linear, parabolic, hyperbolic, logarithmic, power, exponential, and cubic types). Calculates standard error of estimate for each equation and more.

6. Multiple Linear Regression

Performs multiple linear regression using up to ten independent variables. The program computes both unstandardized and normalized coefficients, variances, multiple correlation coefficient, and the standard error of estimate.

7. Correlation Analysis

Computes product-moment correlation matrices, multiple correlation coefficients, and partial correlation coefficients with their associated significance levels.

8. Analysis of Variance

This program performs one-way and two-way analysis of variance for a maximum of ten groups in each control variable. Statistics include the mean and standard deviation for each group, sum of the squares, degrees of freedom, mean square, F-ratios and significance levels.

Graphic Package

CS-3301 Cassette (4K) $11.95
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This package provides a variety of interesting and useful graphing routines. Graphing Package combines text and TRS-80 graphics to plot a variety of functions and other graphs.

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CIRCLE 346 ON READER SERVICE CARD

```
110 CLS 0: '---WANDERING COLOR---
115 X=RND(64)-1
120 Y=RND(32)-1
130 SET(X,Y,C)
135 C=RND(8)
140 A=RND(4)
150 ON A GOTO 160,170,180,190
160 X=X+1: GOTO 200
170 Y=Y+1: GOTO 200
180 X=X-1: GOTO 200
190 Y=Y-1
200 IF X<0 THEN X=63: GOTO 130
210 IF X>63 THEN X=0: GOTO 130
220 IF Y<0 THEN Y=31: GOTO 130
230 IF Y>31 THEN Y=0: GOTO 130
240 GOTO 130
```

Note that the differences are the same as for the City program: the CLS statement needs a zero; the graphics area is smaller; you add another RND function, for random color; and you insert the color factor in the SET line.

Although this has the nice effect of changing the color of blocks previously set, you may be interested in looking at the black-and-white version. For an approximation, delete line 135; make line 130 read

130 SET(X,Y,0)

and set the color controls so the display is in black and white. You may find this more interesting at the higher resolutions, if you have 16K of memory and Extended Basic, and can rewrite the program accordingly.

As for what can be added to this basic program, there's sound, elimination of the wraparound, changing the basic random-pattern movements, etc.

Storing Graphics

One of the problems with programs that create patterns using randomly-located pixels is that, if the program creates a particularly interesting pattern at a particular moment, you can't make the program repeat that pattern.

But there's a way of storing the coordinates of the pixels for "playing back" a particular pattern later. W.A. Fronek, of Houston, TX sent this:

"*Purpose:* At times it is useful to duplicate, at a later date, graphics that have been randomly generated or algorithmically generated. This subroutine will store the X,Y coordinates of any lit graphic block and later, when needed, will duplicate or 'reproduce' these graphics. Duplication is very fast compared to the speed of the original method of generation.

"For example, '3D Plot' (Sept. 1980, p. 166) takes 5 minutes, 15 seconds to generate the entire pattern. This subroutine can 'copy' (re-draw) this pattern in 35 seconds.

"The subroutine can be easily modified for reading/writing the array data to/from disk or cassette.

```
5999 REM SCAN SCREEN - TEST FOR
     GRAPHICS BLOCKS -
     X,Y COORDINATES
     IN ARRAYS X(A) AND Y(B)
6000 DIM X(1000): DIM Y(1000)
6005 A=1: B=0
6010 FOR X=0 TO 127
6020 FOR Y=0 TO 47
6030 IF POINT(X,Y) THEN GOSUB 6060
6040 NEXT Y: NEXT X
6050 GOTO 7000
6060 A=A+1: B=B+1
6070 X(A)=X: Y(B)=Y
6080 M=M+1
6090 RETURN

6999 REM SET GRAPHICS BLOCKS FROM
     COORDINATES TAKEN FROM
     ARRAYS X(C) AND Y(D)

7000 CLS
7010 C=C+1: D=D+1
7020 SET(X(C),Y(D))
7030 IF C=M THEN 7040 ELSE 7010
7040 GOTO 7040
```

"*Function:* Invisibly scans the screen and tests for graphics blocks (6000-6090). Keeps count (6080) of the number of graphics blocks that have been seen by the POINT statement (6030).

"As written, the subroutine will then clear the screen and set graphics blocks using the coordinates stored in the arrays (7000-7040). Line 7030 terminates the loop when the array size equals the number (M) of graphics blocks that were seen by the POINT statement. This will also prevent a Subscript Out Of Range error.

"Arrays must be DIMensioned to cover at least the number of graphics blocks to be scanned."

Storing the Wanderer

As an example of storing graphics, combine Fronek's subroutine with the wandering-pixel program, and add

```
135 K$=INKEY$: IF K$=""
      THEN 140 ELSE 5999
```

If and when the graphics program creates a pattern you want to store, simply press any key, which will call up the storage subroutine. The screen-scan takes just over a minute to scan all 6144 points, so if nothing happens for a while, don't assume the program isn't working.

"There's nothing on worth watching tonight. What's on your computer?"

Fronek's original subroutine didn't contain line 6005. To find out why it's needed, run the program several times without it, and then try to figure out what happened.

Graphics and Cassette I/O

If you know how to use cassette input/output statements INPUT# and PRINT#, or the corresponding disk statements, and how to keep track of the number of pixels involved, you can try writing the modifications suggested by Fronek.

If you've never used these I/O statements, you may prefer to follow along, with TRS-80 in hand, as we look into them.

Delete line 7040, and change the preceding line to

```
7030 IF C=M THEN 8000 ELSE 7010
```

and add these lines to Fronek's subroutine:

```
8000 C=1: D=1
8010 PRINT C;X(C);Y(D);
8020 IF C=M THEN 9999
8030 C=C+1: D=D+1: GOTO 8010
```

Line 8000 resets the C and D counters. Line 8010 prints the number and coordinates of each pixel in the displayed figure; this can be eliminated later (along with lines 8020-8030), but is useful at this point to show the contents of the arrays.

Lines 8020 and 8030 keep count of the number of pixels, by comparing array size with M, which was created in 7030. M is important later, when the computer reads the stored pixel coordinates from tape or disk, to signal when the full count has been reached.

But if you try to use M in the read routine, it won't work if you're counting on M to carry over from the write routine. It should work: after all, there's 7030 with C=M. Yet when you later try to use M, something is wrong. If you wonder what happened to the value of M, you might insert a line in your read routine to display it, and you may be surprised to see that it's zero.

How come? M had a non-zero value in 7030, so what happened between then and the RUN of your read routine? The answer is in the RUN. Look it up in your manual, and you'll find something like "Whenever RUN is executed, computer also executes a CLEAR," which resets all numeric variables to zero.

Carry Over The Count

So how do you carry M over the gap between write and read? Probably the easiest way (can you think of any other?) is simply to record it on the tape or disk ahead of the pixel coordinates.

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CIRCLE 230 ON READER SERVICE CARD

```
9000 PRINT#-1,M
9010 C=11 D=0
9020 PRINT#-1,X(C),Y(D)
9030 IF C=M THEN 9040
9035 C=C+1: D=D+1: GOTO 9020
9040 STOP
```

Line 9000 notes the M value, and 9020-9030 store the pixel coordinates.

PRINT # takes a long time to store data on cassette: several feet of tape for a few dozen pixels. When they're all recorded, you rewind the cassette to the beginning of the data, and RUN 9050 to read the stored data:

```
9050 C=11 D=0
9052 DEM X(1188),Y(1188): DIM Y(1188)
9055 INPUT#-1,M
9057 PRINT "M =";M
9060 INPUT#-1,X(C),Y(D)
9070 PRINT C;X(C);Y(D);
9075 IF C=M THEN 9080
9080 C=C+1: D=D+1: GOTO 9060
```

Line 9055 picks off the value of M, and line 9057 prints it. Line 9060 reads the pixel coordinates, which are printed by 9070. Lines 9057 and 9070 can be eliminated, but are useful here for seeing how the routine works.

If you're wondering why 9052 is necessary, leave it out and see what happens.

Lines 9075 and 9080 use the M value to keep track of the number of pixels involved. When the count reaches M, control moves to 9090:

```
9090 C=11 D=0
9100 SET(X(C),Y(D))
9110 IF C=M THEN 9120
9120 C=C+1: D=D+1: GOTO 9100
9130 END
```

which resets the counters once more, and the subsequent lines reconstruct the original graphics display from the stored pixel coordinates, again using M to keep track of them.

If you'd like to see the pixels displayed one at a time as they're read from tape or disk, use RUN 10000 instead of RUN 9050 when the tape has been rewound:

```
10000 CLS
10010 C=11 D=11
10015 INPUT#-1,M
10020 INPUT#-1,X(C),Y(C)
10025 PRINT @ 0, C;X(C);Y(C)
10030 SET(X(C),Y(C))
10040 IF C=M THEN 10060
10050 C=C+1: D=D+1: GOTO 10025
10060 END
```

Each pixel is displayed to the accompanying faint click of the cassette relay in the computer, because INPUT# turns the tape machine on and off for each pixel coordinate. See the manual for details.

If you have more than a small number of pixels, you'll get a BS error with this routine. Can you figure out what's missing?

Line 10025, which can be eliminated, displays the number and coordinates of each pixel just before it's popped onto the screen. If you want to keep track of how many pixels are in the original, add

```
10017 PRINT @ 2, "M= ";M
```

and change the zero in 10025 to 64, to print on the following CRT line.

Now that you know how the program works, you can delete all the lines that display pixel numbers and coordinates, and rewrite the rest into a tighter and more elegant program.

Blank Program Lines

You probably noticed the blank lines in Franek's subroutine. They're one of the easiest ways to separate program sections. If you haven't been able to figure out how to create these blank lines, you'll kick yourself when you find out how simple it is. I did.

After you write a program line, don't press ENTER. Space with the right-arrow key until the cursor moves down to the next line. Then press either the right-arrow key or the space bar to move the cursor past the first column, and press ENTER.

If you want to add blank lines to a program you've already written, get into EDIT mode, and press X to move the cursor to the end of the line. Then press the space bar (the right-arrow key is inoperative in EDIT mode) until the cursor moves down to the next line, and press ENTER.

That's all there is to it. Just remember to move the cursor past the first column of the second line (reserved for the greater-than sign, unless you're in EDIT mode), and into the line-number columns, or you won't get a blank line.

"That's right Mildred, Mrs. Jones started dropping out with Mr. Smith on June third."

Try to print this out, and you may be in for a surprise, because your printer may ignore the blank lines and act just as though they weren't there.

No problem: when writing or editing the program, just put *two* blank lines between program lines you want to separate. Both will show up on the screen, but only one will appear on the printer.

When all else fails, you can space between printed lines by manually spacing between LLISTs of groups of lines. It ain't elegant, but it's fast and easy.

Sketch-80

The Sketch-80 program generates screen graphics for the 16K Level-II TRS-80, and can be used with or without a light pen. It's $14.95 on cassette from Quality Software (6660 Reseda Blvd., Suite 105, Reseda, CA 91335).

According to the fairly extensive 12-page manual, Sketch-80 will work with several different light pens, including the QS pen manufactured by Micro Matrix (March 1980, p. 155), which uses the amplifier in your tape recorder and is thus cheaper than most other light pens, which have built-in amplifiers.

Enter the machine-language program, and you get a display of five words across the top of the screen, each with a square to the left of it: WRITE, ERASE, CLEAR, STORE, RECALL.

Point the pen at the square beside WRITE, wait until the square turns into an X, then point the pen elsewhere on the screen. The computer then finds where you're pointing, and turns on a large (3 x 3) rectangle of graphics blocks at that place on the screen.

Move the pen slowly across the screen, and a line of rectangles is lit. To erase the line, or any part of it, you do the same thing, but first get into ERASE mode. To wipe out the display, activate CLEAR.

To store the image you've created, aim at the STORE block, then keyboard a number from 0 to 4. To bring back the image later, use the RECALL block, then hit the same number.

To store the image in reduced size, one-third as large as the original you've created, store it by typing a letter from A to C. (A greater number of images can be stored on 32K or 48K systems.) You can store a reduced image in any one of nine buffers; when the image is recalled it will be displayed in one of nine corresponding sections of the screen: three across the width of the screen, and three down, each 40 x 15 pixels (graphics blocks) in size.

