

ST-LOG

THE ATARI ST
OPERATOR'S
MAGAZINE

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ISSUE 8

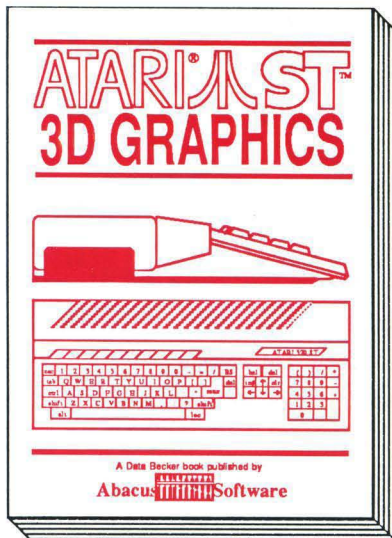


THIS ISSUE:
Alert boxes
ST status report
C compiler reviews

STR

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and another... and another...
and another... and another... and another...



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ST DISK BONUS PROGRAM

Stock Performance Tracker James Luczak 49ST
Track up to 50 stocks, with as many as 250 quotes each.

Status report D.F. Scott 51ST
Atari's plans—for the ST line and beyond.

Printer graphics tutor Matthew J.W. Ratcliff 66ST
Bit-image graphics are within your grasp with this tutorial.

Alert boxes from ST BASIC Matheu Spolin 82ST
The *how-tos* for getting those message boxes into your programs.

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Megamax C (Megamax, Inc.)
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Two impressive C compilers are examined and compared.

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Ian is in the market for entertainment software—and finds it's no game.

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BONUS DISK PROGRAM

by James Luczak

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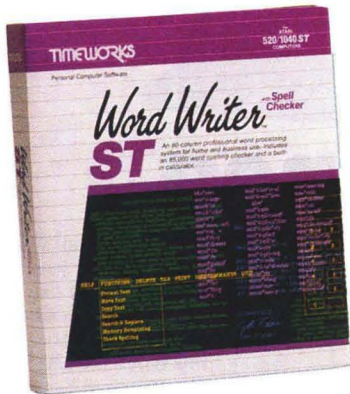
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Jim Luczak maintains and operates electronic telephone switching and processing equipment. He's been writing computer programs since 1979. He bought his first Atari in 1980, and has written programs in BASIC, C, LOGO, FORTH, Action!, and 6502 assembly. He enjoys writing dedicated database programs.

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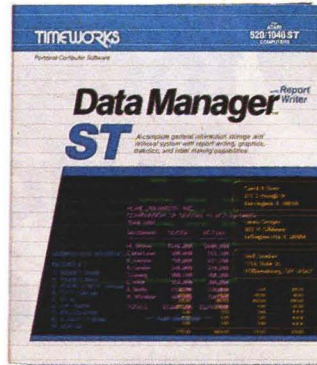
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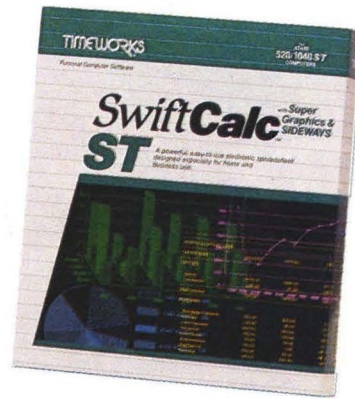
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Status report

ST SECTION

Just how is Atari's future (and that of the ST) shaping up?

by D.F. Scott

This article explores issues vital to the future of Atari Corp. Among our sources are: Michael Katz, Executive Vice-President in Charge of Entertainment Electronics; Leonard Tramiel, Vice-President in Charge of Software; Shiraz Shivji, chief developer of the "blitter" chip for the ST; and Jim Tittler, developer of the ST's IBM PC-compatibility unit. Other sources have asked to remain confidential and not be directly quoted.

The material here is the ST-oriented portion of a complete overview of Atari Corp.'s plans and possibilities. We suggest, to obtain the comprehensive picture, readers also refer to the 8-bit section of the report, on page 13. The future of Atari is dependent upon all of its products.

First things first. . . the TTs are coming.

A new machine is in the works, and it's shrouded in misinformation. From Atari's own corporate heads, with the inconsistencies ironed out, here's what we're free to assume: the CPU of the TT (Thirty-two/Thirty-two) will be the 68020, supporting a 68881 math co-processor. One obvious benefit from the use of these chips: full communicability with the ST. The CPU will not be National Semiconductor's 32000, as previously thought.

The operating system will be UNIX V, the full multi-user version by AT&T. Current implementations of this multitasking system give programs or tasks an operating priority alongside physical devices, as if each program were a "virtual device" in

itself. They also feature exclusive access to a "C-shell," or a type of runtime package which handles C-language routines in a manner more familiar to GEM users.

The TT exists now. Prototype units are running in the labs. Several Atari sources are describing the TT as "VAX-in-a-box." It's obvious someone high up at Atari wants employees and the media to promote the product in that manner.

One Atari source compares the TT to products from Apollo, a company based in Chelmsford, Massachusetts. Apollo now manufactures graphics workstations based on the 68020. These, like the TT, have a 2 Mb RAM base. Using 68881 floating-point co-processors, Apollo's Domain workstations are clocked at 16 MHz. A color raster display of 1280x1024 pixels chooses from a palette of 16 million colors in analog representation. It can plot 100,000 floating-point-transformed 3-D vectors per second, with an area-fill rate of 125-million pixels per second. We're no longer in the Amiga's ballpark.

Atari's projected TT price tag is from \$1,200.00 to \$3,000.00. But Atari's marketing department is stalling. Apollo is a relatively small company, with small sales figures, on the Atari scale. By one estimate, if Atari scores nearly as well with the TT as Apollo has with Domain, Atari could sell 50,000 TTs annually, an amount considered "disastrous" by Atari standards.

Atari is currently considering several final packages for the TT. The leading candidate would use the ST as an input/output device, linked through the TT's Direct Memory Access port. It would then be, in a sense, an ST upgrade (yet another one,

as we shall see). But shipping the TT in this form alone may confine TT owners to a subset of ST owners, limiting the machine's market potential.

Atari also has to consider the question of user support. It disconnected its 800 phone number years ago, so it relies solely upon computer specialty stores for user service and education. Where department stores are concerned, Atari relies on the owner's manual for user support. How then can a corporation market a machine, one it claims will outperform two DEC VAX 760 mainframes, with nothing more from the manufacturer than a 90-day warranty?

There are education and support centers in chain stores, known as Value-Added Resellers. VARs haven't considered Atari products for an instant. The most likely reason isn't the mass-market name, but the need for a big value to add to in order to resell. In other words, "Power without the Price" is powerless to VARs, and VARs are the Apollo domain. Direct competition is most likely out.

So the TT's domain may be the specialty store, where a corporation's systems analyst or consultant may not expect to find a 32-bit UNIX workstation. At the specialty store, it could be sold in a variety of package deals.

Here's where the machine may find its saving grace: it's a multi-user workstation. Buyers would purchase more than one ST for terminals, maybe even enough to outfit an entire office.

On the bad side, specialty stores currently committed to Atari might not be able to afford to keep enough STs in stock for that kind of low-price, high-quantity buying.



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However, if the price were low enough, (and it should be), a company placing a large order might just find the patience to wait a mere couple of weeks.

The TT also interferes with Atari's plans for the ST. If a more-capable ST than the 1040 were to emerge—say a 2080—that machine would go to the specialty stores, and the 1040 would be moved to the mass-market arena. But the 520 is a smart enough terminal. With half a megabyte and a 68000 CPU, "genius terminal" is a more fitting term. Unfortunately, Atari has handed the 520 solely to the mass-market; and the corporation consultant is unlikely to go to a department store for a set of office terminals.

Atari may have to go back on its promise to mass-merchants and market the 520 in specialty stores once again. Or it may rely on private wholesale distributors to sell the 520 to specialty dealers. The idea has not yet been discussed publicly, but in this reporter's opinion, Atari could produce a downgraded 520 terminal-only machine as part of a TT package deal. This way, the TT may—or may not—connect to the ST.

Certainly the TT is too much computer for checkbook-balancing and recipe-filing. It would play the meanest game of *Star Raiders* the galaxy has ever known. But Atari is afraid the buyer may stare at this colossal product of progress and ask, "So, what's it for?"

Consider the following: the Macintosh has practically created the desktop publishing industry. The ST is giving birth to the home computer artist. I see a revolution in which the TT will be the catalyst: *desktop engineering*. The 32-bit mass-market micro may give birth to the freelance engineer. Optimistically speaking, the whole industry may flip over forward—and the creative, tinkering programming geniuses may finally have their turn in space.

As one Atari spokesman put it, "this is the future."

ST Hardware.

This is the present. If ever there's to be an Atari star, the ST is bound to be it. At every major show, wherever there's an ST, there are hundreds of awestruck people in front of it. The future right hand of the TT is currently breaking ground quite well on its own.

Atari itself, though, sees the ST (Sixteen/Thirty-two) in a different light: as an incomplete machine. Its other half is still in the lab. The promised "blitter" enhancement, for instance—(the chip that can move blocks of memory, virtually at once) is still being tested. GDOS, the portion of the ST's Virtual Device Interface currently missing (the part that would allow the machine to perform object-oriented graphics tasks) is promised in program form for the near future, until its ROM version becomes Expansion #1. Atari admits that

GEMDOS, which controls computer input/output, is bug-ridden, but Digital Research, its author, may not be willing to debug the system. Atari may perform this task itself—which makes for ROM Expansion #2. Finally, when the blitter chip arrives, the entire screen graphics system will change. Output may appear similar, but will be plotted much faster. This makes for ROM Expansion #3.

We can expect GDOS soon, perhaps by press time. The new GEMDOS is slated for January. The blitter may not be ready that soon. Until Atari can finally say the ST is a complete machine, third-party software development may be put on hold.

The blitter chip was originally billed as an enhancement to the 1040, but Shiraz Shivji tells us it's now being worked into the 520's architecture. No decision has been made concerning where to seat the chip in the 520 (the 1040 should have a slot for it) but, as Shivji points out, "It's not going to be through the user port. Our intent is to be able to upgrade all the 520s that are out in the field."

"The way this co-processor works," says Shivji, "is that it sits on the bus until it's invoked. Obviously, you'll need the soft-

ware to invoke it." Which may mean it waits for GDOS.

Shivji also stated that the new chip will not be as much of a graphics enhancement as some have been led to believe: "Let me make this perfectly clear: It will not give you greater resolution. It will not give you more colors. It gives you a lot more speed. I also need to add that it is a *transformation engine* that you can use, not just for display. With the blit operation—block move—you can do the screen, or you can use it for other areas of memory, other applications not involving the screen."

Lab tests are currently showing an average speed increase in the ST by a factor of five with the blitter chip. While it's Atari's latest response to the Amiga, the chip is also reminiscent of technology present in the Atari 8-bit product line, which programmers have grown to respect.

As we've noted, Atari is venturing deep into IBM territory, hoping to carve a niche for itself in the "business," or "serious" market. Atari has no emulator for the IBM corporate image, but that image is either heralded greatly or criticized greatly, and many PC-clone buyers made their purchase just to spite Big Blue. Anyway, Atari



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is now targeting the market whose buying decisions seem to rely upon reports of what IBM corporate executives ate for breakfast.