All graphics are constructed in the Enlarged Screen Mode, which "helps the artist see the detail of his work and enables the light pen to work more effectively," the manual says. According to Bob Christiansen of Quality Software, "The TRS-80 video monitor has serious limitations

when it comes to the use of a light pen, in the way of flicker, reflection, screen curvature, and distortion. The latter two problems make it difficult for the user to place the pen exactly on a small dot. For this reason we decided on the enlarged screen method of drawing with a light pen. Even this takes some getting used to, but one can develop a skill for it with a little practice."

When you're working with the reduced image, the first two top-of-the-screen words are DUMP and TEXT, rather than WRITE and ERASE. DUMP displays the address and graphics-character codes for your image, which you can use with POKE or CHR$ routines to create the image in Basic.

Using TEXT, you can mix normal-sized text with your graphic image. Images can also be saved on disk or tape.

Sketch-80 is much faster without a light pen, using the keyboard: W for write, E for erase, C for clear, the four arrows for moving the cursor or the entire reduced image, etc. This mode would be even faster if the keys had an auto-repeat feature.

Using letter keys, images can be manipulated so that, using RECALL and letter A, for instance, you can display a single image, or nine of the same image, or nine different images, all at the same time on the screen. This would be one way of creating animation graphics for entering into a Basic program, since you can set up to nine frames at a time (although each frame is no more than 40 x 15 pixels in size).

Many interesting and complex effects can be created by using a combination of the simple commands of Sketch-80.

Short Program #25: 4-Way Random Draw

In looking for a short program to end this column, I found one that I soon realized had been my subconscious inspiration for the wandering-pixel program. Can you figure out why it creates different patterns than the wandering-pixel program?

Gerald Jervis wrote from Chickasha, OK, "Enclosed is a listing which I have written, called Random Draw. It will make random lines which you could call op art. It uses four lines working together and it is always mirror-imaged.

"Oh! A final note: a touch of the spacebar will halt the drawing, wait a few seconds, then CLS and start again."

The CLS is automatic, after a wait caused by the loop in line 170. Delete that line and the restart is immediate. □

```
0   ****************************
1 ' ***   RANDOM DRAWING     ***
2 ' ***          BY          ***
3 ' ***  GERALD W. JERVIS    ***
4 ' ***  CHEIDWAHA, OKLA.    ***
5   ****************************
6
7   ** HIT SPACE BAR  **
8   ** TO START AGAIN **
10 CLS: RANDOM
20 M=64: N=29: SET(M,N)
22 S=64: T=29: SET(S,T)
25 P=64: Q=29: SET(P,Q)
27 R=64: U=29: SET(R,U)
30 RANDOM: A=RND(4)
40 FOR G=1 TO RND(5)
50 ON A GOTO 60,80,100,120
60 X=X+1: IF X>127 THEN X=127
65 S=S+1: IF S>127 THEN S=127
70 M=M-1: IF M<1 THEN M=0
75 P=P-1: IF P<1 THEN P=0
77 GOTO 140
80 X=X-1: IF X<1 THEN X=0
85 S=S-1: IF S<1 THEN S=0
90 M=M+1: IF M>127 THEN M=127
95 P=P+1: IF P>127 THEN P=127
97 GOTO 140
100 Y=Y+1: IF Y>47 THEN Y=47
105 S=S-1: IF S<1 THEN S=1
110 M=M-1: IF M<1 THEN M=1
115 Q=Q+1: IF Q>47 THEN Q=47
117 GOTO 140
120 Y=Y-1: IF Y<1 THEN Y=1
125 S=S+1: IF S>47 THEN S=47
130 M=M+1: IF M>47 THEN M=47
135 Q=Q-1: IF Q<1 THEN Q=1
140 SET(X,Y): SET(M,N)
145 SET(P,Q): SET(R,U)
150 A$=INKEY$
155 IF A$=" " THEN 170 ELSE NEXT G
160 GOTO 30
170 FOR G=1 TO 1000: NEXT G
180 GOTO 10
```

...intelligent computer games...

David Levy

Correspondence is welcome. Letters with interesting questions and ideas will be used in the column along with a response. No personal replies can be made. Send to: David Levy, 104 Hamilton Terrace, London NW8 9UP, England.

SHOGI

This month I wish to introduce readers to a game which they will almost certainly never have come across. It is related to chess, but has an added dimension of complexity which can result in exciting sequences being sustained for very many more moves than in chess. This game is so popular in its country of origin (there are some 19 million players) that those who excel at the game often become millionaires, and are held in greater esteem than Bjorn Borg in Sweden or Kevin Keegan in England. I am referring to shogi, or Japanese chess, and I can recommend the game very highly to anyone who enjoys 'western' chess. My shogi-playing friends have been trying to persuade me for some time that 'western' chess is an inferior form of the game and, although I have yet to be firmly convinced by their arguments, I must confess that shogi does have enormous appeal. Since it is well known that computer programmers usually show great aptitude for chess, it is likely that among the readers of this magazine there are many potential shogi masters (or dans as they are known in Japan), and many thousands who would enjoy the game if they took an hour or so to learn how to play it.

Japan is the Mecca of shogi, but during the past few years an organisation has grown up in the western world whose aim is to popularise the game outside its native country. The Shogi Association, PO Box 77, Bromley, Kent, England welcomes new members and will supply shogi sets and elementary literature to those who cannot find them elsewhere. It also publishes a regular magazine and holds meetings in London. Through the efforts of the Shogi Association there have been shogi tournaments held in London, for which leading Japanese players have flown half way round the globe, and in last year's tournament I was able to see my colleague Larry Kaufman, an International Chess Master from the USA, who seems to have abandoned the 'inferior' form of the game for its Japanese counterpart. I understand that he has now become completely addicted, to the extent of travelling to Japan in the hope of becoming a professional shogi player.

How to Play Shogi

The best way to learn the game of shogi is to buy a copy of *How to Play Shogi* by John Fairbairn, and to study this slim volume with a shogi set in front of you. Although shogi sets normally have the pieces inscribed in Japanese characters, the Shogi Association imports sets in which the pieces also have westernised lettering as well as arrows to show you how each of them moves. It should take no longer to learn the moves of shogi than to learn how to play western chess, and I am reliably informed that one can even get used to the Japanese symbols rather more quickly than one might suspect. Since the main point of this article is to enable the reader to write his own shogi-playing program, I must begin with a precis of the rules and moves of the game.

Each player starts the game with 20 pieces made of wood or plastic. These pieces are uniform in colour, but for the sake of convenience we call them Black and White, as in chess. The game is played on a 9 x 9 board (does anyone know of a 9-bit processor?) with the two armies set up in the following starting position:

Figure 1. The starting position in shogi

The Pieces and Their Moves

KING: Each player has one king and, as in chess, the object of the game is to checkmate the opposing king. As in chess the king can move one square in any direction (horizontal, vertical or diagonal).

GOLD GENERAL: At the start of a game each player has two golds. The gold moves one square at a time, vertically, horizontally, or diagonally forwards. It may not move diagonally backwards.

SILVER GENERAL: Each player has two silvers. The silver moves one square at a time, diagonally or forwards. It may not move sideways and it may not move straight backwards.

KNIGHT: Each player has two knights, whose move has the same form as the knight in chess but with the restriction that it may only move two squares forwards and then one square to the left or right. So whenever a chess knight has

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eight moves at its disposal from a central square on an empty board, a shogi knight will have only two possible moves, but as in chess it may jump.

LANCE: Each of the two lances moves straight forwards as far as it likes, but it may not jump.

ROOK: The shogi rook moves exactly like its counterpart in western chess, in a straight line as many squares as it wishes. There is no queen in shogi, so the rook is usually regarded as the most powerful piece.

BISHOP: Again this piece moves just like a chess bishop — any number of squares in a diagonal direction.

PAWN: As in chess, the initial shogi position has a row of pawns across the board. Since shogi is played on a 9 x 9 board, each player begins the game with nine pawns, which can move one square forwards. There is no double pawn move when a pawn makes its first move; there is no diagonal capturing move; and there is no such thing as an en passant capture.

Promoted Pieces

One of the most interesting aspects of shogi, as compared to chess, is the fact that whereas in chess only the pawns can promote to a piece of higher value, in shogi some of the other pieces can also promote. A promotion move is made by moving a piece partly or wholly within your promotion zone (the last three ranks or rows furthest from you). Promotion takes place at the conclusion of the promoting move, and it is important to remember that in shogi it is not always compulsory to promote, as we shall see. The following pieces have the ability to promote:

SILVER: The promoted silver moves exactly like a gold. On your shogi set the silver can be turned over and on the reverse side you will see the symbol for a promoted silver.

KNIGHT: The promoted knight also moves exactly like a gold.

LANCE: The promoted lance moves exactly like a gold.

PAWN: The promoted pawn moves exactly like a gold.

ROOK: When the rook is promoted it retains its original ability to move any number of squares horizontally or vertically, and acquires the extra ability to move one square in a diagonal direction.

BISHOP: Similarly, when the bishop is promoted, its original move is retained and it has the new ability to move one square vertically or horizontally.

If a pawn or lance moves to the last rank, or if a knight moves to either of the last two ranks, promotion is compulsory. At all other times promotion is optional.

Capturing

If a player moves one of his pieces onto a square that is occupied by one of his opponent's men, the opponent's piece is captured as in chess. But here lies one essential difference between the two games, and it is this difference that adds an extra dimension to the game of shogi.

In chess, when you capture one of your opponent's pieces it is removed from the board forever. In shogi you keep this piece "in hand", and later in the game you may drop it onto any vacant square (subject to a few restrictions). The drop is made instead of moving a piece from one square to another, and it is important to remember that a piece may only be dropped in its unpromoted state, even if it had been promoted before it was captured. When you drop a captured piece onto the board it becomes your own piece, and for this reason the capture of an enemy piece has a double significance. One interesting aspect of the drop is the fact that you might well decide to sacrifice a valuable piece on one part of the board in return for an inferior one, simply because you want to be able to drop that inferior piece on another part of the board within the next few moves.

Check and Checkmate

When a king is attacked it is said to be in check, just as in chess, and the player who is in check must take evasive action immediately — moving his own king, capturing the checking piece, or interposing a piece between the two. If the king is attacked and there is no way to save it, the player has been checkmated. Since all of the pieces are, in practical terms, in play throughout the game, it is extremely rare for a game of shogi to end in a draw. In chess the number of the pieces on the board is gradually reduced as the game progresses, and when sufficient reduction has taken place the game will inevitably end in a draw. Those who find master chess games boring because too many of them (some 55 percent or more) are drawn, need have no such fear regarding shogi.

How to Program Shogi

There is no reason why most of the principles that apply to chess programming cannot also be applied to shogi programming. Growing and searching a game tree is the obvious approach, the most serious problem being the large branching factor caused by the increased number of pieces (40 instead of a maximum of 32) and the possibility of the drop. If you hold just one type of captured piece "in hand" you will have 42 or more squares on which it may be dropped. It is easy to see how the number of legal moves at one's disposal can easily increase to 150 or 200, once two or three enemy pieces have been captured. Clearly it is necessary to find some way of reducing the list of legal moves to produce a list of plausible moves which is of manageable size. The answer to this problem lies in the use of intelligent shogi heuristics, or "proverbs" as they are known in the trade.

Anyone who is interested in writing a chess program need only refer to the enormous wealth of chess literature in order to find a number of heuristics which can be employed in a plausible move generator or an evaluation mechanism. A lot has also been written about shogi, but unfortunately for most readers of this article it is almost entirely published in Japanese, and if your Japanese is anywhere near as bad as mine is you will not relish the thought of ploughing through tomes of mysterious symbols. Here I have space for only a very small number of heuristics, and I must recommend the reader to take a look at the extensive list which can be found at the back of Fairbairn's booklet. In addition, those of you who would like to make your shogi programs as strong as possible ought to join the Shogi Association and try to obtain all the back numbers of Shogi magazine *(issue 1 is sold out — Ed.)*, in which the most important proverbs are explained. Once you understand a proverb, it is an easy matter to convert it to numerical form so that it can form part of the evaluation/plausibility mechanism.

Shogi Openings

The exact order in which the opening moves are played does not appear to be so critical in shogi as it is in chess. The most important aspect of opening play in shogi seems to be the squares on which one places one's pieces, and not the exact order in which they are moved there. The only source of shogi openings that I can find in any language other than Japanese is, once again, that published by the Shogi Association.