Thus the PC-compatibility attachment to the ST—as yet unnamed, so I'll just call it the Big-Blue Box (or 3B, for short). Its developer, Atari's Jim Tittsler, tells us it contains the expected 8088 CPU, which can use the ST's 68000 as a co-processor if necessary, and will support an 8087 math co-processor. Using the ST's I/O (which is reportedly being revised in the new GEMDOS), it hogs the space of the full ST monitor. In other words, the models currently being tested override the ST, though future software enhancements may allow a PC task to run in a separate window of ST GEM, while the ST is doing something else. No word yet whether 3B will have its own RAM, but it probably won't have its own 5¼-inch disk drive—instead, slots will be available for 5¼-inches, and the current SF354s and 314s may be used for 3½-inch IBM-formatted software.

According to Tittsler, the prototypes are currently allowing upgrades of PC files to ST-legible files, most notably from Lotus

1-2-3 to **VIP Professional**, and from dBase III to **dBMan**. The speed at which some PC applications are run may be faster or slower on the 3B than on the PC, unless an 8087—or perhaps the acclaimed V20 chip—is used.

While downplaying his own product, Tittsler describes its intended market: "Mostly we see this as a bridge to let people take advantage of their older software, because you can get better performance with software that's written directly for the 68000. . . . If (people) have spent a large portion of their lives learning how to effectively use Multiplan or something, they don't want that training to be useless."

Tittsler, further downplaying his product, calls it "just an add-on appendage. . . . It's intended to give the people who have STs—or who want to take advantage of the newer technology of an ST—the ability to still run older-generation software." He admits it's possible, but not likely, that Atari may write software specifically for the 3B.

So it's obvious that Atari is seeking the buyer who was at first taken aback by the ST's dazzling appearance, the one who, after seeing **Neo-Chrome**, **1st Word**, and **dB Master One**, asked, "Yeah, but what does

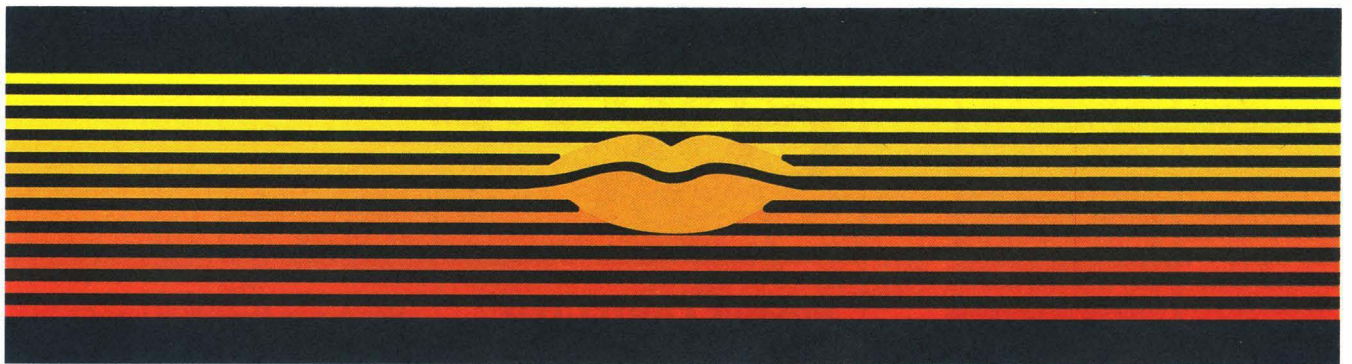
it do? Can it run Lotus?" The company is also attempting to sway the person who invested thousands in 8086/8088-based software into finally taking the step to use of the next-generation computer.

Atari hopes to speed up progress in plugging the numerous small holes in the ST. But, in reviewing this report, one may get the impression that Atari wants to *slow down* progress just long enough to profit a bit more from its spoils. It's easy to see why. It would be a major blunder for Atari to cast the yearling ST into the realm of obsolescence by introducing a 32000-chip-based system for about the same price.

So the TT will run on a 68020, and thus become a family member, paired with it like a brother. The box I call the 3B is Atari's attempt to profit from the fact that IBM is viewed as the axis upon which the computer world revolves. At its surface are the clones, held there by the centrifugal force of repulsion from the corporate axis. There's still a profit to be made from the older generation—until the ST's earthquakes settle—and 68000/68020-based machines constitute the new axis.

ST Software.

In the process of turning heads, Atari



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Corp. has acquired some frustrated ST owners. The library of ST software is growing steadily, but is still not as profuse, or as well-backed, as the older generation of software. The ST owner's frustration occurs while awaiting a breakthrough. It's here we see Atari trying to speed up progress, to make Atari into Big Grey.

To that effect, there's good news: Microsoft is joining the ST league. It is working with Atari to make a GEM-based version of the blockbuster program **Word** for the ST, to be called either **Word** or **Write**. One source says the program should resemble **Word** for the Macintosh. Another states he feels Microsoft is unsure what the program should resemble, since the company must undergo the humiliating task of adapting **Word** to GEM, a product of rival Digital Research. A superior **Word** using GEM may jeopardize the future success of the version which employs Microsoft's own **Windows**.

Word, both for the Mac and the PC, includes extended laser-printer support, beyond mere dot-matrix. It's considered by many to be a tool for desktop publishing, an industry made possible (in large part) by the Macintosh. Of desktop publishing, Leonard Tramiel says, "That phrase is so overused that it no longer means anything."

"As far as being able to support a laser printer is concerned," the Vice-President continues, "there's half-a-dozen laser printers out there, which emulate so many different (dot-matrix) printers that any product can support laser power. . . So virtually every word processor at this point supports laser printers; it's actually difficult to write one that doesn't."

Beyond the emulation of dot-matrix printers, Tramiel is unsure that preprinting layout will be a feature of **Word**, saying, "I'd have to be clairvoyant to tell you." Contradicting other sources, Tramiel confirmed that Atari is working with Microsoft to develop a superior product.

Superior or mediocre, Atari has scored a victory in acquiring Microsoft's assistance. There's only one microcomputer I can name, to date, which has thrived without being somehow shaped by the hand of Bill Gates at Microsoft, and it is the ST. That should be an indication of the machine's strength—it has independence, not "compatibility."

It's not indication enough, though, for Lotus Development Corp. (1-2-3, Jazz) and Ashton-Tate (dBase III, Framework, MultiMate), the two other largest software manufacturers. Both, according to one source at Atari, are ready and willing to write versions of their best for the ST, provided the magic number has been reached: 1,000,000. Once a million STs have been sold, and a huge worldwide customer base established, we'll see the world's best-selling programs running on an Atari.

Then, it will be no contest. All the buyer's excuses will be gone. The ST will run the best, and run them better and faster than anything else. If there's something that wouldn't otherwise run, the 3B box or DataPacific's **MacCartridge** (which Atari is staying clear of, due to possible legal action by Apple) will make it work. But we need a million out there, and that won't be easy.

Where do we stand in the meantime? We have Microsoft on our side now. **Word** will be first; and, of course, there will be MS-DOS for the 3B box. Without the box, the ST will run **dBMan** and **VIP Professional**, which generate results so close to their IBM-league work-alikes that Jim Tittler's men can successfully convert files from one program to the other—without any noticeable difference.

Atari admits the current version of **ST BASIC** is bug-ridden, perhaps even a mistake. Microsoft may remedy that situation, and indications from Atari are that, with the necessary money, we may see an MBasic interpreter for the ST.

With so many companies marketing utilities and programming languages for the ST, what could possibly be lacking? Atari's answer comes in two names: Lotus and Ashton-Tate. Atari would like to see those companies join the list of ST developers, for the sake of their names alone. After all, if the genuine items run on the ST, it must be a solid machine (in the eyes of potential dealers). And that will be seen when there are a million STs "in the field."

So Atari is wondering how to sell a million, and here's where the "TT" comes into the picture. The TT will sell STs for "genius terminals." A small office complex could use (and afford) a TT system networking a half-dozen STs, giving the 16/32-bit machine an entirely new, broad-scope market.

Imagine a TT system with an ultra-high-resolution display. In one corner of the display, dBase III is sorting out metal parts. In another, **Word** shows a document detailing the cost of those parts. In a third, the IBM-emulation window is running a 3-D tally spreadsheet like **VP Planner**. In the ST window, there's a **Neo-Chrome** diagram of a part. Finally, in the center, the TT is rotating a 3-D cutaway image of the future shuttle booster rocket.

This type of technology is not just a possibility; if marketing comes to a decision soon, we may be seeing a TT/ST component system in retail outlets by late 1987. It could carve a new niche as the first 32-bit machine capable of running the familiar software of the 8/16-bit era.

This does pose a problem for **ANALOG Computing**: will this mean another schism in readership? We hope not!

But onward . . . if there's anyone Atari supporters feel threatened by, it's the potential dealer or buyer who publicly

claims that the company responsible for **Asteroids** is incapable of manufacturing the TT—that game-playing and data-processing are two separate worlds, and ne'er the twain shall meet. By now, we're well acquainted with the person whose guilty conscience brings forth the statement that only kids play video games; adults are too busy doing *real* computing to notice. Too often creativity gets tossed aside in favor of "productivity." Still, as presented in Orwell's 1984, the notion that some higher person is watching over our every move, passing judgment over our productivity, is a mistaken one—that is, unless we are captives of our paychecks.

Entertainment Electronics.

Atari's roots are in game machines, and that's nothing to be ashamed of. The creative genius who invents or programs a computer is the same genius who toys around with it. Still, the 8-bit Ataris have always had to be proven and fought for. It's as if the machines themselves were a cause, like unionization or the abolition of apartheid.

Atari began with game machines. The mind that will play for hours will, often, program in a creative way, will invent a new kind of wheel. Having its roots in the game market makes Atari Corp. no less a computer in the business world.

The current ST line is bringing Atari into the ring in the "real" world. It is creating a vital excitement in the computing community. And the "game machine" revenue feeds the growth of all Atari products.

Atari has some choices to make, directions to choose. But, if Jack Tramiel has proven anything, he's shown the world that Atari's options are wide open. **A**

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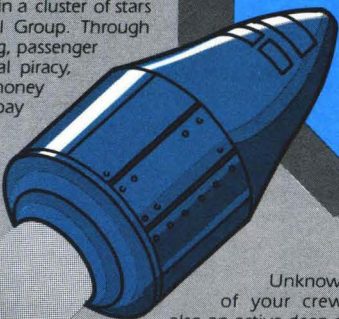
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WHAT IS ST-CHECK?

Most program listings in **ST-Log** are followed by a table of numbers appearing as DATA statements, called "ST CHECKSUM DATA." These numbers are to be used in conjunction with **ST-Check** (which appeared in **ANALOG Computing/ST-Log** issue 41).

ST-Check (written by Clayton Walnum) is designed to find and correct typing errors when readers are entering programs from the magazine. For those readers who would like copies of the article, you may send for back issue 41 (\$4.00).

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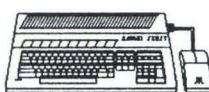
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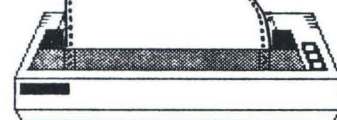


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• GEM BASED

C-MANSHIP

by Clayton Walnum

Everyone give a hearty cheer. This month we'll be finishing up the most grueling details of programming in C, so that next month we can start learning about GEM. It's been a long time coming, but you can't bake a cake until you've heated the oven, right?

Last month's program listing overflowed with new material. Consequently, we didn't have time to cover most of the program's details. So guess what the first item on the agenda is? If you have last month's listing, take it out. Otherwise, just read along; I'll try to make this as self-contained as possible.

Unfinished business.

At the top of the listing, beneath the block of defines, you'll see a function, `fopen()`, being declared as returning a pointer to type `FILE`. If you think back, you'll remember that any time a function is going to return something other than an integer, it must be declared. But what the heck is `FILE`, anyway? We've never discussed this data type, have we?