Since it is not necessary for your shogi program to have access to large tables of opening variations, you need only devise some method of encouraging the program to make moves that will lead to its pieces being on the right squares. A simple method of accomplishing this is to examine each of the pieces in a desired formation and

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determine how many moves away from its target square it is at the moment. The "opening" feature in the evaluation function can then be penalized by (say) 1 point for each piece that is one move away from its target square, 2 points for each piece that is two moves away, and so on. This method, or any similar pattern-matching process, will provide a useful measure as to the degree to which a desired opening formation has been achieved.

The Middle Game – a Few Heuristics

As in chess, the middle game in shogi sees most of the maneuvering and struggling for a strategic advantage. This is the part of the game for which an evaluation function will be of the greatest use. The players must fight for control of important squares, and in particular for control of the area near their opponent's king. In shogi the initiative is just as important as it is in chess, and by building up a strong attack in the area near the enemy king, a player may develop an initiative which can later be converted into a win. Many of the heuristics that you will find in Shogi magazine will relate to the initiative and to the concepts of king attack and king safety.

Perhaps the most difficult problem that you will encounter when writing a shogi program is that nobody has written one before you, so there is absolutely no published literature on the subject. In order to convert a shogi heuristic into a feature for your evaluation function you will therefore be compelled to make various guesses and estimates, and then improve the weightings of your function in the light of experience.

Possibly the most surprising aspect of shogi heuristics is the fact that there is no recognized scale of values for the pieces themselves. Almost every schoolboy knows that in chess a bishop or knight is worth roughly three pawns, a rook five pawns, and a queen nine pawns, but to the best of my knowledge there is nothing reliable in the shogi literature to compare. (Readers should be warned that in one book, published in English, the rook is said to be more valuable than the king – ignore this book and, probably, anything else not published by the Shogi Association.)

Those of you who have read my articles on chess will know that the second most important feature, after material, is mobility. In fact the chess pieces have material values which are not entirely disproportionate to their average mobilities, so it would be possible to write a chess program that was governed by present and potential mobility, rather than by material and present mobility. In shogi, since material values cannot be defined in the same way as they can in chess, mobility is possibly the most important feature. We define mobility in shogi in the same way as we do in chess — the number of squares attacked by a piece.

The attack on the enemy king is of greater importance in shogi than it is in chess. For this reason, two features which are employed in many chess programs are absolutely vital in a shogi program: King Attack and King Safety. A primitive measure for King Attack is found by adding 2 points for every attack on a square which is not more than three squares distant from the enemy king, and 1 point for every possible move to a square from which such an attack can be made. The sum of these attacks and potential attacks provides a measure of the extent to which a player's pieces can operate within the vicinity of the enemy king, and the extent to which they control possible flight squares that might be used by the enemy king to escape from a strong attack.

King Safety can best be measured by taking into account the number, nature and proximity of friendly pieces that are situated near the king. If your king is surrounded by many of its own pieces

it will be much safer from attack than if it is in an exposed part of the board, with few of its own pieces nearby. As in chess, it often pays in shogi to keep the pawns in front of your own king as defensive pieces, obstructing the attack of the advancing enemy. In addition, it is useful to have two or three generals (golds and silvers) near your king for added protection. The different shogi openings usually define a particular defensive formation for the king, so by reading about the openings you will learn the various defensive formations and you can design a feature for your evaluation function based on giving bonus points for having your own king well protected by the correct piece.

Gaining material in a game of shogi is useful for two reasons, and some method must be found to reflect this fact in your evaluation function. When you capture an enemy piece you deprive his king of a certain measure of protection – if the captured piece was near to the king this protection will be much greater than if the piece was many squares away from the king. You also have an extra piece 'in hand' which may be used later in the game to achieve some strategic aim or to expose the enemy king still further during the blistering attack which you launch prior to checkmate. One way in which your program can measure the value of a captured piece lies in the loss of mobility experienced by your opponent when you capture one of his pieces. Another way is simply to add a certain number of points for every piece that you hold in hand.

So far, we have discussed only a very small proportion of the total number of shogi principles, but these are among the most important. A computer program which takes into consideration mobility, king attack, king safety and the number of pieces held 'in hand' would be able to play a game better than the novice who has just learned the rules of the game. One very important aspect of shogi is the mating attack, and this is one area in which your program will be able to play better than many humans, because it requires pure calculation.

The Mating Attack

In shogi there is no endgame in the same sense as there is in chess. Because captured pieces can reappear on the board, it is rare for a shogi game to end when the board is almost completely devoid of material. To win at shogi you must launch a successful mating attack. We have already discussed two of the evaluation features which can help a program set up and develop an attack against the enemy king. The tactical phase that ends the game will often contain a long, forcing sequence of moves that is difficult for many human players to spot. A computer program should have no such problems, provided that it is looking along the correct path of the tree.

The answer lies in knowing when to search for a mating continuation, and in ignoring all other factors when looking for a mate. It is normally sufficient to have four of your own pieces attacking the enemy king area, so your mating routine can be triggered by a test which counts the number of your own pieces which impinge on any of the squares which are within (say) three squares of the enemy king. If this test provides a positive result, the program can then look along all variations in which its own moves are checking moves. During this phase of the game all other moves may be ignored, on the assumption that if he is given a single move's respite, your opponent will be able to bring another piece to the defence of his king, or will move his king to a safer square. The routine which searches for mate should therefore be single-minded, and by ignoring all moves other than checks it ought to be able to search 7 or 9-ply deep, or even further. If no mate is found within some predetermined horizon, the program simply reverts to the middle-game search algorithm and looks for a move which improves its strategic control of the position.

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How to Deal with Drops

As I mentioned earlier, one of the most serious problems in writing a strong shogi program is the very large branching factor caused by being able to drop a captured piece onto almost any vacant square on the board. (In fact you may drop onto any vacant square provided that (a) you are not dropping a pawn, lance or knight onto a square from which it will never be able to move; (b) you will not have two unpromoted pawns on the same file at the same time; and (c) you do not drop a pawn in such a way as to give checkmate on the move.) How can we reduce the branching factor without ignoring most of the better drops?

The answer lies in identifying a number of key vacant squares (say ten) and examining drops only onto those key squares. This can be accomplished by using the evaluation function to measure the improvement in score that could be achieved by dropping a hypothetical piece (a 'genie') onto each vacant square. The genie has the power

of all the other pieces combined, and by estimating its effect on the mobility, king safety, king attack and other features of the evaluation function, when placed on each of the vacant squares, it is possible to produce a ranking order for the vacant squares which indicates which squares are the best candidates for drops. By reducing the number of such squares from (at least) 42 to ten, we can reduce the total number of moves which the program needs to consider. This is especially important when more than one type of piece is in hand, or when the same piece is in hand.

It's a Shogi-playing Program Is Too Difficult

It is, perhaps, daunting enough to the reader for me to suggest that you learn a new game as complex as shogi without my adding to this suggestion with the thought that you should also write a shogi-playing program. You may feel that the game itself requires enough of your time, and that a shogi-playing program might be beyond you, especially in view of the paucity of literature on shogi heuristics. In that case, there is still one programming exercise which you will definitely find worth your while, as it will test your understanding of many of the tree-searching ideas that we have discussed in this series of articles, and it will stretch your ability to write code that executes efficiently.

Just as there are many people who are interested in chess problems ('White to Play and Mate in two Moves'), so there is even greater interest in shogi problems. An extremely interesting programming exercise can be found in writing a program which will search for checkmates. In the composition of a chess problem it is part of the composer's task that he must not allow a checking move to be the key to the solution. In shogi, the opposite is true: all moves in a shogi problem must be checks or replies to check.

A program which solves shogi problems must therefore employ an efficient test to determine whether or not a move is legal (ie, whether a reply to check achieves the aim of moving out of check), and whether or not a move gives check. These two tests are sufficient, since a move which fails both tests is inadmissable in the tree search. Your problem-solving program has only a very small number of branches at each node, and so a deep search is possible without the program consuming enormous amounts of time. There is not too much scope within a problem-solving program for speeding up the search without the use of heuristics, but one or two notions do suggest themselves. Prefer a checking move that is near to the enemy king to one which is further away (reason – a far away move allows more interposing possibilities). Prefer a 'safe' checking move to a move which allows the free capture of material (reason – with more pieces of your own side on the board, you have greater chances of forcing mate). Prefer to evade check by moving the king than by interposing a piece (reason – an interposing move may allow a free capture). Prefer to evade check by capturing the checking piece than by moving the king (reason – the less material your opponent has on the board, the harder it will be for him to force checkmate).

Of course, these rules of thumb all have very many exceptions, but other things being equal (which they never are) all of them have some value in ordering the search. □

Bibliography

Fairbairn, J: *How to Play Shogi*.

Shogi Association: *Shogi* (magazine).

The reader is strongly warned against all other shogi literature published in any language other than Japanese. Up to the time of writing this article (May 1981) no other accurate literature is known, and errors in the rules and the moves of the pieces abound.

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A Beginner's Guide to Character Sets

David and Sandy Small

When the Atari computer was first designed, Atari planned on selling a good deal of software for it. They knew that the more varied and interesting displays they could program for it, the more software they could sell. So they designed in as much software-controlled hardware flexibility as possible. In this way they hoped to achieve widely varied effects, but never to have to change the basic hardware.

Over the past few months we've been looking at the capabilities of the Atari. We've covered playfield (i.e., display list generated) graphics and become familiar with player-missile graphics. In this column I'll cover another of the many playfield features: the ability to reprogram a character set.

"What's a character set?" you ask. A character set is the table of shapes the computer uses to define what a character looks like. This character set, or shape-table, is what makes an "A" character look different from a "B" character onscreen. With the Atari, these shapes may be altered at will.

With many computers, you're stuck with the characters the designers provide. The shapes are stored in a ROM, which is an unmodified memory, and can't be changed except by making a new chip. This places a limitation on those machines, for reprogramming character shapes is a powerful tool for certain applications. Here's an example.

Let's say you are writing a program that will be a lesson dealing with the Russian language. Naturally, you would like to be able to write words in that language. But since the Russian language has a different alphabet from English, with most machines, you would be stuck at this point. Unless you use high resolution graphics to draw characters—a slow and clumsy process—you can't get them onscreen.

On the Atari, however, it's easy to design your own characters. You can use those new letters for the lesson, and save yourself time and effort.

If you should happen to need some small, high resolution figures on a character screen, but don't want to hassle with mixing graphics modes, a character set might be just the thing. You can control dots the size of an individual graphics 8 pixel with custom characters and you can mix the special symbols you create right in with your text. For mathematicians in need of special characters (summation, integral) this could be a real help.

As soon as you begin to consider characters as graphics 8 figures drawn at high speed onscreen, more and more interesting possibilities will occur to you. So first let's review a bit about character shapes and generation, then learn how to modify them.

Character Shapes

The Atari plots letters and graphics on the screen using the same individual TV dots. It uses 320 horizontal dots and 192 scan lines for this purpose. Characters are 8 x 8 groups of dots, some lit, some not. Since there are 320 horizontal dots, that's 320/8 or 40 characters across and 192/8 or 24 rows. There is no space on the screen between characters; that space is provided within the character shapes. (Brief detour: This thoughtful add-on makes possible continuous script letters, which "flow" from one to the next with no interruption. It also allows screen graphics using characters that have no breaks in them.)

A character shape is stored as an 8 x 8 group of bits. A lit dot is represented by a 1 bit, an unlit dot by a 0 bit. (See Diagram 1.) Since each horizontal "slice" of the character is 8 bits, the Atari designers put each slice into one byte, making for eight bytes total per character. There are 128 different characters possible, and they are stored all grouped together, so the compatible "character set" is 128 x 8 or 1024 bytes long. (See Diagram 2.)

```
Byte # 1   0 0 0 0 0 0 0 0
Byte # 2   0 1 1 1 1 0 0 0
Byte # 3   0 1 1 0 1 1 0 0
Byte # 4   0 1 1 0 0 1 0 0
Byte # 5   0 1 1 0 0 1 0 0
Byte # 6   0 1 1 0 1 1 0 0
Byte # 7   0 1 1 1 1 0 0 0
Byte # 8   0 0 0 0 0 0 0 0
```

8 bytes in memory per character.

Diagram 1.

ALF Music Synthesizer

The ALF Apple Music Synthesizer (AMS) is an easy to use peripheral which allows you to program music into an Apple II computer using standard musical notation. The ALF kit includes the synthesizer board (plugs into any peripheral slot), exceptional quality software, and an extensive user manual.

Sophisticated Music Entry Program

Sheet music is easily entered using the Apple game paddles. The high-resolution ENTRY program features the familiar music staff with a "menu" of musical items listed beneath it (note lengths, rests, edit commands, accidentals, etc.). One game paddle moves a cursor up and down the music staff and is used to select the note pitch; the second paddle chooses from the menu items (note length, etc.) With the ALF hi-res ENTRY program, you won't have to use cryptic codes to select note parameters.

As you program sheet music with ENTRY, measure bars are inserted automatically (and note values are tied over the bar where necessary). Key signatures are also automatic—you don't have to keep writing in every sharp or flat!

Three monophonic, individual parts can be programmed with each ALF Music Synthesizer. Two boards are required for stereo. A total of three synthesizers can be used simultaneously for a maximum of nine voices. By controlling the envelope (or shape) of each voice, many different instrumental sounds can be simulated.

Eight-octave Range

The ALF Music Synthesizer has a pitch range of eight octaves—a wider range than a grand piano. The ALF can also play semitones—"blues notes" or the pitches in between the keyboard notes of a piano. (The pitch range is from 27.5 to 55,000 Hertz, well beyond the limits of human hearing.) Tuning accuracy is virtually perfect within two cents of pitch value.

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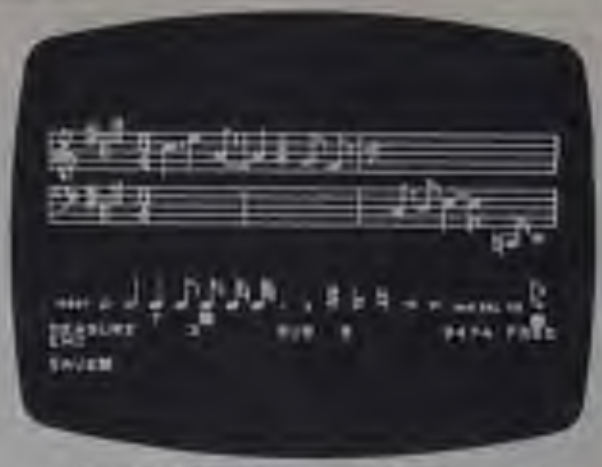
You can save songs on either cassette or disk, and play them back using either ENTRY or PLAY. The playback speed is adjusted with one of the game paddles, and can be varied during the playback, if you wish to change the overall tempo.

Colorful Playback Display

The ALF Music Synthesizer features a 16-color low-res graphic display during song playback. Each musical part is represented on a stylized piano "keyboard"—the intensity of the note determines the color, and the pitch is shown in relation to "middle C".

The ALF Music Synthesizer requires the use of an external audio amplifier. Stereo programming is possible with the use of two or three synthesizer boards.

The ALF software includes the ENTRY and PLAY programs, sample songs, an introduction to "envelope shaping", and demonstrations of advanced uses of the synthesizer.



With the ALF software, entry of music is easy, fast and accurate.

Nine Voices for only $198

The new ALF "AM-II" music synthesizer offers an unbeatable value for the Apple owner who is a music hobbyist. With nine voices on a single music board for $198.00, the AM-II is the most economical device for creating music with the Apple.

The AM-II uses the same excellent ENTRY and PLAY programs as the more sophisticated ALF Music Synthesizer (AMS); the same hi-res graphic display from which notes are selected with the Apple game paddles (not typed with cryptic codes). All of the conveniences of the ENTRY program apply—easy editing, playback with low-res display, ability to save songs on cassette or disk, etc.

The AM-II has **stereo output** (3 voices in left, 3 voices in the middle, 3 voices in the right).

How can the AM-II offer so much for only $198.00? The two basic differences between the AM-II and the ALF Apple Music Synthesizer (AMS) are pitch accuracy and dynamic range. The AM-II has an accurate pitch range of about six octaves. Pitch values above the treble staff become increasingly inaccurate. Also, the AM-II has a dynamic range of 36db, with 16 different volume levels. (the AMS has a dynamic range of 78db).

The AM-II is manufactured with the same high quality standards as other products from the ALF Corporation. No sacrifice has been made in reliability; the new AM-II is simply a great bargain.

Professional musicians will still want to use the original Apple Music Synthesizer (AMS) for its extended range and volume controls (the AMS has a range of 8 octaves). But for the Apple owner who is interested in music as a hobby, the AM-II is the best music peripheral value available today.

Requires: 16K Apple II or Apple II Plus, cassette or Disk II, and an external audio amplifier (all necessary patch cords are included).

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Atari, Continued...

Every time a character is displayed, the Atari consults this table. Let's quickly examine the process.

When Antic finds a display list entry to generate characters (modes 0-1-2 to Basic memory users), he looks to his current location in display memory, kept in an internal register.

Let's assume graphics 0 for now. One graphics 0 instruction means 40 characters are plotted in one row (in one display block). In a character mode, one byte of display memory represents one character, so Antic fetches 40 bytes. Each character has a unique number, 0-127, and Antic uses that number to look up the shape of the characters in the character set. Let's see how it finds the shape.

First Antic must find the character set. That's easy, it is POKEd to Antic every sixtieth of a second by the operating system as part of the screen refresh process. It is given to Antic from location 2F4 hex or 756 decimal in memory.

This location we'll call CHBAS, for "character set base." The number in this byte, when multiplied by 256, specifies the start of the character set in memory.

(Why by 256? In the Atari, like all 6502 processor machines, memory is divided up into "pages." Each page is 256 bytes long, corresponding to 8 bits of address. In a 16-bit address, the upper 8 bits specify which page number, and the lower 8 bits specify which byte within the page. Because the character set always starts on an even page mark, we only need to tell Antic where the first page of the character set is.)

The character number in display memory, known as the "internal character set number" (not ATASCII) is multiplied by 8. This is then added to the CHBAS*256 number to give Antic the starting address in memory of where the shape table for the character is stored. (See Diagram 3.) When displaying the character, Antic grabs the first byte of the shape table, displays it as eight on or off dots according to the bits in the shape table, then for the next line down, it just moves down one byte in the shape table. After eight passes, it has moved down eight scan lines and eight bytes and is finished with the character. (See Diagram 4.)

Now if we were to tell Antic the shape table began somewhere else in memory, he would faithfully look to the new location and start using whatever data was found there to display characters. You will recall a few columns back we told Antic that display memory was located in low memory, to watch him display pages 0 and 1 of memory as characters. This is the same idea. If the new area of memory happens to be a table of character shapes, redefined to what you want them to be, Antic will use them without complaint. If

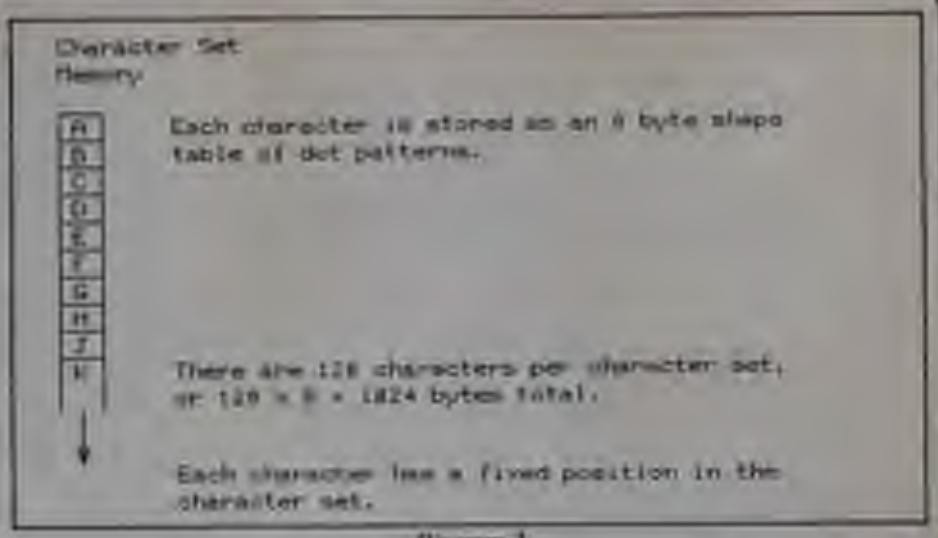

Diagram 2

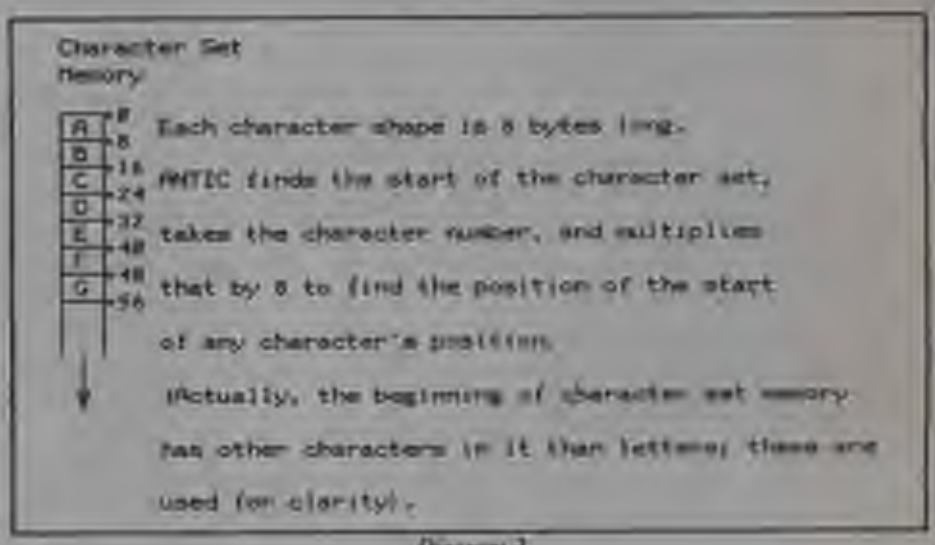

Diagram 3

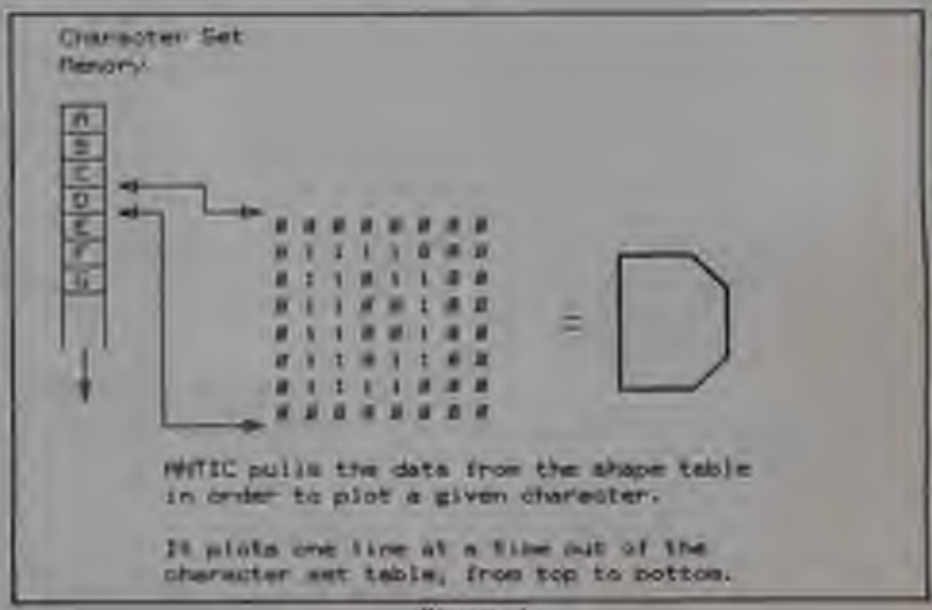

Diagram 4

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not, he will still use them, but what you see won't be much like a character display!

Now we can't change the existing character set. That's stored in ROM at E000 hex and cannot be modified. So what we need to do is copy that ROM character set into RAM, where we can modify it, and tell Antic to start looking to RAM for a character set. All we do to change where Antic looks is to POKE a new page number in memory into location 756. A sixtieth of a second later, the operating system will give Antic that new value as part of the screen refresh, and he will start using it.

Examples

Time now for some examples and programs. Let's run some routines to help us visualize the process and see how characters are stored.

Program 1 begins at the start of the unmodifiable character set the Atari normally uses, the ROM character set. It fetches the 8 bytes per character, breaks each byte up into individual bits, and displays them as 0's and 1's. (Well, actually, it displays 0's as spaces to make the 1's stand out). It goes through the entire character set this way, displaying the characters in binary patterns. See the listing for an example.