Actually, in a way, we have. Last month, we talked about structures—data types that are specifically tailored by the programmer. `FILE` is a structure defined in the `stdio.h` file, containing the data elements required to handle file I/O.

Wait a minute. That `fopen()` isn't our function. Except for the function calls, this guy is nowhere to be found in our program listing.

That's true. It's a library function. Now, one would think that, if whoever composed the `stdio.h` file went to all the trouble to set up the `FILE` structure, he would have at least gone to the extra effort to make `fopen()` "ready to go," by declaring it as returning a pointer to `FILE` and finishing the job.

For some strange reason, the version of `stdio.h` that comes with the Atari developer's kit doesn't include the declaration, so we must do it ourselves. If you have the Megamax compiler, however, you can delete this declaration from the program; they *did* award us the courtesy of finishing the job.

By the way, the sample listing we're discussing was developed using the Megamax-C development system. I included the function definition only to make the listing more compatible with the Atari development kit.

As for the file declaration for `fclose()`, you can ignore it. It was included in error and is unnecessary, since this function returns an integer, not a pointer to `FILE`.

A quick look at GEM.

Just beyond the file declaration for `fopen()`, there are declarations for a number of global arrays: `work_in[]`, `work_out[]`, `ctrl[]`, `intn[]`, `ptsin[]`, `intout[]`, and `ptsout[]`. If you've looked at some of the C source code for various GEM programs in the public domain, or those published in magazines, you've noticed that these arrays are almost always present. In fact, you've probably seen some of them used in ST BASIC programs, as well.

All the above arrays have one thing in common: they provide GEM a place to store or retrieve information about the program. This information can then be easily manipulated by the programmer.

I know, I know. I told you we weren't going to be getting into GEM until next month. But we are going to learn a little about initializing a GEM program, since the cursor control functions I used in last month's listing are found in the VDI portion of GEM.

What's VDI? GEM is made up of many libraries of functions, each of which is responsible for handling a certain portion of the system's activities. These libraries are

// C-manship *continued*

grouped into two major units, called AES (Application Environment Services) and VDI (Virtual Device Interface). The libraries making up the AES handle such things as windows, dialog boxes, menu bars and event processing. (An event is some action from the user, such as typing a letter or moving the mouse.) The VDI contains the subroutines to control the ST's graphics, as well as some mouse and cursor control functions.

Since GEM is capable of handling several programs at once (such as using a desk accessory with a word processor), there has to be a way of keeping one job separate from another. GEM tackles this by assigning each program and its associated device (in our case, the screen) a "workstation" which can then be referred to by an identifier known as a "handle." The first thing any GEM application must do is open a workstation.

Which brings us back to the arrays that started this discussion. When we open a workstation, we have to tell GEM how we want the system's attributes initialized. What color should the text be? And should it be shadowed? Or maybe bold? What style fill do we want? Solid? Checkered? All these attributes should be placed in the array `work_in[]` before we open the workstation, since that's where GEM is going to expect to find them.

We're not going to worry, at the moment, which elements of the array hold information for which attribute. We're just going to take it on faith that `work_in[10]` must be initialized to 2, and the rest will be perfectly happy at 1.

After we've set up the array, we tell GEM to open the workstation with the `v_opnvwk[]` call:

```
v_opnvwk(work_in, &handle, work_out);
```

The parameter `work_in` is the address of our array `work_in[]`, which contains the attribute information we wish to pass to GEM. And `&handle` is the address where GEM should store the handle, the integer value that will allow us to refer to this program's workstation. In our sample program, it's the address of the variable `handle`, which is defined after the `work_in[]` and `work_out[]` arrays at the top of the listing. The parameter `work_out` is, of course, the address of our array `work_out[]`.

When we open the workstation, GEM will load the `work_out[]` array with all the information a programmer needs about the workstation. For instance, `work_out[12]` will contain the number of hatch styles available, while `work_out[13]` will contain the number of colors that can be displayed at one time. We don't have to be concerned with this information now, but it is important that you understand why we need these two arrays.

You can see the mechanics of opening a workstation in the `open_vwork()` function of the program listing. Also, at the end of `main()`, notice the function call:

```
v_clsuvw(handle);
```

This closes the workstation to further output. The argument `handle` is the device handle passed to you by the `v_opnvwk()` call.

And a peek at VDI.

The remaining five arrays, `ctrl[]`, `intin[]`, `ptsin[]`, `ptsout[]` and `intout[]` are directly associated with the VDI. The first

three are used to pass information to the VDI routines, while the last two provide a means for the VDI to return information to the program. These arrays are used by GEM for its own purposes; you need do nothing more than declare them at the beginning of your program. It's ironic that, although C is considered to be a lower-level language than BASIC, when manipulating the VDI from ST BASIC, you must deal with the VDI arrays yourself rather than leaving them to the system.

Moving along.

If you've spent the time to examine last month's program listing, you were probably wondering what was going on with the function call:

```
Cconws("FIRST NAME: ");
```

This function does nothing more than write a string to the screen. Why didn't I just use `printf()` and avoid all this confusion? It has to do with another discovery I made concerning Megamax-C. With Megamax, `printf()` won't print anything until it encounters a `\n`. This makes handling prompts tricky, if you want the user's input on the same line as the prompt. Resorting to `Cconws()` solved this problem.

Another new function call, `fscanf()`, was used in the sample program in the `disk_file()` function.

```
fscanf(p_file, "%d", &num_recs);  
fscanf(p_file, "%s", recp->street);
```

This is similar to `scanf()` except it retrieves and formats information from a file, rather than from the keyboard. In fact, the only difference between the two calls is the addition of one argument, the pointer to the FILE structure. Otherwise, it contains the same conversion specifications as its cousin, followed by the addresses where the data should be stored. The first example above reads an integer from the file and places it in the integer variable `num_recs`. The second reads a string from the file and places it in the structure member `street`.

The opposite of `fscanf()` is `fprintf()`. In our sample listing, it's called within the function `save_file()` like this:

```
fprintf(p_file, "%d\n", num_recs);  
fprintf(p_file, "%s\n", recp->city);
```

This function is almost identical to `printf()`, the only change being the extra argument, the pointer to the FILE structure.

In the first example, we're printing to the file the integer value stored in `num_recs`, followed by a newline. In the second, we're printing to the file the character string stored in the structure member `city`, also followed by a newline.

The VDI cursor stuff.

If you look at the functions `screen()` and `pos_cur()` in the program listing, you'll see the cursor control function calls I mentioned earlier. In order to take advantage of these functions, you must first make the call:

```
v_enter_cur(handle);
```

This gets you out of graphics mode and into text mode. In this function, as with all the following, `handle` is the workstation identifier that was returned to you by the `v_opnvwk()` call.

We can position the cursor anywhere on the screen by

passing the X,Y-coordinates to the function `vs__curaddress()`:

```
vs__curaddress(handle,y,x);
```

Notice that the coordinates are passed in the opposite order of what you'd expect; that is, Y followed by X. Also, keep in mind that we're now in text mode. The cursor location is based on character positions, not raster coordinates. In medium-resolution text mode, the screen's size is interpreted as 80x24, whereas in graphics mode it's 640x200. Quite a difference!

Printer output.

I don't know if it's a difference between Megamax-C and the Atari development kit, or just plain bad luck, but I had an awful time getting printer output. I have a feeling the solution I incorporated isn't as elegant as it might be, but I had to settle for it under the pressure of time. So, with that disclaimer in mind...

Take a look at the function `printer()` in the sample listing. The first thing we have to do is check to see if the printer is on.

```
status = Cprnout(0);
```

The line above accomplishes this by sending a null character to the printer. If the printer times out, a 0 will be returned by the function. Another way to check the printer is with the function `Cprnos()` which returns a nonzero value if the printer is ready to receive:

```
status = Cprnos();
```

We then open a file to the list device:

```
p__file = fopen("LST:", "w");
```

After this call, `p__file` will contain a pointer to a structure of type `FILE`. The first argument passed to `fopen()` is the filename, in this case, the list device. The second parameter tells the function the attributes we want the file to have. There are six possibilities:

```
r...read only
w...create for writing
a...append (write at end of file)
r+...update (read and write)
w+...create for update
a+...random read or write
```

If the open was not successful, the function will return a null pointer.

Now comes the tricky part. The file we just opened is a disk file. We want to send the output to the printer. The pointer `p__file` is now pointing to our `FILE` structure. The fifth member of this structure, `__fd`, is a file descriptor. If we replace the value in `__fd` with a 3, we'll fool the system into sending the output to the printer:

```
p__file->__fd = 3;
```

Now, we can output the data using `fprintf()`. When we're done, we close the file:

```
fclose(p__file);
```

The function `fclose()` will return a 0 if successful, or an EOF (-1) if an error is encountered.

Finally, since we ended up opening a disk file, we want to get rid of the evidence:

```
unlink("LST:");
```

The function `unlink()` will remove the directory entry for the filename passed. It returns a 0 if successful, or a -1 if an error is encountered.

The problem with the above method of obtaining printer output is that a disk must be present in the drive.

Odds and ends.

That covers all the material from last month's sample program. We have a final task to complete, before we can move on to GEM: touching on a few details of the C language we haven't yet covered.

What do you make of the following line?

```
z = (x < 4) ? x : y;
```

Believe it or not, this is nothing more than a shortcut version of:

```
if (x < 4)
    z = x;
else
    z = y;
```

The `?` is a conditional operator that requires three operands. The first operand (within the parentheses) is the expression that's tested. If it's true, the statement yields the evaluation of the second operand (between the `?` and `:`). If the first expression is false, the statement yields the evaluation of the third operand (between the `:` and `;`). Here's another example that'll get the highest value of two variables:

```
highest = (x > y) ? x : y;
```

C also has a construction similar to BASIC's `ON...GOTO`:

```
switch (exp) {
    case 1 :
        printf("exp = 1");
        break;
    case 2 :
        printf("exp = 2");
        break;
    case 3 :
        printf("exp = 3");
        break;
    default :
        printf("exp < 1 or > 3");
}
```

The switch statement works by first evaluating the expression in the parentheses, then checking the following labels to see if there's one that matches the expression's value. If there is, program execution jumps to the matching line and continues until it encounters the statement `break`. But what if there's no match? What if, in the above example, `exp` is not 1, 2, or 3? That's where the label `default` comes in. Program execution will jump to this line if none of the other labels match. Otherwise, if there's no default, it'll jump to the next line following the end of the switch statement (after the closing brace).

What happens if we leave out the `break` statements? Remember I said that, once the expression following `switch` is evaluated, the program jumps to the matching label and continues until it encounters a `break`. The program doesn't care if there's no `break` before the next label. It'll go on, past the succeeding labels (ignoring them), and execute every statement it finds—until it either finds a `break` or reaches the closing brace. In the example above, if we left out all the `break` statements and `exp` evaluated to 2, the

output would look like this:

```
exp = 2exp = 3exp < 1 or > 3
```

Under the same conditions, if exp evaluated to 3, we would see:

```
exp = 3exp < 1 or > 3
```

A new loop.

We've become very used to the while and for loop constructions. Both these are entry condition loops; that is, the loop conditional is checked *before* each iteration of the loop. There's another loop construct we've ignored so far, the do while loop.

The do while construct is an exit condition loop. The loop conditional is evaluated *after* each iteration:

```
x = 0;
do {
    ++x;
    printf("x = %d\n", x);
} while (x < 4);
```

The above would print values of x from 1 to 4. Contrast that with:

```
x = 0;
while (++x < 4) {
    printf("x = %d\n", x);
}
```

which will print values of x from 1 to 3.