You will soon notice that characters are not stored in ATASCII order. They are in the order of the internal character set, which is a different thing. You can find a listing of the internal order on page 55 of your Basic manual.

Program 2 dumps the specified character to the printer; just type in the letter whose bit pattern you want to display. It is converted into an ATASCII number, then into the internal character set number, then displayed. Hence, this program is handy for showing how to convert from ATASCII to internal format. To find the eight bytes in the character set, the internal number is just multiplied by 8 and added to the number that represents the start of the character set, which you'll recall is just how Antic does it (CHBAS+(8*(the number))).

The character set at which we are currently looking is in ROM. Let's learn how to move it to RAM so we can modify it. There are three steps we must follow:

1. Finding a place to put it: we need 1024 free contiguous bytes of RAM.

2. Copying the ROM character set to RAM.

3. Changing the "pointer" Antic uses to find the character set from its old ROM location to the new RAM location.

Step 1 is tricky. To understand how to do this, we must delve into some Atari memory secrets.

```
70 REM PROGRAM 1
80 DIM BINR$(8)
90 REM U.S. SHADOW FOR CHBAS+EF4 HEX
100 CH=256*(PEEK(106)-4)
120 CHBAS=PEEK(CH)*256
200 REM
210 FOR CHARNUM=0 TO127
211 PRINT CHARNUM,CHR$(CHARNUM);
212 GOSUB 220
213 PRINT
214 NEXT CHARNUM
215 REM FIGURE CHRS VALUE TO REM VAL
220 IF CHARNUM<32 THEN CH=CHARNUM+64
230 IF CHARNUM>96 THEN IF CHARNUM<128 THEN CH=CHARNUM-32
240 IF CHARNUM>=128 THEN CH=CHARNUM
250 REM PULL 8 BYTES, TRANSLATE,PRINT
260 CLOC=CHBAS+(8*CH)
270 FOR B=0 TO 7
280 BYTE=PEEK(CLOC+B)
290 GOSUB 500
300 PRINT BIN$(B);" ";BINR$
310 NEXT B
320 RETURN
500 REM DECIMAL TO BINARY
505 BINR$=""
510 DIV=128
515 BYTE1=BYTE
520 FOR T=1 TO 8
525 BIT=INT(BYTE1/DIV)
530 IF BIT=1 THEN BINR$(T,T)="1"
540 IF BIT=1 THEN BYTE1=BYTE1-DIV
550 DIV=INT(DIV/2)
560 NEXT T
570 RETURN
```

Program 1.

```
70 REM PROGRAM 2
80 DIM BINR$(8)
90 REM U.S. SHADOW FOR CHBAS+EF4 HEX
100 CH=256*(PEEK(106)-4)
120 CHBAS=PEEK(CH)*256
200 PRINT "ENTER CHARACTER NUMBER"
210 INPUT CHARN
211 PRINT CHARN,CHR$(CHARN);
212 GOSUB 220
213 PRINT
214 GOTO 200
215 REM FIGURE CHRS VALUE TO REM VAL
220 IF CHARN<32 THEN CH=CHARN+64
230 IF CHARN>96 THEN IF CHARN<128 THEN CH=CHARN-32
240 IF CHARN>=128 THEN CH=CHARN
250 REM PULL 8 BYTES, TRANSLATE,PRINT
260 CLOC=CHBAS+(8*CH)
270 FOR B=0 TO 7
280 BYTE=PEEK(CLOC+B)
290 GOSUB 500
300 PRINT BIN$(B);" ";BINR$
310 NEXT B
320 RETURN
500 REM DECIMAL TO BINARY
505 BINR$=""
510 DIV=128
515 BYTE1=BYTE
520 FOR T=1 TO 8
525 BIT=INT(BYTE1/DIV)
530 IF BIT=1 THEN BINR$(T,T)="1"
540 IF BIT=1 THEN BYTE1=BYTE1-DIV
550 DIV=INT(DIV/2)
560 NEXT T
570 RETURN
```

Program 2.

When the Atari is first turned on, a check is made to determine where RAM ends. This can be anywhere from 8K to 48K from the beginning of memory; it depends on how many boards you have installed. In location 106 decimal (6A hex) is stored the page number of the first byte of nonexistent memory. In other words, 256*PEEK(106) is the address of the first byte of nonexistent memory.

The Atari uses the very top of RAM memory, wherever that might be, for the display memory and display list storage. Right below that is free RAM, and below that is the Basic storage. (Hence, Basic and the graphics modes "grow" toward each other into free RAM when they use more memory.) (See Diagram 2.) So whenever a graphics command is executed, and the Atari needs to set up a new display

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memory display list, it checks location 106 to see where RAM ends. It then backs up the required number of locations and puts the display memory in. Thus 106 can be thought of as a "fence," that is used to find the end of memory.

Now let's assume we POKE 106, PEEK (106)-4. This will move the end-of-memory fence back four pages. Each page, you will recall, is 256 bytes, so that's 4 x 256 or 1024 bytes moved back. We then re-execute a graphics command, so the Atari will move the display memory display list out of that 1024-byte area, behind its fence. (See Diagram 6.) In this way we reserve 1024 bytes of memory starting on a page border.

There are several advantages of getting 1024 bytes this way. It doesn't matter what size memory your machine has, as long as the minimum 1024 bytes are available. Nor does it matter how long your Basic program is or what graphics mode you are in. You can see it is quite a handy general purpose thing to have.

This is also the preferred technique to use when reserving memory for the Player-Missile bitmap area. Eight pages are required for a 2048-byte bitmap (single line resolution) or four for 1024 bytes (double line resolution). You will see this byte 106 modification in most Player-Missile articles.

One warning note: Basic cannot handle setting up a display list and display memory for graphics modes 7 and 8 in all cases when you modify the 106 pointer by less than 4K at a time. This means graphics 8 will produce truly bizarre results if you use PEEK(106)-8. Use a minimum of 4K change, or PEEK(106)-16. This may explain the problems some people have using Player-Missile graphics with high resolution graphics modes.

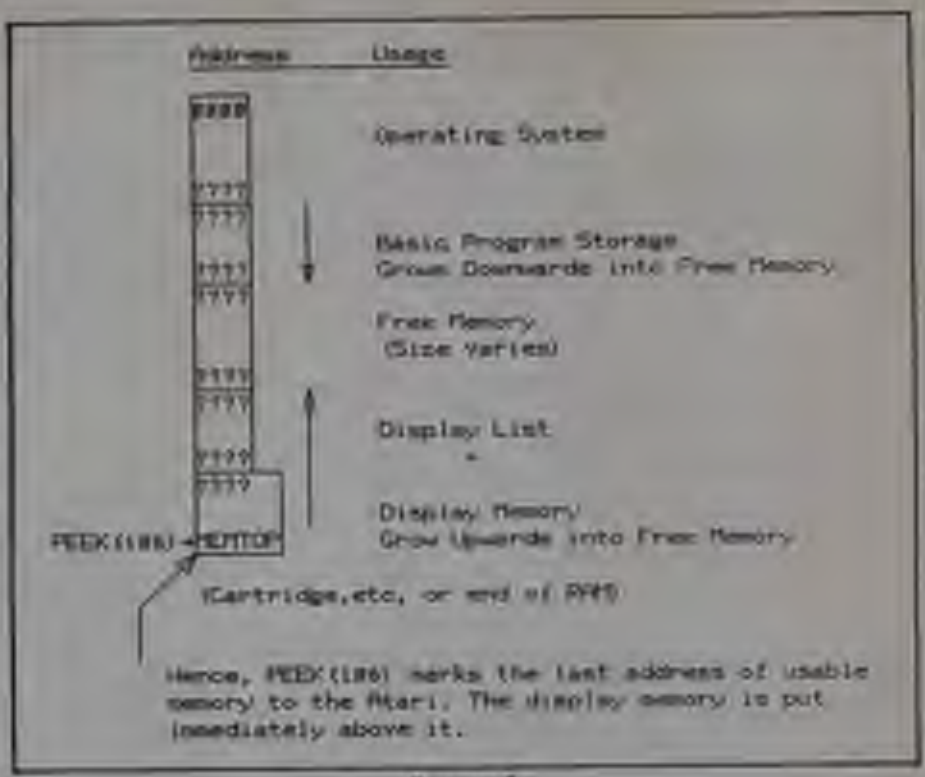

Diagram 5.

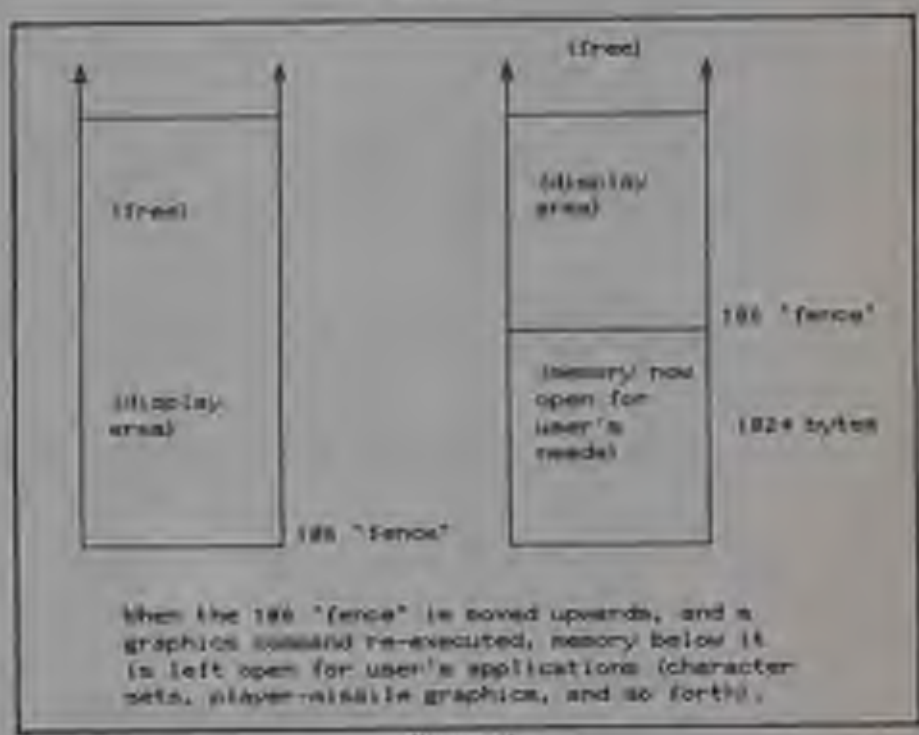

Diagram 6.

Copying the Character Set

We now know the beginning of the RAM area, and where the ROM character set starts (E000 hex or 57344 decimal). Let's use Program 3 to copy the ROM character set to RAM. This program moves the 106 pointer back four pages and copies the character set over. It takes a while—around ten seconds to copy 1024 bytes—but later we will see a better way to do this.

Finally, the CHBAS pointer is changed to reflect the page of the beginning of RAM. Antic is now using the RAM character set. (See Diagram 7.)

Now Program 3 doesn't show you much, for Antic will still be displaying characters as usual. So, let's watch the copy process in action. This time we will move the character set pointer *first*, then do the copy. Your screen will then display whatever junk is in memory at the start of the copy as the pointer is changed, then more and more letters will appear as Basic copies character shapes into the RAM table. At the end of the copy, the screen will once again appear normal. (See Program 4.)

Program 5 represents an interesting variation. It copies characters from ROM to RAM upside down. It does this by copying the eighth byte of every character into the first byte of the new bitmap for that character, the seventh to the second, and so forth. The result is that the new RAM bitmap is an inverted image of the ROM bitmap. This is fun; the characters

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are still onscreen, and you can edit and so forth, but they are upside down. (See Diagram 8.)

```
50 REM PROGRAM 3
80 REM COPIES CHARSET TO RAM
100 REM(PEEK(106)
110 GRTOP=REMTOP-4
120 POKE 106,GRTOP
130 REM RESET
140 GRAPHICS 0
141 LIST
150 CHRAM=PEEK(PEEK(88)
160 CHRAM=CHRAM+256
180 PRINT "COPYING."
190 FOR NUM TO 1023
200 POKE CHRAM+NUM,PEEK(CHROMAN)
300 NEXT N
310 PRINT "COPIED."
320 REM NOW MODIFY POINTER
340 POKE 106,GRTOP
```

Program 3

```
50 REM PROGRAM 4
80 REM COPIES CHARSET TO RAM
100 REM(PEEK(106)
110 GRTOP=REMTOP-4
120 POKE 106,GRTOP
130 REM RESET
140 GRAPHICS 0
141 LIST
150 CHRAM=PEEK(PEEK(88)
160 CHRAM=CHRAM+256
170 REM NOW MODIFY POINTER
180 POKE 106,GRTOP
190 PRINT "COPYING."
200 FOR NUM TO 1023
210 POKE CHRAM+NUM,PEEK(CHROMAN)
300 NEXT N
310 PRINT "COPIED."
```

Program 4

Program 6 shows yet another useful variation. It makes the last byte of every character a 255, or solid 1's. This puts a solid line at the base of the characters, and creates a line at the bottom of each of the 24 character rows—a silly effect.