And now...

break, continue and goto.

We talked about the break statement earlier, in conjunction with switch, but it can also be used to get out of for, while, and do while loops. When used in a nested loop construction, it only terminates the loop in which it's used. The outermost loops will continue normally.

```
while (x < 10) {
    while (y < 10) {
        if (y == 5)
            break;
        else
            printf("y is not 5\n");
        ++y;
    }
    ++x;
}
```

Another method of affecting loop execution is with continue. When continue is encountered within a loop, the loop doesn't terminate, but, instead, starts the next iteration.

```
x = 0;
while ((ch = getchar()) != '*') {
    if (ch == '\n')
        continue;
    s[x++] = ch;
}
```

Finally—though I hate to mention it, due to its inevitable abuse—C has a goto statement. The keyword goto is followed by the label identifying where program execution should continue:

```
goto print_name;
```

```
print_name: printf("Name: %s", name);
```

Quite frankly, there's little or no use for the goto statement in a structured language like C. The same goes, though not as strongly, for break and continue, except when the former is used within a switch statement. There's almost always a more structured and elegant way to get around the use of these statements. If you're a BASIC programmer, it will take you a while to get accustomed to structuring your programs in such a way as to avoid the use of a goto. But, trust me, it can be done—and the results are much more readable than BASIC's typical tangle.

The end again.

Next month, as I promised, we'll begin programming with GEM. I know you've been waiting a long time, but you'll find your patience rewarded. Now that you know most of the fundamentals of programming in C, it's time for some fun! ☐

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CIRCLE #136 ON READER SERVICE CARD



IAN'S QUEST

ST news and information

by Ian Chadwick

I think I'll write a column about games. That should be easy, right? I already know and enjoy **Time Bandit**. I'll just drop by the local Atari dealer, watch a bunch of screens, take notes, then come home. Nothing to it: add a passel of sage comments to my notes and I have a column. Okay...

"Got anything new in games? Like chess? Or a wargame? Something intellectual."

"Here! I have this wonderful new game. It's called **Rogue**, from Epyx," the salesman said. He leaned over to report, in a confidential voice, "It was taken from a mainframe game." And he winked, conspiratorially.

Mainframe? The last time I saw a mainframe playing games was when the awesome might of the University of Toronto's computer system massed to match me at 3-D tic-tac-toe. It lost. That was back in the days when a terminal meant a printer with a keyboard, and a video output was called a CRT. No one had CRTs then. "Show me."

Oops. He's in medium resolution, and it won't load. I see a message about "Low-rez" on the screen. It must be a translation from a mainframe that didn't speak English. They must mean "low-res"! He changes his modes, regardless. Click, click, he taps the mouse. Ah...color, graphics!

"It has twenty-six levels," the clerk mutters, almost adoringly. I type in my name and the first screen comes up, full of neat little walls and a little caricature of a character who looks like Bilbo, being chased by a bat.

"Nice graphics," I say, trying to dodge the bat.

"Watch. Here, go there. No. Open the door, that one. Watch out for the hobgoblin! Oh. Oh, dear."

I'm dead. Well, that was short. Twenty-six levels, eh? I choose "new

game." Whirr, whirr, whirr. Back to the same initial picture. What? No reboot without having to go back to square one? Sigh. Try again. Ah, an ice monster. Hack, stab, hack, stab. I defeat it! What five miserable gold pieces? Grrr...

Okay, so I go on. I get attacked by bats and emus. Why do I feel like I'm fighting in Australia? Okay, down the stairs. There's an amulet I have to find. Use the zoom; ah, there's the stairway. What? A letter I attacks me. Hmm...killer alphabets.

"That's an ice monster," the salesman informs me. In the same climate as emus? I wonder. Trudge, trudge. Oops. I throw my bow at a centaur. Sigh; It's lost. Now I go around trying to stab monsters with arrows. Of course, I die. Again.

"Can you win at this thing?"

"I don't know, but it has twenty-six levels!"

"That doesn't answer my question."

"But twenty-six levels! Who cares if you win? Think of all the fun!"

Okay, so it's fun. It's also not very original in concept, but if a new user has never heard of or played *Dungeons & Dragons*™—say, if you just came from Mars—it's a nice introduction. It's not *Time Bandit*, but then again, where else can I fight emus?

Okay, so it's nicely done; I admit it. He beams at me and tells me it has twenty-six levels again. I saw only three of them. I don't know if I could last another twenty-three. At least I can save a game and return to it later (well, it also makes you quit the game if you save it. . .). My version of *Time Bandit* doesn't allow that. Maybe Gord will send me a new one.

"What else have you got?"

"You're gonna love this one: **Temple of Apshai**."

"Huh? I played that on my TRS-80 Model 1. Around the last ice age."

"The Trash 80 didn't have graphics. Or sound. Watch this." He boots it up, in low-res, just in case we get attacked by a "low-rez" warning. Hmmm.

"This has a predefined character called Brian Nailfoot. Sounds clumsy."

"You can change it," he says.

"No, leave it. I don't want to get too attached to him." Let's see, 140 pieces of silver. He's been moonlighting. Better buy a shield, some armor, a what? A Bastard-sword? Don't ask; it's only a game. Buy one anyway. Oops, I'm not strong enough. Can I take a Charles Atlas course first? No? Okay, get the broadsword. What about a bow? Twelve? Offer nine. No? Try ten. No? Eleven? Come on. . .okay, twelve. And it says I'm a hard bargainer—for paying what he asked! Artificial stupidity. . .so buy what you can and save the character. Now, let's try our mettle.

Ah, it's animated. I walk forward. No, not that far, stupid. Argh. Hit by a skeleton. Come back! Wait. No, hit it, bounce off, ohhh. . . I'm dead. Try again. Okay, fire a few arrows. That killed it. Grab the treasure. Hmmm. Trash. Sigh. What are my options? Ylixir? What's that, a Martian pet? Must be from the same guys who put "low rez" in the last game.

More trash. Boring. Who keeps their trash in little treasure cases in a dungeon? Carry on. . . All this trash. At least these are neat monsters. I have mushrooms, a cloak and kelp. Some treasure. I have mushrooms growing in my basement already, and who needs kelp? Maybe if I

wanted to open a sushi bar. . . Ah, there's a likely looking box. And a spider. Surely I can defeat a spider, right? Wrong. I die, again.

"Okay, try this one." He pushes me aside and boots up **Swords of Kadash**, from Penguin Polarware. Penguin? I wonder if it'll be full of polar bears and ptarmigans. Nothing like killer ptarmigans. Nope. It's another D&D™ clone, I think. A slice off the old bologna, as they say. I read the opening message. Accursed villains? My favorite foes. I enter the dungeon. I choose a joystick.

It's not as well done as **Rogue**, even **Apshai**. Maybe on a par with something 8-bit, like **Crypts of Terror**. Remember that game? Ho hum. I keep hitting myself with my own arrows. I die. A lot. Luckily, this game has a benevolent deity, and I get reincarnated. A lot. It's a lot like **Lode Runner**, without quite as much fun. I pop the disk. It wasn't a lot like D&D™ after all, much to its detraction.

"Anything else?"

The clerk looks at me in exasperation. "If you don't like fantasy role-playing games, maybe you'd prefer something more action oriented." Why should I tell him I played D&D™ when he was still in diapers? These are good games, sure, but I'm not all that keen on fighting green slimes and magic centipedes. Orcs give me hives.

"**Mudpies**. Hey, this is fun. You'll love it. Trust me." I shiver when anyone says those words. A lawyer once used them to me. I'm still recovering. **Mudpies**, he tells me, is from MichTron. I wait with baited breath. Another **Time Bandit** perhaps?

"What's the point of the game?"

"You have to throw mudpies at the clowns and clear them off the screen," he says. Mudpies? Not very manly. "Make sure you keep your energy level up."

"How do I do that?"

"See those McDonald's bags? Those are fries. Eat them, the milkshakes and the burgers whenever your food indicator turns red. But not too many."

Not too many is right. I don't even eat that stuff in real life. How can I do it here? Besides, I'm a vegetarian. He shows me how to throw a pie. I bonk a clown. The others gang up on me and throw bowling pins. Sheesh!

All I have are mudpies! More come out of the holes in the walls. Bonk! Bonk! Bonk! Sigh. "I know, don't tell me. It has twenty-six levels, too."

"Look, this is good. **Red Alert**, from Antic. You've heard of them." He nudges me in the ribs. I try not to nudge him back with the disk drive. He boots up the game. "You put your cities anywhere you like, then you put your missile silos and laser bases to protect them." He spreads the items across a map of North America.

"Don't put one there." I say.

"Where, here? That's Toronto! Your hometown."

"I know. Just don't put one there. It would make me queasy if I lost it."

"All right. I'll put it here. That's Detroit." Right. Who cares if they take out someone else's hometown? "Watch." The missiles start coming in over the pole. Zap, blam. Subs pop up and shoot from the oceans. Argh! There goes San Francisco! What? What happened to Miami? The damn Cubans had missiles, and they fired at me! Sneaky weasels! I'll nuke 'em myself. Huh? I can't hit the Cubans? My mood goes black. So do my cities. More missiles approach. My silos are empty, my lasers drained. Boom, boom. Game over.

"Like that?"

"No. Too much like real life. Sort of like watching 'The Day After' over and over again. How about something less violent?"

"Do you like 007 movies? Here, try **Major Motion**."

I do. I'm driving a car with a front-aimed machine gun. Always wanted one of those things on the highway. I blast a few nasties, bump others off the road; then—squeal!—I skid into a tree. Some guy with spikes on his wheels ripped my tires! Grr. . . the truck drops me back on the road again. Wait! That guy with the spikes is still there, waiting for me to get out of the truck. Squeal! Grr. . . Next time I get a missile, I fire at him from behind. Hee, hee. . . wait! Nothing happened! Argh. Squeal. . .

Okay, this calls for serious action. I clear the road. What are tourists doing on attack alley, anyway? What! Some F15 slipped down from 12-o'clock high and nuked me. Okay. Try again. "Hey! That's a clone of this car!" I say. "How do I kill it?"

"You don't. You just have to get in the truck and hope it goes away."

"Where's the truck?"

"You'll have to wait." I can't. The clone which I can't kill is very apt at killing me. Too bad. I was just starting to like this game. I never like to play games where I don't have at least a 50-50 on an opponent.

"How about something cerebral?" I ask.

The clerk is a disappointed man. He boots up **Electro Solitaire & 21**, from Soft Logik. "Well, there's always this. . ."

"Now you're talking. Black jack? I'm a whiz. Let's see. . ." I sit down and play a hand. Hmmm. It doesn't bother to tally my score. Sloppy. I think to myself. I win! Dealer goes bust. What? The screen says "Your up \$20." My up what? Could they possibly mean "you're"? Same guys who came up with "low rez," I bet. Must be a conspiracy to have all the illiterates in the world band together and write software. I try again. This time, it's a push. The dealer wins. Huh? Shouldn't it be a tie, and the money stays down? I give the clerk back the disk. "I want a game that knows the rules," I say, simply. I didn't add from someone who knows the basic rules of English.

He just shrugs and gives me **Cards** from MichTron.

"Ah, this is more like it," I say. The clerk beams. Five games in one. Blackjack, Poker Squares, Klondike, Cribbage and Solitaire. Hmmm; just called Solitaire? What's that? Ah! It's La Belle Lucie, an old and popular version of solitaire. Klondike looks familiar, except I can't select the more common three-card (rather than one) draw method. Oh well, let's try Blackjack.

Hmmm. I have 13 showing. At least it tallies my score. "How do I get another card?"