Program 7 illustrates another handy character set feature. We can POKE different values into the CHBAS pointer and thus switch between multiple character sets immediately. In Program 7 we have two character sets, one normal, one flipped upside down. The program switches between them rapidly for an effect that is hard on the eyes. Assembly language programmers take note: with a display list interrupt, you can change character sets midway down the screen. The possibilities are amazing. Just POKE a new value into the Antic hardware address for CHBAS.

Changing a Character

Now let's assume we have decided to change a ROM character set character to a custom one. Let's work it out by hand the first time. Incidentally, an editor based on this hand working out is none too difficult to write and there are many more on the market. None, however, has the storage scheme I'm going to explain which is so convenient.

First, let's design the character we want as an 8 x 8 dot matrix. (See Diagram 9.)

This is, of course, the character from the "Have a Nice Day!" button.

Next, let's determine the bit patterns. You can do this by converting to hex each nibble (four bits), and then going to decimal (as I do), or by adding the number shown on the top of the column to the total for that line whenever the dot it represents is on. For example, in the diagram, 16 and 18 are on, so add 16+8 =24.

At the end of this process, you will have 8 bytes of data which represent the bitmap for that character. Next, let's figure out which character we will replace with our character. How about the space character? There are plenty of those onscreen. OK, the space character is the first one in the ROM-RAM character set—character #0, in internal code. So what we do is to POKE these eight bytes into the location where the bitmap of the space character is located, replacing it with the "smile" character. See Program 8, which is our copy-the-character-set-from-ROM-to-RAM routine with the added POKEs. (The numbers are in the DATA statement.)

If we wanted to replace another character we would multiply its character number by 8, add it to the start of the

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Atari, continued...

```
40 REM PROGRAM 5. COPIES UPSIDE DOWN.
50 REM COPY CHARSET UPSIDE DOWN
100 MEMTOP=PEEK(106)
110 GRTOP=MEMTOP-4
115 CLOC=GRTOP
120 POKE 106,GRTOP
130 REM RESET GR.0 DISPL AREA
140 GRAPHICS 0
141 LIST
150 CH=256
160 CHROM=PEEK(CH)*256
170 CHRAM=GRTOP*256
175 PRINT "CHRAM=";CHRAM;"  CHROM=";CHROM
180 PRINT "COPYING."
190 REM COPY ROM TO RAM
200 POKE CH,CLOC
300 FOR MYB TO 1023
310 POKE CHRAM+MY,PEEK(CHROM+MY)
320 NEXT M
330 PRINT "COPIED."
350 REM  NOW COPY UPSIDE DOWN
360 FOR CHNUM=0 TO 127
410 FOR BYTE=0 TO 7
415 Z=PEEK(CHROM+CHNUM*8+BYTE)
420 POKE CHRAM+CHNUM*8+(7-BYTE),Z
430 NEXT BYTE
435 NEXT CHNUM
440 PRINT "DONE."
```

Program 5

```
40 REM PROGRAM 6. UNDERLINES CHARS.
100 MEMTOP=PEEK(106)
110 GRTOP=MEMTOP-4
115 CLOC=GRTOP
120 POKE 106,GRTOP
130 REM RESET GR.0 DISPL AREA
140 GRAPHICS 0
141 LIST
150 CH=256
160 CHROM=PEEK(CH)*256
170 CHRAM=GRTOP*256
175 PRINT "CHRAM=";CHRAM;"  CHROM=";CHROM
180 POKE CH,GRTOP
400 FOR CHNUM=0 TO 127
410 FOR BYTE=0 TO 7
415 Z=PEEK(CHROM+CHNUM*8+BYTE)
420 IF BYTE=7 THEN LET Z=255
430 POKE CHRAM+CHNUM*8+BYTE,Z
435 NEXT BYTE
440 NEXT CHNUM
450 PRINT "DONE."
```

Program 6

```
40 REM PROGRAM 7. COPIES UPSIDE DOWN.
45 REM THEN FLIPS BACK AND FORTH
100 MEMTOP=PEEK(106)
110 GRTOP=MEMTOP-4
115 CLOC=GRTOP
120 POKE 106,GRTOP
130 REM RESET GR.0 DISPL AREA
140 GRAPHICS 0
141 LIST
150 CH=256
160 CHROM=PEEK(CH)*256
170 CHRAM=GRTOP*256
175 PRINT "CHRAM=";CHRAM;"  CHROM=";CHROM
180 PRINT "COPYING."
190 REM COPY ROM TO RAM
200 POKE CH,CLOC
300 FOR MYB TO 1023
310 POKE CHRAM+MY,PEEK(CHROM+MY)
320 NEXT M
330 PRINT "COPIED."
350 REM  NOW COPY UPSIDE DOWN
360 FOR CHNUM=0 TO 127
410 FOR BYTE=0 TO 7
415 Z=PEEK(CHROM+CHNUM*8+BYTE)
420 POKE CHRAM+CHNUM*8+(7-BYTE),Z
430 NEXT BYTE
435 NEXT CHNUM
440 PRINT "DONE."
500 REM FLIP
510 POKE CH,224:REM NORMAL ROM
520 POKE CH,CLOC
530 WAIT 210
```

Program 7

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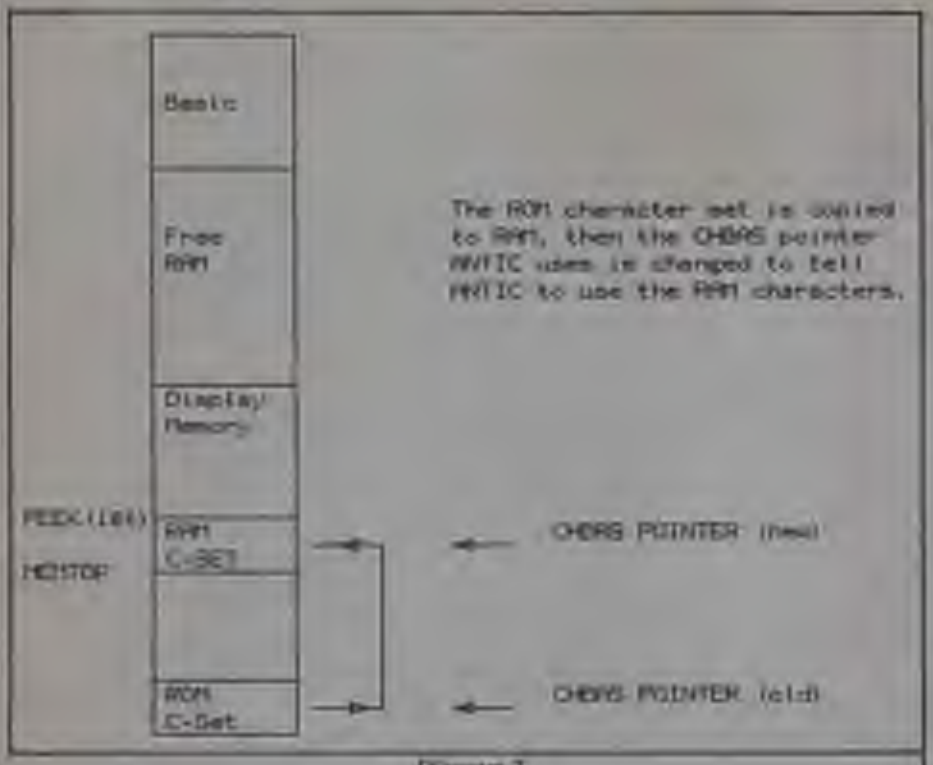

Diagram 7.

```
NEEDS DETRENVI  IRRIA NA SIHT

Sample of inverted characters. Editing and
all cursor functions can be performed with the
Atari in this mode.
```

Diagram 8

address of the character set and start POKEing there. That's why I added the LOC=(CHBAS + (PEEK)), which at first seems nonsensical. Replace the 0 with whatever number you wish.

At this point your Atari will be smiling proudly. Take a minute and enjoy its happiness at your success.

Storing and Retrieving Your Character Set

You don't want to have to re-POKE your character set each time you want to use it. And let's face it, the POKE method of copying the 1024 bytes from ROM to RAM is incredibly slow. Let's solve these problems with some custom routines. They all work with string manipulations, which I'm rapidly beginning to realize are extremely powerful and usable on the Atari. The reason for their power is their speed in an otherwise slow Basic; the string manipulation routines are just high speed assembly language copy routines. Let's subvert them for our purposes, and have assembly speed without all the hassles.

Each string is stored in memory as a continuous group of bytes. A string has a DIMensioned length, a "currently in use" length, and a location in memory. Let's say we have two strings, RAM$ and ROM$, and assume they both have length 1024. Assume also that the storage location where the Atari thinks RAM$ is in memory just happens to be our RAM character set area. (What a marvelous coincidence.) Let's further assume that ROM$ is in the ROM character set area (or so the Atari thinks.) What will happen then when we execute RAM$=ROM$?

The Basic string manipulation routines will copy 1024 bytes (dimensioned length) from ROM$ to RAM$, and thus copy the ROM character set to the RAM character set at extremely high speed!

Now let's modify the RAM character set. Bear in mind that you can do this with either a POKE or a string operation; when you modify the string, you're modifying the RAM character set. (It won't let you modify ROM$ for obvious reasons). Then let's write RAM$ out to disk. Fine, the Atari will store your character set on disk as a string. Next, let's read it back in, still using all string manipulation operations and store it back into the character set area. You will have stored and recovered your character set. Nice, eh? No hassles with bits and bytes, just a PRINT to disk and an INPUT later on. (The details of reading and writing said string I'll leave to you; it's awfully easy).

Incidentally, the power of the copy capability is also usable in player-missile graphics. In the April 1981 "Output: Atari," George Blank assigned a string to the player bitmap area, and then moved the player up or down at high speed using a $=$. This is a nice, fast way to move a player vertically, which before required either assembly language or slow POKE copies. And strings may be used for data storage; the display list interrupt routine I wrote and documented not too long ago used a string to store data bytes for color registers, and another string to hold the assembly program used for the interrupt handling.

Let's learn how to change where the Atari thinks a string is located in memory. Then we'll get to the actual subroutines you can use.

The Atari keeps two tables in memory for Basic that deal with string variables. One is called the variable table, the other the array table. There are 128 possible variable names on the Atari, numbered 0-127, and the variable table has an 8-byte entry for each name in use. All the entries are packed together. For strings this entry has dimensioned and in-use length, and location in the array table in which the string is stored.

The other table is the array table, in which the actual data of the string is kept. So, what we have to do is alter the dimensioned and in-use length as shown in the variable table, both to 1024, then modify where the Atari thinks the variable is stored in the array table. The only tricky part of this is that the address of where the string is actually stored is relative to the array table; in other words, a 0 for this value doesn't mean the string starts at location 0, it starts at the beginning of the array table.

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You can find the beginning of the variable table by:

VT=PEEK(134)+256*PEEK(135)

and the array table by:

AT=PEEK(140)+256*PEEK(141)

Next, we must consider the actual layout of the variable table entries. I will assume that RAM$ and ROM$ are the first two variables in the table. In reality, to do this they must be the first variables typed in a NEW program or ENTERed from a program LISTed to disk (A SAVE-LOAD won't work, it stores the variable table along with the program). So if you are starting out with a new program, just have the DIM line (10 DIM RAM$(1),ROM$(1)) as the first line of your program after a NEW. If you're adding these to an existing program, make that the first line and LIST-ENTER it to disk.

Note: The variable table entry is created for any variable referenced by your program. This includes variables you used once and then deleted; they are still there taking up space. You can run out of space in the variable table when it gets too full of these nonexistent variables. LIST, then ENTER the program from disk to clear out the table; it forces a new variable table to be built.

Table 1 shows the variable table with explanations.

This is the entry for RAM$, the first string in the table. The entry for ROM$ immediately follows.

This subroutine should now become clear. It modifies the address and length of RAM$ to that of the character set. It not only copies ROM$ to RAM$, it also modifies the variable table data for ROM$. (All the modifying, by the way, is quite speedy, so the RAM$=ROM$ still executes much faster than the previous POKE copy). (See Program 9.)

Conclusion

Well, there you have it. A painless introduction to character sets. If you've a mind for a little experimenting, you can have a great deal of fun with them, while expanding the abilities of your Atari tremendously. I'm considering using multiple reprogrammed characters, for example, in a dungeon game I'm thinking of writing, to show in fine detail the monster approaching you. That's just one of many applications. □

Location	Value	Meaning
VT+0	129	"This is a string"
VT+1	0	"This is variable #0"
VT+2, VT+3	??	16 bits. Location from the start of AT.
VT+4, VT+5	??	DIMensioned length.
VT+6, VT+7	??	In-use length.

Table 1.

```
50 REM PROGRAM 8
60 REM COPIES CHARSET TO RAM
70 REM POKES POINTER W/A COPY
80 REM ADDS CHILE
100 REMCOP=PEEK(106)
110 SRTOP=REMTOP-4
120 POKE 106,SRTOP
130 REM RESET
140 GRAPHICS 0
150 L=151
160 CHRSOURCE=256*106
170 REM NOW MODIFY POINTER
180 POKE 756,SRTOP
190 CHRSOURCE=CHRSOURCE/256
200 PRINT "COPYING..."
210 FOR SOR TO 1023
220 POKE CHRADR(SOR),PEEK(CHRSOURCE+SOR)
230 NEXT SOR
240 PRINT "COMPLETE."
250 REM ARCDEFGHIJKLMNOPQRSTUVWXYZ
260 REM 1234567890!"#$%&'()*+,-./:;<=>?
1000 REM CHILE BITTON LAYOUT:
1010 REM 00=00000000 BC 000
1020 REM 01=00111110 BC 062
1030 REM 02=01000001 BC 065
1040 REM 03=01000000 BC 064
1050 REM 04=01000000 BC 064
1060 REM 05=01111100 BC 124
1070 REM 06=00000010 BC 002
1080 REM 07=01000010 BC 066
1090 REM
1100 DATA 00,62,65,64,64,124,2,66
1110 FOR SOR=CHRSOR TO CHRADR+7
1120 READ DAT:POKE CHRSOR,DAT
1130 NEXT SOR
```

Program 8.

```
0 REM PROGRAM 9
5 REM PROGRAM TO COPY ROM TO RAM
6 REM VISUAL STRING MANIPULATORS
7 REM
8 REM NOTE MOST CALCULATIONS ARE NOT
9 REM NECESSARY TO MAKE SOME USE
10 DIM RAM$(1),ROM$(1):REM VT ENTRY 1
20 DIM AT,VARIABLE,SLOT,LOC
100 AT=PEEK(140)+256*PEEK(141)
110 VTADDR=PEEK(134)+256*PEEK(135)
120 POKE 106,PEEK(106)-16:REM WE HAVE
125 GRAPHICS 0:REM RESET OUT OF THE WAY
130 RAMLOC=PEEK(106)*256
150 REM CALCULATE OFFSET FROM AT
160 OFFROM=RAMLOC-AT
170 OFFROM=INT(OFFROM/256)
200 REM CALCULATE LOCAL BYTES
220 LEN1=PEEK(REM 5-SET LENGTH
230 LEN1=INT(LEN1/256)
240 LEN2=INT(LEN2-LEN1*256)
245 REM
250 OFFROM1=INT(OFFROM/256)
260 OFFROM2=OFFROM-(256*OFFROM1)
270 OFFROM=INT(OFFROM/256)
280 OFFROM=OFFROM-(256*OFFROM1)
290 REM SEARCH DATA IN VT
310 FOR VT=0 TO 128
320 FOR VT1=0 TO 7 :VAR #1
330 POKE VT1,OFFROM2:REM OFFSET
340 POKE VT2,OFFROM1:REM OFFSET
350 POKE VT3,LEN2:REM DIM LENGTH
360 POKE VT4,LEN1:REM DIM LENGTH
370 POKE VT5,LEN2:REM USED LENGTH
380 POKE VT6,LEN1:REM USED LENGTH
390 REM REPEAT FOR DATA IN VT
410 REM VT=VT+128
420 FOR VT=0 TO 7 :VAR #1
430 POKE VT10,OFFROM2:REM OFFSET
440 POKE VT11,OFFROM1:REM OFFSET
450 POKE VT12,LEN2:REM DIM LENGTH
460 POKE VT13,LEN1:REM DIM LENGTH
470 POKE VT14,LEN2:REM USED LENGTH
480 POKE VT15,LEN1:REM USED LENGTH
500 REM RESTORE CHARS ROUTINE
510 POKE 106,PEEK(106)+16
520 REM END OF CODE
530 POKE 0,0:POKE
```

Program 9.

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Add With Carry Drill and practice on some regrouping numbers to be carried.

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CIRCLE 354 ON READER SERVICE CARD

MEMORY SYSTEM FOR ATARI 800

Axlon Incorporated has announced a 128K memory system for the Atari 800.

The Ramdisk Memory System comes with software that makes the new system function like a disk device. The system can also be programmed as bank selectable RAM memory.

The Ramdisk Memory System, when utilized as an additional disk device in conjunction with an Atari 810 disk drive, is compatible with existing software written for the Atari 800 system. $849.

Axlon Inc., 170 N. Wolfe Rd., Sunnyvale, CA 94086. (408) 730-0210.

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CIRCLE 283 ON READER SERVICE CARD

the CP/M* and S-100 user's journal

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Edited by Sol Libes
Published every other month

CIRCLE 247 ON READER SERVICE CARD

New Products, continued...

32K UPGRADE FOR TRS-80 COLOR COMPUTER

Spectral Associates introduces the Ramcharger, a 32K upgrade module for the TRS-80 Color Computer. The Ramcharger module will extend the memory of a 16K Color Computer to 32K and is compatible with Color Basic.

Ramcharger is an assembled and tested printed circuit board which fits inside of the Color Computer and requires no soldering or hardware modifications. This leaves the ROM-PAK port free for other peripherals. $99.95.

Spectral Associates, 141 Harvard Ave., Tacoma, WA 98466. (206) 475-8483.

CIRCLE 358 ON READER SERVICE CARD

PERIPHERALS

CONVERSION FOR ELECTRONIC TYPEWRITER

Eaton Products, Inc. announces the ETI-567 conversion system which allows computer-controlled operation of any IBM Electronic Typewriter Model 50, 60, or 75.

Computer Games!

How can we tell you about 400 computer games in one advertisement?

We've got the world's largest line of computer games. Over 400 in all. They're on cassette and disk for eight popular personal computers: Atari, Apple, TI 99/4, PET, TRS-80, Sorcerer, Sol and CP/M.

From A to Z, Action Games to Z-Corps II, we've got loads of best-sellers including Super Invader for the Apple, a complete line of six Adventure games, Backgammon, Milestones and Cycle Jump.

Not only that, we publish the best-selling books *Basic Computer Games* and *More Basic Computer Games* with over 500,000 copies in print.

We've also got a nifty board game, *Computer Rage*, sets of three binary dice, acrobatic toy robots, T-shirts and lots of other goodies.

You'll find comprehensive descriptions of all of our software, books, games and peripherals in our huge 48-page catalog. It's unique in the small computer field. For your free copy, write or call us today or circle our number on the reader service card.

Super Invader features superb high-resolution graphics, nail-biting tension and hilarious antics by the moon creatures.

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The only thing you can do with a baked Apple is eat it.

The more you stuff your Apple II™ with plug-in boards, the more of a chance it has to overheat.

And once that happens, it won't do anybody any good. Your program bombs and you start losing time and money.

The solution? Simple. Take two minutes to install the Dana Industries fan in the back of your Apple, and you'll practically never have to worry about overheating again.

So pick up the Dana Industries fan at your local computer store. And your Apple will have a long and fruitful life.

*Apple II is a trademark of Apple Computer Inc.

CIRCLE 195 ON READER SERVICE CARD

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ABM PRODUCTS

CIRCLE 105 ON READER SERVICE CARD

Why would anyone spend $59.95 for a joystick?

Super Joystick

Star Wars. Played with paddles, it's difficult at best and frustrating at worst. But with a joystick, it becomes an entirely new experience. It's still challenging. It's also fun. And very addictive.

Have you ever used a drawing program in which one paddle controls the horizontal movement of the "brush" and the other paddle the vertical? It's slow, tedious work. But with a joystick, drawing is an absolute joy.

Exceptional Precision

The Apple high-resolution screen is divided into a matrix of 160 by 280 pixels. To do precise work on this screen, you need a precise device. Most potentiometers used in paddle controls are not quite linear. If you rotate a paddle control at a constant speed, you'll notice that the cursor speeds up slightly at the beginning and end of the paddle rotation.

The Super Joystick has a pure resistive circuit which is absolutely linear within one tenth of one percent. In other words it would give you precise control over an image of 1000 by 1000 pixels, since such resolution is available. Thus it is suitable for high precision professional applications as well as educational and hobbyist ones.

Matched to your application

The Super Joystick also has two external trim adjustments, one for each direction. This allows you to perfectly match the unit to your application and computer. Say you want to work in a square area instead of the rectangular screen. Just reduce the horizontal size with the trim control.

How many times have you played Space Invader and had your thumb ache for hours from the repeated button pressing? This won't happen with the Super Joystick. It's two pushbuttons are big. Moreover, they are massive contact surfaces with a life of well over 1,000,000 contacts. A few games of Super Invader using these big buttons will justify the purchase of the Super Joystick.

The Super Joystick is self-centering in both directions. That means when you take your hand off it, the control will return to the center. However, if you want it to stay where you leave it, self-centering may be easily disabled.

The Super Joystick plugs right into the paddle control socket and doesn't require an I/O slot.

High-quality construction

The sturdy high-impact molded plastic case of the Super Joystick matches that of the Apple computer. Every component used is the very highest quality available.

We invite your comparison of the Super Joystick with any other unit available. Order it and use it for 30 days. If you're not completely satisfied, return it for a prompt and courteous refund plus your return postage. You can't lose.

By removing two springs, self-centering can be defeated.

The Super Joystick consists of a self-centering, linear joystick, two trim controls, and two pushbuttons mounted in an attractive case. It comes complete with instructions and a 90-day limited warranty. Cost is $59.95.

Order Today

To order the Super Joystick send $59.95 plus $2.00 postage and handling. (NJ residents add $3.00 sales tax) to our address below.

Experience the joys of using the world's finest joystick. Order your Super Joystick at no obligation today.

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CIRCLE 239 ON READER SERVICE CARD

New Products, continued...

A single-board computer is the heart of the system, giving the user full control of all typewriter operations, including "code" functions. Speed is optional at nominal 15-1/2 cps. RS-232 and Parallel computer input is accommodated in the standard package, with an adapter to IEEE-488 available as an option.

A 96-character buffer is used for incoming character storage, with various handshaking protocols accommodated. RS-232 baud rates are switch selectable from 110 to 9600.

Price of the system is $435 for the RS-232/Parallel, $535 for IEEE-488.

Escort Products, Inc., 12919 Alcosta Blvd., San Ramon, CA 94583 (415) 820-1256.

CIRCLE 237 ON READER SERVICE CARD

APPLE PARALLEL INTERFACE

The Grappler is a Centronics compatible parallel interface for the Apple II and Apple II Plus computers which features on-board firmware to copy the Apple high resolution graphics screen to many popular graphics printers.

It also features text commands, including text screen dumps, setting of margins and page lengths, auto-skip-over perforations and word wrap-around with breakpoint on nearest blank.

The Grappler interface is compatible with Apple Pascal and CP/M, and currently supports Anadex, IDS Paper Tiger, Centronics 739, Epson MX80 and MX100 printers. It also supports Epson MX80 and MX80/FT printers with the Graftrax-80 graphics upgrade installed.

Orange Micro, 3150 E. LaPalma #L, Anaheim, CA 92806. (800) 854-9275 in (714) 630-3322.

CIRCLE 238 ON READER SERVICE CARD

TRS-80 JOYSTICK INTERFACE

Joy-6 is a joystick interface for TRS-80 Models I and III, featuring potentiometer-type joysticks with pushbuttons, sound effects capability, and simple control software. It can also be used as a general purpose six-channel analog to digital converter with temperature sensors or other transducers and can drive an external relay for control applications.