"Press 1."

"Huh? No mouse option? Why not press H for hit? You know, and S for stand? Mnemonics, you know. . ."

"Just press 1," he snarls. I do. I get an eight. Twenty-one. I win.

"What's this?"

"It's where you enter your name and bet amount."

"I just did. Last turn."

"You have to enter it every turn. It's easy; just press RETURN."

"Can't I tell it to use the figures for good?"

"Why? It's easy!"

"No mouse option?" Nope; he shakes his head. I'm a real nitpicker, he figures. I try again. It's a push situation. Ah! It lets it stand. Good work. Someone read the rules before they attempted to program. But the keyboard entry method doesn't overwhelm me. So I won't play Blackjack. The rest look good. "Wrap it. I'll take it."

The clerk falls off his chair in surprise. A sale? From me? I get up to leave. "Wait!" he shouts. "Don't you want to see **Universe II**?"

"What happened to **Universe I**?"

"It's not out for this machine."

"Call me when it is. Meanwhile, I'll practice my solitaire."

"But what about the adventures? **Sundog? The Pawn? King's Quest II**?"

"What happened to **King's Quest I**? Don't tell me—it's not out for this machine."

"**Hacker? Borrowed Time? Hitchhiker's Guide to the Galaxy**?"

"Next time!" I say and close the door behind me. I look back for a brief moment and see the clerk grabbing boxes of adventure games from the shelves, his mouth still moving. Calling out games, I guess.

Well, I got something. . . not chess, like I had really hoped, and not a wargame, but something to while away those idle moments when I don't have time for a **Time Bandit** session. Maybe I'll go back and look at the adventures next month.

I walk down the street and pass a McDonald's. I hurry past, afraid some nut with a pie in his hand will come at me. **A**

Ian Chadwick is the author of Mapping the Atari and other nonsense. He lives in Toronto with his wife and their small menagerie, none of whom are willing to learn any computer languages. He is currently writing mystery fiction, because he wants to publish something people can read in the john.

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UPDATED FAST/BASIC

Philon has released an upgrade of their BASIC compiler. **Version 1.35** includes full graphics interface through support of the GEM VDI graphics interface. Graphics output is produced by using PEEKs and POKEs into GEM VDI. Philon also has a BASIC interpreter out, **Henry's Fundamental BASIC**.

Philon **Fast BASIC-M**, version 1.35 is \$129.00, from Philon, Inc., 641 Avenue of the Americas, New York, NY 10011 — (212) 807-0303.

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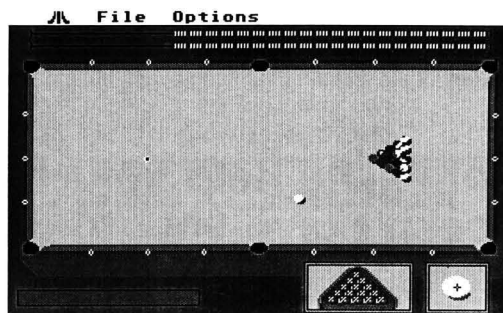
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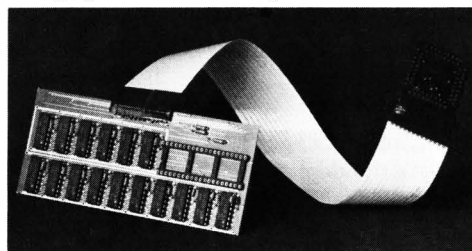
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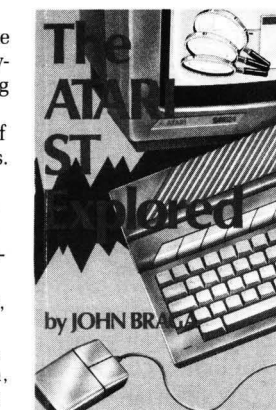
EZRAM is priced at \$199.00. You may order it from Terrific Peripherals, 17 St. Mary's Court, Brookline, MA 02146 — (617) 232-2317.

CIRCLE #176 ON READER SERVICE CARD

A NEW GUIDE TO GEM

The Atari ST Explored is a recently released book covering the ST's GEM operating system and ST languages. It's written for anyone considering an ST, who'd like an idea of its capabilities. Experienced users will get in-depth info on icons, windows, menus and interfaces, BASIC, Logo and assembly. By John Braga, the 250-pages are from Kuma

Computers Ltd., 12 Horseshoe Park, Pangbourne, Berkshire RG8 7JW, England — 01-07357-4335.



CIRCLE #194 ON READER SERVICE CARD

Printer graphics tutor

Here's the help your manual doesn't give you, to do bit-image graphics on your Epson, Epson compatible, or Prowriter.

by Matthew J.W. Ratcliff

There is no such thing as a standard when it comes to printer graphics. Epson was one of the first with an expensive "Grafrax" option for their earliest MX-80 printers. Since that time, many "Epson-compatible" printers have come out, none of which is 100 percent. As the demand for inexpensive home printers with graphics capabilities has increased, several standards—of sorts—have become dominant. First and foremost is Epson; then there's the Prowriter. Earlier NEC printers used the same graphics commands as the Prowriter, but their more recent models are Epson compatible.

One of the most widely known Epson compatibles is the Star Micronics Gemini printer series. Their graphics and other features have closely followed that of the Epson, but have always been just a little behind. The SG-10 has an "IBM mode" switch which comes closer than any other previous model, but is still not totally compatible. I've been informed that their newest NX-10 indeed has a 100 percent Epson-compatible mode. Being a true Missourian, I'd have to see it to believe it.

The problem with learning how to do bit-image graphics on your own printer is the printer's manual. I have yet to see one written by a real programmer. If it were, you wouldn't see silly cartoons in it, or the useless sample program listings (which are, more often than not, incorrect). In this tutorial, I hope to show how your computer can speak graphics to your Epson or compatible, or Prowriter. Many other printers follow one of these pseudostandards to some degree, so you should still get some use from these pages.

Printer manuals make two major mistakes in teaching you bit-image graphics. First, nearly all graphics examples are symmetrical, either vertically, horizontally, or both. This is confusing to a novice trying to figure out which comes first, what's the top or bottom, and when the computer starts sending graphic bytes. Also, they always use LPRINT statements. This can cause real "mystery" problems, because the computer tries to help you out. I'll explain more on the technical problems you can run into with printer graphics, after we get the basics down.

Bit-image graphics.

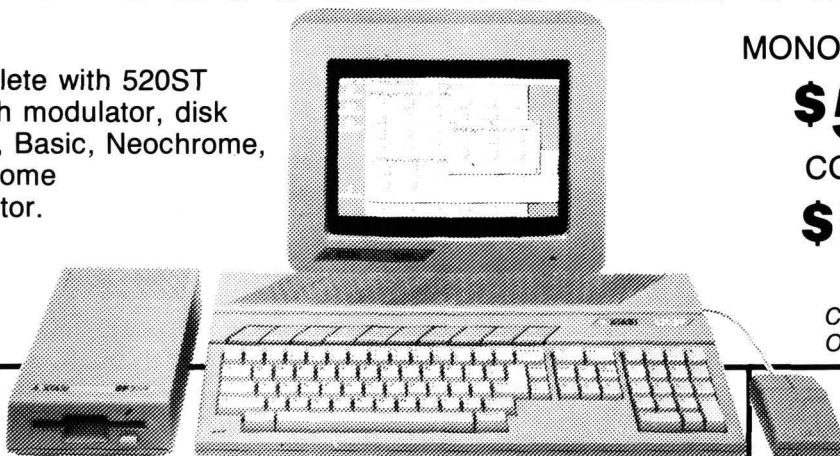
The phrase *bit-image graphics* is used frequently in reference to printers and graphics. Once your printer has been put in the graphics mode with the proper "escape sequence," it accepts subsequent bytes from your computer verbatim. Each byte is made up of 8 bits. Each bit becomes a dot in your final printer graphic. If a bit is 0, then the pin in the dot-matrix print head associated with that bit will not fire, thus leaving a white dot in your printout. If a bit is set, then the pin will fire, to create a black dot on the page. The summation of all these dots, controlled a bit at a time, is referred to as "bit-image graphics."

While learning how to do printer graphics, you'll probably define your picture on graph paper, filling in squares where you would want a dot printed. From here, it's a simple task to convert from graph paper to a binary representation. Each black dot will be a 1, and each white dot a 0. The binary data, grouped in chunks of 8, must be converted to decimal bytes for your data statements. A value is placed on each bit in a byte, as shown in Table 1 below. You simply add up the values for each bit that's set (1) and you have the decimal representation. A programmer's cal-

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// Printer graphics *continued*

culator with binary capabilities is very helpful in this process. (The Casio FX450, which has extensive hexadecimal and binary calculation features and sells for under \$30.00 is also a full-function scientific calculator and never needs batteries; it's solar.)

Table 1.

7	6	5	4	3	2	1	0	← Bit Positions
1								
2	6	3	1					← Bit Values
8	4	2	6	8	4	2	1	
1	0	1	0	0	1	1	0	

Sample Binary Representation of Decimal 166
 $=128*1+64*0+32*1+16*0$
 $+8*0+4*1+1*1+0$
 $=128+32+4+2=166$

Bytes to graphics.

The print head in a dot-matrix printer is made up of a vertical column of small pins. When your printer outputs text, it fires these pins in a predefined sequence from a character set "bit map" it stores in its own ROM. When we want to send it bit-image graphics, we must first tell the printer, "accept the following 43 bytes of data as graphics," for example. The printer expects what we commonly refer to as an "escape sequence." When most printers see a `CHR$(27)` (escape code), it knows that a command follows.

After sending the proper escape code, the bit-image graphics bytes follow. Part of the escape code tells the printer how many bytes to interpret as graphic data. That way, escape characters within the graphics data won't inadvertently be interpreted as more commands.

When printing simple text, the top seven of nine pins are used for uppercase, and lowercase which doesn't require descenders. The lower seven of nine are used for lowercase characters with descenders (such as p, y, q, etc.). The bottom pin is turned on whenever continuous underline is enabled, also. When we're sending graphics data bytes to the printer, we take control of the top eight pins. Here, it's best to think in binary. When you send a graphic byte to the printer, each bit controls an individual pin in the print head. For the Epson and compatibles, you can see in Figure 1 that the least significant bit controls pin 8 and the most significant bit controls the top pin, pin 1. In the case of the Prowriter and its compatibles, the reverse is true, as shown in Figure 2. The least significant bit controls the firing of the top pin of the print head, and the most significant bit controls pin 8.

Take a look at Figure 3. Here, a simple graphic of a space shuttle is defined. It's eight dots high and thirteen dots wide. Each dot column is defined by a single graphic byte from your computer. To make it easier to visualize, think of rotating the print head, pivoting at the bottom, to the left for Epson and to the right for Prowriter. In the figure, I've taken care of all the arithmetic for you. If your graphic must be taller, you can create it on a larger grid. You simply break it up vertically in groups of eight rows. You would send the graphics data for the first row (after the appropriate escape codes), print a carriage return (and line feed for the ST), then the next row—and so on. More details later.

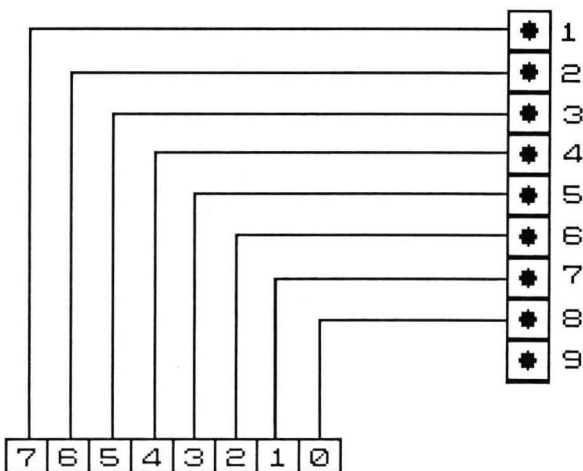
The computer and printer.