The complete package includes Joy-6, two joysticks with pushbuttons, power

Unwrap the Crypto Mystery for $495.

Thanks to the Western Digital CryptoPrimer™ Development Kit, cryptography is no longer a deep, dark secret. In fact, the kit is specially designed for personal computer owners and is based on the National Bureau of Standards' data encryption algorithm. Included in the kit are a CryptoPrimer™ manual, a cryptographic system built around our WD 2001/2 data encryption chip, a convenient RS 232 connector and a special hardware manual. All for just $495. Best of all, you'll end up with more than a clue on how to implement all the benefits of data encryption. So send your check or money order (including $9.00 for shipping and 6% sales tax if you're a California resident) to: Western Digital, 3445 McCabe Way, Irvine, CA 92714. Please also specify your computer's make and model number.

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MUMFORD MICRO SYSTEMS

Box 310, [illegible] Sacramento, California 95867 (916) 969-4557

CIRCLE 313 ON READER SERVICE CARD

New Products, continued...

supply, user's manual, and a 16K Level II machine language cassette with six joystick games. The Model III requires an adapter cable. $124.95. A kit is available for $99.95.

Mega Systems Inc., 362 Park Lane, King of Prussia, PA 19406. (215) 337-3876.

CIRCLE 388 ON READER SERVICE CARD

MULTIFUNCTION CARD AND RS-32 ADAPTER FOR APPLE II

The Mountain Computer CPS Multi-Function Card provides the capabilities of a serial interface, parallel output interface and real-time calendar/clock on one card. Serial and parallel output may be used simultaneously from CPS.

CPS is configured from a set-up program on diskette which sets the parameters (such as baud rate, etc.) for all functions contained on the card and is stored in CMOS RAM on the card.

Mountain Computer Inc. also announces the RS-232 DB25 Pin Reconfiguration Adapter. Consisting of a printed circuit card with one male and one female DB25 connector mounted on it and incorporating a special "matrix switch," this device enables users to make almost any serial I/O device to any computer by remoting RS-232C signals.

The PRA eliminates the task of fabricating special cables or modifying existing cable wiring to achieve signal interfaces between a computer and peripheral I/O device, such as a modem, printer or terminal. A simple flat cable with DB25 connectors and the PRA adapter ties the proper signal lines together. $69.95.

Mountain Computer Inc., 300 El Pueblo Rd., Scotts Valley, CA 95066. (408) 438-6650.

CIRCLE 389 ON READER SERVICE CARD

DISK SYSTEMS

DISK DRIVES FOR H-89, H-8

Percom Data Company has announced add-on drives for Heath H-89 and H-8 computers.

Both 40- and 80-track versions of the "Z" drives are available and may be ordered in either one- or two-drive modules.

The 40-track drives work with all H-89/H-8 software, while 80-track units support HDOS programs after a minor change to the Heath disk-operating system is made. $[illegible]

Percom Data Company, 211 N. Kirby, Garland, TX 75042. 800-527-1592.

CIRCLE 381 ON READER SERVICE CARD

FLOPPY DISK SYSTEM FOR PET

CGRS Microtech, Inc. introduces a floppy disk system for the Commodore PET series of computers.

Petink II can be purchased with 5 1/4" or 8" disk drives. A small 2 1/2" x 5" disk controller board mounts inside the machine.

SORCERER SOFTWARE

SUPER ASTEROIDS by Apollo

'A new era in real time graphic arcade games'.

Never has there been such a captivating and superbly written arcade game for the Sorcerer. Styled after the well known and very popular ASTEROIDS DELUXE arcade game, SUPER ASTEROIDS is declared to become the most popular piece of domestic arcade software ever for players and users alike. Perhaps it is the outstanding use of fast line graphics or the silky smooth movement. Maybe it is the breathtaking sound. Exciting explosions, gripping sound effects or simply the challenge of avoiding those fast balls from that persistent flying saucer that relentlessly follows you across the screen. Whatever it is, we urge you NOT to purchase this game for fear that you may join the ranks of hundreds of other ASTEROID ADDICTS who, upward and billion need of 3 are just MUST have ONE more go at trying to beat that high Score.

The object is to guide a small space ship across the screen avoiding fast shooting asteroids as they spin past. When an asteroid is hit, it will break up into many smaller pieces, by repeatedly hitting the pieces they will soon disintegrate and disappear. If you score your ship into an asteroid it will break into pieces and spinner across the screen in a process of scatter. However if you manage to stay in one piece, whenever are you? have to pursued by a flying saucer that heavy fires of that fast that you beat him with care, after you they make his friends VERY aggressive.

Apollo has used a novel but ingenious method of constantly representing graphics characters with fast efficient screening results. All movement is done pixel by pixel but without speed loss. Numbers of asteroids, directions, speeds and swift like are all totally unpredictable. If you can show us a piece of software that has time, sensitive and faster graphics than SUPER ASTEROIDS, we guarantee to refund your money in full!

Cassette $29.95

ZAP80 'Secret Code Disassembler', by Ian Robinson

This is far from your average run of the mill documentation. Other than being a very 66 long, able to disassemble at the speed of light and packed with options, ZAP80 will display before your very eyes all those unknown instructions 28.05, never hide about! Ian has been doing extensive research into the primary of the Z80 processor when confronted with the 1500 is an unknown mystical beast so called 'illegal' code sequences. Over 100 of these yet VERY useful! Did you know you have extra 8 bit registers and a complete set of instructions to manipulate them? Did you know about more secret instructions?

ZAP80 will disassemble ANY code sequence flagging a illegal & will allow you to program secret codes that no other disassembler can decipher! Think about that ...

ZAP80 comes with documentation and explanation of all new mnemonics used. These versions are supplied that cause in low, mid and high memory. Options include ASCII output, screen speed and customised printer control.

Whether you are a serious programmer, a beginner or simply curious, ZAP80 is a piece of software you must have. Come and play a REAL scientist game!

Cassette $24.95

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ALL PRICES ARE IN AUSTRALIAN DOLLARS.
One Australian dollar equals 1.18 American and 1.4 Canadian. All programs come standard on cassette but some may be requested on either Microdisk 5 (Quad density or VISTA 5¼" diskettes for an additional cost of $5.00 per diskette). Note that more than one program will fit on a diskette. Programs available on diskette include CIRCLE, GALAXIANS, CROTHIR WARS and ZAP80.
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(714)735-1041

CIRCLE 296 ON READER SERVICE CARD

New Products, continued...

and contains the PDOS software ROM and all the disk control circuitry.

One, two, or three drives connect to the Polbit II controller board. The single drive 5-1/4" system retails for $595 and offers 180K bytes of storage. The dual drive 5-1/4" quad density system provides 572K bytes of high speed storage and retails for $1195.

CGRS Microtech, Inc., P.O. Box 1012, Langhorne, PA 19047, (215) 757-0284.

CIRCLE 362 ON READER SERVICE CARD

DISK SUBSYSTEMS FOR PERSONAL COMPUTERS

Maitlen Systems introduces the MX-800C, a disk subsystem compatible with Heath/Zenith 89, Apple II, TRS-80 Model II and all S-100-based computers.

The subsystem includes case, power supply, fan, cables and a choice of four different drive configurations: one single-sided drive ($1050), two single-sided drives ($1595), one double-sided drive ($1395), and two double-sided drives ($2095). Single/double density controllers and software are available at additional cost.

Maitlen Systems, 18444 South Broadway, Gardena, CA 90248, (213) 327-1010.

CIRCLE 363 ON READER SERVICE CARD

MISCELLANEOUS

LEARNING SYSTEM OFFERS INTERACTIVE VIDEO CAPABILITIES

Coloney Productions announces Carrel, a custom-built student learning station.

The system includes a 48K Apple II Plus computer, disk drive, laser reflective videodisc player, 12" color monitor, audio amplifier, stereo speakers, and the Coloney interface package housed in a fiberglass and wood carrel.

The interface package consists of a videodisc control card, video switching and junction box, cables, operating software in Basic and Pascal, and system documentation. The interface switches the computer and videodisc output to a single monitor where they can be combined in Computer Assisted Instruction applications.

The complete system sells for $6500. The carrel is available separately for $800.

Coloney Productions, 1248 Blountstown Hwy., Tallahassee, FL 32304. (904) 575-0691.

CIRCLE 384 ON READER SERVICE CARD

"Does the repair man? Did you find me the new programs?"

computer store of the month

Computer Center, New York

Numerous computer stores sell Creative Computing Magazine, Press, and Software. In this issue we are spotlighting Computer Center, N.Y. We would like to recognize their salesmanship, success and service to the community.

No visit to the "Big Apple" would be complete without a visit to the Computer Center, one of New York's fastest growing computer chains. The management team at the Computer Center believes in customer support and education and interested beginners and visitors alike browse in a relaxed atmosphere. Due to the free advice and information provided, most customers "get involved" with the store because of the attention they receive and desire for additional knowledge.

Futuristic decor in the store lends visual appeal that touches everything from mirrored walls to the brightly lit display units that bring together the largest selection of computer software and "state of the art" technology in the country today. With something for everyone, the product lines include Creative Computing Magazine, Press, and Software as well as Cromemco, Hewlett Packard, NEC, Atari and Apple.

The Computer Centers are located at 31 East 31st Street and 460 Madison Avenue and a third store presently being planned is due to open late this year. The New York phone number is (212) 889-8130, from outside New York you can call toll free (800) 221-3144. If you are ever in New York, stop in and see them.

ECHO SERIES™ SPEECH SYNTHESIZERS

COMPUTERS ARE SPEAKING OUT!

Now you can add intelligible speech to your computer without using vast amounts of memory! The ECHO II™ speech synthesizer for the Apple* is the first of a series of synthesizers based on the same technology that made the Speak & Spell** a success.

The initial operating system allows the creation of your own vocabulary with phonemes (word sounds) while using very little RAM memory (approx. 600 bytes + 20 bytes/word). Enhanced operating systems and vocabulary ROMs will be offered as they become available.

The ECHO II™ comes complete with speaker, instruction manual, and a disk containing a speech editor, sample programs, and a sample vocabulary. Suggested list price is $225.

See your dealer or contact:

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** Trademark of Texas Instruments

CIRCLE 249 ON READER SERVICE CARD

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7 Industry Leaders Offer Their Views

The Future of Personal Computers

How will personal computers change our lives in the future? How will the equipment and its applications evolve in the coming years? What roles will personal computers have in society?

The world's leading authorities on personal computers provided some insightful answers at The Boston Computer Society second annual Forum on the Future of Personal Computers, October 15, 1981.

• **Philip D. Estridge**, Director, Entry Systems Business, International Business Machines, Boca Raton, Florida. Mr. Estridge—the creator of IBM's new personal computer—looked into the near future and "The Next Steps for Personal Computers."

• **H.E. James Finke**, President, Commodore International Ltd., Norristown, Pennsylvania. Mr. Finke gave his perspective on the explosive growth of microcomputers with "The Mass Market Micro: The Future Ain't What It Used to Be."

• **William H. Gates**, President, Microsoft, Bellevue, Washington. Mr. Gates—the father of microcomputer software—provided an inside look at "Things to Come in Personal Computer Software."

• **A.C. (Mike) Markkula**, President, Apple Computer Inc., Cupertino, California. Mr. Markkula examined forthcoming breakthroughs in personal computer technology in his talk "Making Computers Easier to Use: Trends in the User Interface."

• **Peter Rosenthal**, Marketing Manager, Atari Computer Division, Sunnyvale, California. Mr. Rosenthal offered a vision of "The Home Computer of the Future" and its impact on our homes.

• **Jon Shirley**, Vice President, Radio Shack Computer Merchandising, Fort Worth, Texas. Mr. Shirley explored the business applications of future computers with "Personal Computers in the Office of the Future."

• **Nigel Searle**, Vice President, Sinclair Research Ltd., Cambridge, England. Mr. Searle considered the impact of personal computers on consumers in his talk "The Consumer Marketplace for Future Personal Computers."

Moderated by Jonathan Rotenberg, President, The Boston Computer Society.

All seven presentations along with questions and answers are available on two C-90 tape cassettes (2-1/2 hours) for $25 postpaid. If you would also like to subscribe to *Small Business Computers*, add $12 to your order ($37 total). Or, to subscribe to *Creative Computing*, add $20 ($45 total). Send payment or credit card number and expiration date (Visa, MasterCard, American Express) to the address below or call our toll-free number.

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