At this point, you should type and run the appropriate program. If you have an ST and an Epson or compatible, type and run the first program example. It will print our

Epson/Gemini

Graphic byte from computer's memory.

Print Head



The most significant bit maps to the top pin of the print head, the least significant to the bottom.

Figure 1.

Epson/Gemini graphics byte to print head control example.

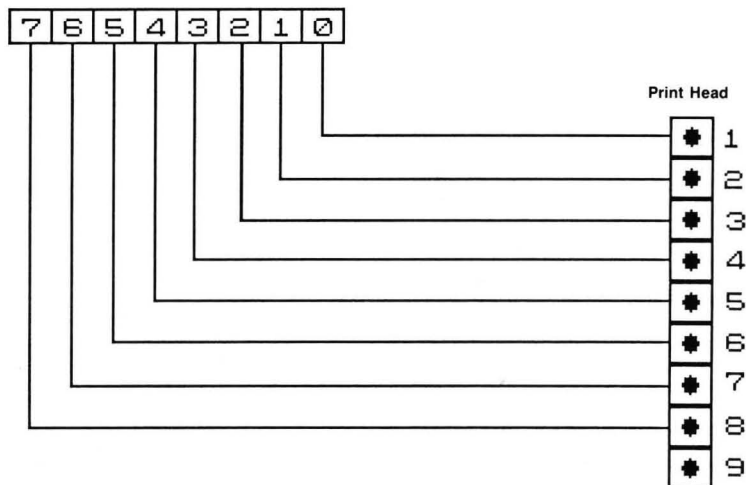
ST DISK FILE: EPSGEM.PI3

A DEGAS high-resolution graphics file.

Prowriter

Graphic byte from computer's memory.

Print Head



The most significant bit maps to the BOTTOM pin of the print head, the least significant to the TOP.

Figure 2.

Prowriter graphics byte to print head control example.

ST DISK FILE: NECPRO.PI3

A DEGAS high-resolution graphics file.

shuttle in single-, dual- and quad-density graphics, respectively, ten shuttles per line. Note that Line 120 has a lowercase z as part of its escape code sequence. That's the code used to set the Gemini 10X (or SG10 in the Star Mode) in quad density. This should be changed to an uppercase Z for Epson and other, *more compatible* printers. The same change should be made for the second program listing, but at Line 130. This is for 8-bit Atari computers equipped with Epson or compatible printers.

Listing 3 is for Prowriter or compatible owners, and ST BASIC. Finally, Listing 4 is for 8-bit Ataris and the Prowriter. If you're using a Prowriter compatible (like an older NEC printer), you may find that all shuttles look the same size. Some are graphics command compatible with the Prowriter, but do not have variable dot densities.

The escape codes.

Each printer has a certain character sequence, usually preceded by the escape character, `CHR$(27)`, that tells it what special function to perform. For the Prowriter, you must send the escape code, followed by the ASCII equivalent of the letter S, which is 83. Immediately following that, the Prowriter expects four characters telling it how many graphic bytes follow. This must be an ASCII string, padded with 0s, if necessary. Graphics density on the Prowriter is set by selecting print pitch, as shown in the sample programs. On the ST, for example, we could use the following to tell the Prowriter that 265 bytes of bit-image graphics data is on its way:

```
LPRINT CHR$(27);"50265";
```

Then 265 bytes of bit-image graphics data must follow.

For the Epson and compatibles, the printer expects the escape character, followed by a lead-in code. This code tells the printer that bit-image graphics bytes are on their way and selects density, as well. Changing print pitch has no effect on the density of graphics, as it does with the Prowriter.

After the lead-in code, the Epson or compatible expects 2 bytes telling it the total number of bit-image graphics characters to follow. The first byte sent will be the low byte, followed by the high byte. So, if we were sending 265 bytes of graphic data to an Epson, it might appear as follows on the ST:

```
LPRINT CHR$(27);"K";CHR$(9);CHR$(1);
```

Why 9 and then 1? What is $9+256*1$? That comes out to 265. Old 8-bit Atarians should be familiar with the high-byte, low-byte format of addressing in the machine. The Epson thinks similarly.

Bit-image graphics density determines the total number of dots per print line, and how close together the dot spacing will be—as you can see from the samples. Single-density graphics on the Epson come out to 480 dots per line; dual is 960, and quad density gives you 1920. On the Prowriter, setting 10 characters per inch (CPI) print pitch will give you 640 dots per line in subsequent bit-image graphic functions. Setting 12 CPI gives 786 dots per line, 17 CPI results in 1088, and proportional spacing will select 1280 dots per line. Look at the listings to see how these are selected with different escape code sequences.

Why not LPRINTs?

Notice that none of the programs use the LPRINT statement any more than is absolutely necessary. The LPRINT poses particular problems on most computers when it comes to bit-image graphics. On the 8-bit Atari, the LPRINT is sent from a 40-character print buffer in the computer. If your LPRINT line is less than 40 characters, then the rest of the line is padded with NULLs, `CHR$(0)`. This really goofs up the bit-image graphics count, set up with the escape code.

On the ST, I found no problems with LPRINT, but avoided it anyway. Note that our space shuttle is thirteen dot columns wide. In the escape code sequence for the Epson, telling the printer how many graphics dots are to follow, there will be a `CHR$(13)` sent. On the ST, the operating system is smart enough to know if an ASCII 13 is being sent at the end of a line, and, thus, should be followed with a LINE FEED, `CHR$(10)`. If not at the end of a line, then only the `CHR$(13)` is sent, unmolested. While testing some of my routines on the IBM PC, however, I found that their BASICA *always* sends a line feed after a `CHR$(13)`, whether it's at the end of a line or not. I used the "out 0" command with the ST BASIC, because I knew this couldn't possibly be misinterpreted by the computer. This simply tells the ST to send a single byte out port 0, the printer, no questions asked. The LPRINT may have some other hidden "features," where it might misinterpret graphic data going to your printer. On the 8-bit Atari, `PUT #1` (where you had previously done an `OPEN #1,0,"P:"`), is equivalent to the "out 0" command of the ST.

In the Epson example above, we were sending 265 graphics bytes to the printer. That poses a problem on some computers. Sending the `CHR$(9)` to the printer from the LPRINT works fine on the ST, but another computer I use interprets a `CHR$(9)` as a TAB character. The computer thinks, "a tab character. . . let's help out by converting that to eight space characters." Of course, that will clobber your bit-image graphics, too. The `CHR$(9)` doesn't pose a problem on the 8-bit Atari or ST computers, but it's something to keep in mind if you work on other (heaven forbid), non-Atari computers.

In the ST BASIC sample listings, note the "width lprint 255" command. Similar to IBM BASICA, ST BASIC assumes that your printer is only 80 columns wide. Normally, ST BASIC will automatically send a carriage return and line feed to your printer once every 80 characters you send to it, if you don't. If you're running a 15-inch carriage printer (such as the Gemini 15X or the Epson FX185), then your printer can handle 132 characters per line. This can be set from ST BASIC with a "width lprint 132" command. However, when it comes to bit-image graphics, we may send as many as 1920 graphics bytes in quad density without a return. When ST BASIC sees that you have set the width of the printer to 255 columns, it shuts off all checking and will not send a carriage return/line feed combination, unless told to under your software control.

Additional 8-bit limitations.

One thing many 8-bit owners don't realize is that you absolutely cannot send a `CHR$(155)` to your printer. Why?

// Printer graphics *continued*

The 8-bit Atari uses a 155 as a carriage return representation. The printer driver in the 850, **P:R: Connection** or similar printer interface, always converts the 155 to a standard return value of 13. What if you wanted to send 155 graphic bytes to your Epson on an 8-bit Atari? You can't, because the printer interface helps you out:

```
10 OPEN #1,8,0,"P:"
20 PRINT #1;CHR$(27);"K";CHR$(155);CHR$
  $(0);
```

In the above segment of code, the printer interface would see the 155 coming out and convert it to a 13 before it got to your printer. (The same holds true if you use **PUT #1,155**.) Then your Epson would expect only 13 graphic bytes, while you want to send 155 of them. Of course, the simplest solution is to change your setup to send 156 graphic bytes, instead. You could then send a dummy graphic byte at the end, without messing up the picture.

Usually, with screen dumps and other graphic utilities, you're sending an entire line of bit-image graphics. You know ahead of time how many bytes need to be sent, and can avoid that particular problem. But what if your bit-image graphics line going to the printer happens to have 155s in it? They'll be converted to 13s by the printer interface and goof up the graphic. Many graphic dump utilities for 8-bit Ataris have this little-known bug. A smart graphics utility would look for 155s and convert them "on the fly" to 153s, possibly (which are similar enough in bit-image graphics to go unnoticed).

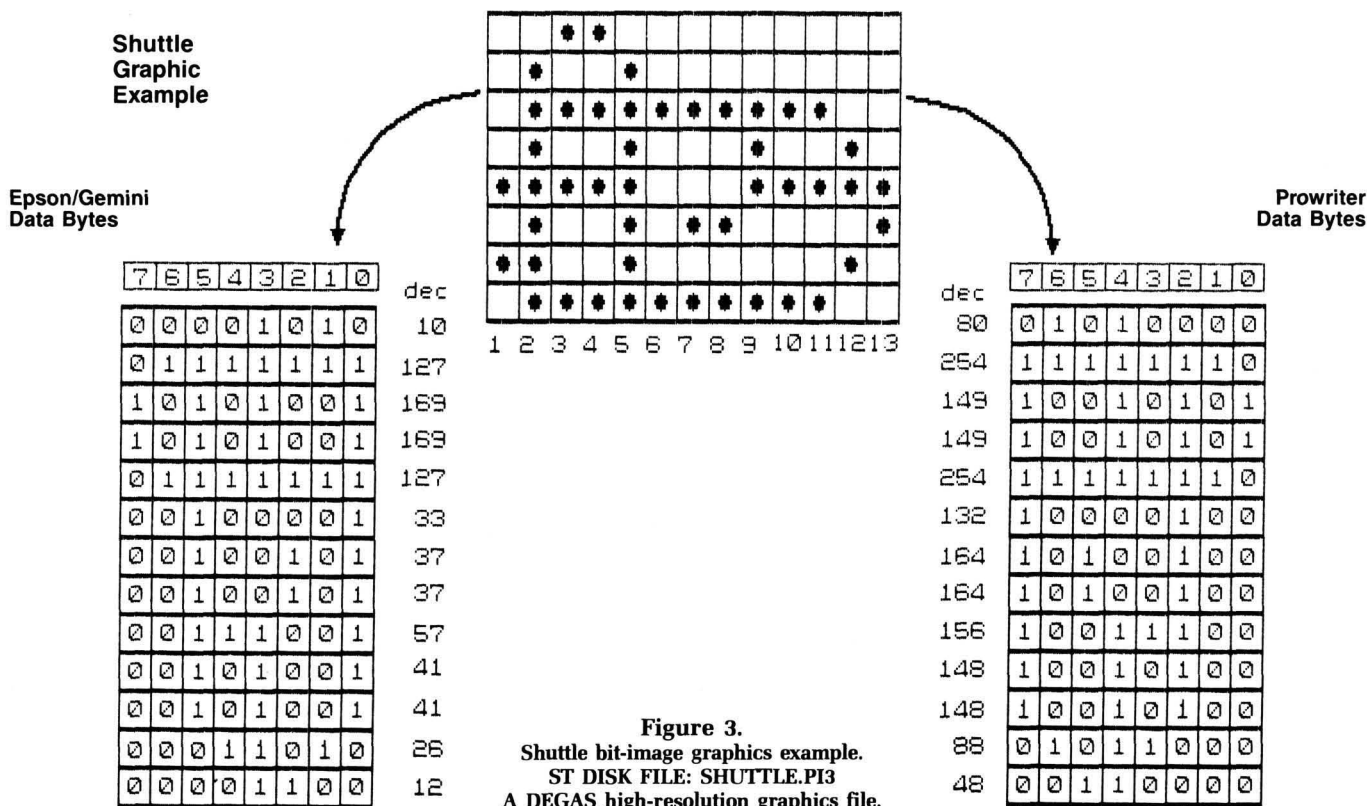
P:R: Connection owners should also take note of another special feature where they get unwanted help. If you're

sharing the printer between the ST and 8-bit Atari, as I do, then you probably have the line feed switch set in the **P:R:** box. That way, you don't have to change the auto-line-feed dip switch in the printer when you swap it between the two computers. Whenever the **P:R:** sees a 155 going to the printer with this switch set, not only does it convert the number to a 13, it also sends a line feed, 10, to follow up (similar to the problem noted above with the IBM).

This problem never appears in **The Print Shop**. The program avoids the potential 155 problem in a completely different way. **The Print Shop** always drives the bottom seven of eight pins on the Epson, or the top seven of eight on the Prowriter, used for bit-image graphics. This results in the lower seven bits of each graphic byte being used to define the image, with the most significant bit always 0. In other words, the maximum value of any graphic byte going to the printer is 127, so the 155 glitch will never appear. The programmable line feed of the printer is adjusted under software control for proper vertical alignment of your graphic rows.

Vertical spacing on Epson.

It's not likely that all your graphics will be only eight dots high, as are the sample programs. Line spacing for your printer is normally set for text at about $\frac{1}{6}$ of an inch, or sixty-six lines per page maximum. For bit-image graphics, we want each graphic line to stack one exactly above the next, with no extra white space between. On the Epson and Gemini printers, assuming eight bit-image graph-



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ics, you'll want $\frac{8}{72}$ line spacing. If only using seven pins, as in the **The Print Shop**, then set $\frac{7}{72}$. The vertical spacing is set on the Epson and compatibles with the ESCAPE-A command, followed by a byte (between 0 and 127), specifying the new setting in 72nds of an inch for each line feed the printer does. In ST BASIC, it could be set with the following:

```
LPRINT CHR$(27);"A";CHR$(8);
```

Or, avoiding LPRINT as suggested, the following would work just as well:

```
OUT 0,27:OUT 0,ASC("A"):OUT 0,8
```

Both the Epson and Gemini printers have another programmable line feed control, the ESCAPE-J command. On all Gemini printers through the SG-10 (whether in the Star or IBM mode), this programs the line feeds in increments of 144ths of an inch.

On the Epson, however, it programs in increments of 216ths of an inch. This "minor incompatibility" has been a major source of headaches for Gemini owners over the past few years. Any time you get Epson-compatible graphic software that gives you extra white space between every graphic line on your Gemini, you can bet they're using the ESCAPE-J command, instead of the more universal ESCAPE-A.

Why would anyone want to use ESCAPE-J? Well, the dots line up properly using the $\frac{7}{72}$ -inch increment, but sometimes graphics dump routines need even finer control over the line feed, to adjust for aspect ratio (proportionality) in your output.

If the newest Gemini, the NX10, programs in increments of 216ths of an inch with the ESCAPE-J command, then maybe — just maybe — it's finally 100 percent Epson compatible.

Vertical spacing on Prowriter.

The Prowriter's line feed is programmed in increments of 144ths of an inch, with the ESCAPE-T command. To set $\frac{7}{72}$ - or $\frac{1}{144}$ -inch line spacing, you can use one of the following from ST BASIC:

```
LPRINT CHR$(27);"T16";
```

or:

```
OUT 0,27:OUT 0,ASC("T"):OUT 0,ASC("1")
:OUT 0,ASC("6")
```

A final Epson note.

As more escape commands have been added to newer Epson and Gemini printers, some are followed by a 0 to disable, or 1 to enable a particular feature. For example, the following turn on continuous double-width printing on the Epson and Gemini printers:

```
LPRINT CHR$(27);"W";CHR$(1)
```

or:

```
OUT 0,27:OUT 0,ASC("W"):OUT 0,1
```

(continued on next page)

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Pascal and Modula-2 source code are nearly identical. Modula-2 should be thought of as an enhanced superset of Pascal. Professor Niklaus Wirth (the creator of Pascal) designed Modula-2 to replace Pascal.

Added features of Modula-2 not found in Pascal

- CASE has an ELSE and may contain subranges
- Programs may be broken up into Modules for separate compilation
- Machine level interface
 - Bit-wise operators
 - Direct port and Memory access
 - Absolute addressing
 - Interrupt structure
- Dynamic strings that may be any size
- Multi-tasking is supported
- Procedure variables
- Module version control
- Programmer definable scope of objects
- Open array parameters (VAR r: ARRAY OF REALS;)
- Elegant type transfer functions

Ramdisk Benchmarks (secs)	Compile	Link	Execute	Optimized Size
Sieve of Eratosthenes:	6.2	4.3	3.5	2600 bytes
Float	6.4	4.8	8.3	4844 bytes
Calc	5.5	4.2	3.3	2878 bytes
Null program	5.1	3.2	—	2370 bytes

```
MODULE Sieve;
CONST Size = 8190;
TYPE FlagRange = [0..Size];
VAR FlagSet = SET OF FlagRange;
i: FlagRange;
Prime, k, Count, Iter: CARDINAL;
BEGIN
  ('$$-$$R-$$A+ ')
  FOR Iter:= 1 TO 10 DO
    Count:= 0;
    Flags:= FlagSet(); (* empty set *)
    FOR i:= 0 TO Size DO
      IF (i IN Flags) THEN
        Prime:= (i * 2) + 3; k:= i + Prime;
        WHILE k <= Size DO
          INCL (Flags, k);
          k:= k + Prime;
        END;
        Count:= Count + 1;
      END;
    END;
  END;
END Sieve.
```

```
MODULE Float;
FROM MathLib0 IMPORT sin, ln, exp, sqrt, arctan;
VAR x,y: REAL; i: CARDINAL;
BEGIN ('$$-$$R-$$A-$$S-')
  x:= 1.0;
  FOR i:= 1 TO 1000 DO
    y:= sin(x); y:= ln(x); y:= exp(x);
    y:= sqrt(x); y:= arctan(x);
    x:= x * 0.01;
  END;
END Float.
```

```
MODULE calc;
VAR a,b,c: REAL; n, i: CARDINAL;
BEGIN ('$$-$$R-$$A-$$S-')
  n:= 5000;
  a:= 2.71828; b:= 3.14159; c:= 1.0;
  FOR i:= 1 TO n DO
    c:= c*a; c:= c*b; c:= c/a; c:= c/b;
  END;
END calc.
```

Product History

The TDI Modula-2 compiler has been running on the Pinnacle supermicro (Aug. '84), Amiga (Jan. '86) and will soon appear on the Macintosh and UNIX in the 4th Qtr. '86.

Regular Version \$79.95 Developer's Version \$149.95 Commercial Version \$299.95

The regular version contains all the features listed above. The developer's version supplies an extra diskette containing a symbol file decoder — link and load file disassemblers — a source file cross referencer — symbolic debugger — high level Windows library Module — Ramdisk and Print Spooler source files — Resource Compiler. The commercial version contains all of the Atari module source files.

Other Modula-2 Products

Kermit	— Contains full source plus \$15 connect time to Compuserve.	\$29.95
Examples	— Many Modula-2 example programs to show advanced programming techniques	\$24.95
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CIRCLE #143 ON READER SERVICE CARD

// Printer graphics *continued*

I've frequently seen this shown (translated to ST BASIC) in printer manuals, as follows:

```
LPRINT CHR$(27);"W1"
```

This is wrong, however, and will not work. Many printer manuals show it incorrectly. The Epson and Gemini printers expect a `CHR$(1)` not 1, or `CHR$(49)`. This does get confusing.

Now, the newer Epson FX printers don't care. They'll accept either of the above as a valid command sequence, but only the former will work properly on the Gemini and many other Epson compatibles. In other words, Epson is making up for deficiencies in their past documentation with updates in the printer's ROM control software. It will, of course, create more confusion among other Epson compatible users.

Normally, if the third byte of an escape code is shown as a 0 or 1 only, then send `CHR$(0)` or `CHR$(1)` not 0, which is `CHR$(48)`, or 1, which is `CHR$(49)`. If you use the former, you'll be guaranteed compatibility with virtually all Epson-compatible printers (and older Epson models), not just the newest Epson FX series. (I wonder

if Star Micronics caught this little trick before releasing their new NX/NL printer series? If not, then it *still* isn't 100 percent Epson compatible, is it?)

Wrap up.

I hope this tutorial has helped you understand how to speak graphics to your printer. The sample programs were kept brief and simple, so you can see the essence of computer-controlled printer graphics. Armed with this more accurate information and specific program examples for your computer, you should be able to make more sense out of your printer manual—and tackle that printer graphics utility you've been wanting to write.

I would like to thank Phil Bunch of Comm Tech computer services in St. Louis, Missouri for his valuable Prowriter assistance in developing this tutorial. **A**

The two-letter checksum code preceding the line numbers in the 8-bit BASIC listings here is *not* a part of the BASIC program. For further information, see the *BASIC Editor II* in issue 47.

Listing 1. ST BASIC listing.

```
10 fullw 2:clearw 2:width lprint 255
20 gotoxy 1,1:? "SHUTTLE Graphics:"
30 for j%=1 to 3
40 on j% goto 50,60,70
50 ? "Single";:lprint "Single Density
Graphics:":goto 80
60 ? "Dual";:lprint "Dual Density Grap
hics:":goto 80
70 ? "Quad";:lprint "Quad Density Grap
hics:"
80 for i%=1 to 10
90 out 0,27:on j% goto 100,110,120
100 out 0,asc("K"):goto 130:rem sgl de
ns Graphics Select
110 out 0,asc("L"):goto 130:rem dbl de
ns Graphics Select
120 out 0,asc("Z"):rem Gemini, use "Z"
for Epson printers
130 out 0,13:out 0,0:rem Lo,Hi bytes o
f total Graphics chrs
140 restore
150 for k%=1 to 13
160 read a%:out 0,a%
170 next k%
180 lprint " ";
190 next i%
200 lprint:lprint:? " done.":chr$(7)
210 next j%
220 closew 2
230 end
240 data 10,127,169,169,127,33,37,37,5
7,41,41,26,12
```

ST CHECKSUM DATA. (see page 56ST)

```
10 data 754, 902, 900, 426, 855, 766
, 861, 47, 801, 34, 6346
110 data 14, 240, 514, 549, 956, 342
, 399, 757, 401, 812, 4984
210 data 381, 435, 786, 180, 1782
```

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CIRCLE #144 ON READER SERVICE CARD

Listing 2.
BASIC listing.

```

BJ 10 GRAPHICS 0:POKE 752,1
TY 20 ? "Shuttle Graphics:"
GO 30 OPEN #1,8,0,"P:"
EC 40 FOR J=1 TO 3
PT 50 ON J GOTO 60,70,80
WB 60 ? "Single";: ? #1;"Single Density Gr
aphics:";GOTO 90
RS 70 ? "Double";: ? #1;"Dual Density Grap
hics:";GOTO 90
NL 80 ? "Quad";: ? #1;"Quad Density Graphi
cs:"
GJ 90 FOR I=1 TO 10
DN 100 PUT #1,27:ON J GOTO 110,120,130
QU 110 PUT #1,ASC("K");GOTO 140:REM sgl d
ens graphics select
RF 120 PUT #1,ASC("L");GOTO 140:REM dbl d
ens graphics select
VU 130 PUT #1,ASC("Z");REM Gemini quad se
l, use "Z" for Epson printers
VB 140 PUT #1,13:PUT #1,0:REM Lo,Hi bytes
of total graphics bytes to send
CK 150 RESTORE
TO 160 FOR K=1 TO 13
FZ 170 READ A:PUT #1,A
HB 180 NEXT K
PI 190 ? #1;" ";
FS 200 NEXT I
TE 210 ? #1: ? #1: ? " done."
II 220 FOR W=15 TO 0 STEP -.15:SOUND 0,6
0,10,W:NEXT W:SOUND 0,0,0,0
GI 230 NEXT J
VD 240 POKE 752,0:CLOSE #1: ? " ** Finished
**"
OB 250 END
MD 260 DATA 10,127,169,169,127,33,37,37,5
7,41,41,26,12

```

Listing 3.
ST BASIC listing.

```

10 fullw 2:clearw 2:width lprint 255
20 gotoxy 1,1: ? "SHUTTLE Graphics:"
30 for j%=1 to 4
40 on j% goto 50,60,70,80
50 ? "640 Dots";:lprint "640 Dots/Line
Density:";goto 90
60 ? "786 Dots";:lprint "786 Dots/Line
Density:";goto 90
70 ? "1088 Dots";:lprint "1088 Dots/Li
ne Density:";goto 90
80 ? "1280 Dots";:lprint "1280 Dots/Li
ne Density:"
90 out 0,27:on j% goto 100,110,120,130
100 out 0,asc("N");goto 140:rem 640 D
ots, 10 CPI select
110 out 0,asc("E");goto 140:rem 786 D
ots, 12 CPI select
120 out 0,asc("Q");goto 140:rem 1088 D
ots, 17 CPI select
130 out 0,asc("P");rem 1280 Dots, Prop
ortional Print Select
140 for i%=1 to 10
150 out 0,27:out 0,asc("S");rem select
bit image graphics
160 lprint "0013";:rem 13 Graphics byt
es to send
170 restore
180 for k%=1 to 13
190 read a%:out 0,a%
200 next k%
210 lprint " ";
220 next i%

```

```

230 lprint:lprint: ? " done.";chr$(7)
240 next j%
250 closew 2
260 end
270 data 80,254,149,149,254,132,164,16
4,156,148,148,88,48

```

ST CHECKSUM DATA.
(see page. 56ST)

```

10 data 754, 902, 902, 710, 99, 140,
995, 55, 228, 587, 5372
110 data 605, 715, 574, 948, 64, 809
, 558, 965, 351, 380, 5969
210 data 738, 382, 821, 390, 444, 79
5, 866, 4436

```

Listing 4.
BASIC listing.

```

BJ 10 GRAPHICS 0:POKE 752,1
TY 20 ? "Shuttle Graphics:"
GO 30 OPEN #1,8,0,"P:"
ER 40 FOR J=1 TO 4
RS 50 ON J GOTO 60,70,80,90
ES 60 ? "640 Dots";: ? #1;"640 Dots/Line D
ensity:";GOTO 100
TC 70 ? "786 Dots";: ? #1;"786 Dots/Line D
ensity:";GOTO 100
PP 80 ? "1088 Dots";: ? #1;"1088 Dots/Line
Density:";GOTO 100
PZ 90 ? "1280 Dots";: ? #1;"1280 Dots/Line
Density:"
WE 100 PUT #1,27:ON J GOTO 110,120,130,14
0
OJ 110 PUT #1,ASC("N");GOTO 150:REM 640 D
ots, 10 CPI select
BA 120 PUT #1,ASC("E");GOTO 150:REM 786 D
ots, 12 CPI select
KX 130 PUT #1,ASC("Q");GOTO 150:REM 1088
Dots, 17 CPI select
XD 140 PUT #1,ASC("P");REM 1280 Dots, Pro
portional Print select
QU 150 FOR I=1 TO 10
RP 160 PUT #1,27:PUT #1,ASC("S");REM Sele
ct Bit Image Graphics
WO 170 PRINT #1;"0013";:REM 13 Bytes of g
raphic data
CR 180 RESTORE
TU 190 FOR K=1 TO 13
FM 200 READ A:PUT #1,A
GO 210 NEXT K
OV 220 ? #1;" ";
FY 230 NEXT I
TK 240 ? #1: ? #1: ? " done."
IO 250 FOR W=15 TO 0 STEP -.15:SOUND 0,6
0,10,W:NEXT W:SOUND 0,0,0,0
GO 260 NEXT J
VJ 270 POKE 752,0:CLOSE #1: ? " ** Finished
**"
OH 280 END
NS 290 DATA 80,254,149,149,254,132,164,16
4,156,148,148,88,48

```


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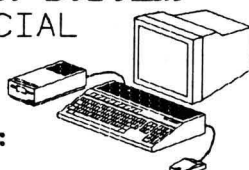
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by Douglas Weir

Time flies, doesn't it? Only twelve months ago the ST was beginning to appear in stores. Soon after that I was compiling my first program with Alcyon C. It finished linking sometime in early February of this year. My second one is a special Christmas project (Christmas 1988). I hope it finishes soon—I'm already behind schedule.

But seriously, folks. . . . When the **Megamax C** compiler arrived, I had been trying for several hours to link a desk accessory version of a GEM demonstration program with DRI's Link68. In desperation I turned to **Megamax**. In less than 15 minutes I had the program compiled and linked. It ran beautifully. I've never used Alcyon since.

Megamax C (MMC) is distributed on two single-sided disks. Included is the compiler and linker, plus a disassembler, code improver, librarian and resource construction program (similar to the Resource Construction Set supplied with the Atari Developer's Kit). These programs can be run from a GEM-driven shell program also included, or directly from the desktop (as .TTP applications), or with any command shell processor (the manual mentions Beckemeyer C-Shell as an example; I used the command.tos from Atari).

The **MMC** shell includes a "make" feature for compiling and linking multiple source files. A GEM-driven editor is also supplied. It operates more or less on the **1st Word** model, but I found it rather clumsy and used **1st Word** instead, with no problem.

Compiling and linking a program is very easy, partly because there are essentially no compiler or linker options. Only one source file can be compiled at a time. The output object file will be written to the same disk (and directory) as the source file. Error messages are written to the screen and also to a file named errors.out, on the same disk as the source file.

A "Megamax" folder is required to be in the root directory of the disk the compiler or linker is on. This folder contains the libraries and header files.

The compiler is one-pass, and as a result it is fast—almost unbelievably so at first (some timings are given in Table 1, at the end of this review). Also as a result, and in the true C spirit, error checking is limited. I never realized I had a redefined macro in a fairly large GEM program I had written, until I put it through the **Mark Williams** compiler. But that's part of the language. As the famous French programmer, Gaston de Gautou, said, "The C, she is a harsh mistress, no?"

The linker's lone option allows you to override the default name (a.out) and destination of the output file. Of course, you can also specify extra libraries to be searched.

The **MMC** library system is very simple. Virtually everything (including AES and VDI calls) comes out of syslib, which is searched automatically. There are two other libraries. Double.l is used for double-precision arithmetic, and acc.l is used when linking desk accessories (the only extra step in creating an accessory). Otherwise, you specify libraries only when you want to use ones created with the **MMC** librarian.

Some peculiarities should be noted. First, the linker builds on its disk a temporary file from which the run file is finally written, and it must have enough space to do so. For those using only floppy disk drives, this means the linker has to have a disk pretty much to itself (except for the Megamax folder and libraries). The location of this temporary file (in contrast to that of the destination file) cannot be overridden.

Second, there is no list of linker error messages in the manual. Some of these can be a bit mystifying. **MMC** does not allow the size of separate data structures (such as arrays or structures), or the data segment as a whole, to exceed 32K bytes. You can easily get around this by declaring pointers instead, then allocating whatever memory you need at runtime with calloc() or malloc(). If you forget about this and, say, declare a 32000-element array of int, you may get a reasonable error message from the linker, saying you've exceeded the allowable data space, but you could instead get the message *couldn't find some local labels*. This is the linker's way of telling you the data segment is exhausted. You can also get the *couldn't find* message by using a label (for example, *goto jail*) without declaring it.

Object modules produced by the **MMC** compiler are, as you might expect, incompatible with anyone else's. Syslib includes bindings for all GEM calls listed in the VDI and AES manuals, but not all of them are documented in the **MMC** manual.

As Clayton Walnum pointed out in an earlier installment of **C-manship**, the behavior of **MMC's** implementation of get-char() is rather odd. The function doesn't

return from a call until it encounters a carriage return, so you have to use something like `Concin()` to get a character immediately.

You can get the source code for the entire **MMC** library, including the GEM bindings, by sending \$50.00 to Megamax. Much of the code is written for the compiler's in-line assembler, which is a delight to use. In-line assembly code begins with the keyword `asm` and a left-hand curly bracket, and is terminated with a right-hand curly bracket. Macros can be implemented with the `#define` directive.

The assembler adheres to standard Motorola syntax—the only real exception is that register names must be in upper case. Both local and global variables in your program are accessible to the assembly code; the variables are addressed by using register A4 (external and static) or A6 (local) as a base register. Since in-line code is located entirely in the code segment of a C program, you can't explicitly write to variable space allocated within the code. However, if you need to use either of these registers for something else, you can save it with the trick in Figure 1.

The assembler has only one bug that I could find. The last line of assembly code must be commented (e.g., see the `;and return` in Figure 1), otherwise you will get an instruction syntax error from the compiler. The `#include` directive can be used in the middle of `asm` blocks to include other assembly code files. Both C-style and Motorola-style comments are accepted; you can use the former to comment out blocks of code containing the latter.

Using **Megamax** to "compile" a large file of in-line assembly code will be much faster than simply assembling with many of the stand-alone assemblers currently available. You can use the **MMC** disassembler as an aid to writing optimized in-line code, but you can't directly "tweak" the compiler's output, since there is no separate assembly pass. The disassembler is as easy to use as the other parts of the package.

A "code improver" program performs branch optimizations on an object file. The manual says that output code is "about 3% faster and 10% smaller" than the original. The improver affects only the nonlibrary portion of your code.

MMC contains the following important extensions: structure and union assignment, and passing to and from functions; character constants can consist of one, two or four characters between single quotes; significant length of identifiers (variable names, etc.) is ten characters; four data and two address registers are available for register variables.

MMC does not allow a program's size to exceed 32K bytes. To get around this, the compiler implements an "overlay" directive that allows you to break up a program

into smaller parts. Note that these are not dynamic overlays; the effect of using this directive is simply to generate a multisegment program, all of which is loaded into memory at runtime. In other words, overlays are transparent to the programmer.

The **MMC** manual comes in a full-size, loose-leaf ring binder. The documentation is mostly well written, and there is a lot of it—over 370 pages. The GEM calls (with the exceptions noted above) are covered.

Megamax requires no royalties for commercial programs developed with its C package. It is my favorite C compiler of all those now available for the ST. For users without a hard disk, it's the only sane choice. I love this compiler.

Mark Williams C (MWC) is not just a C compiler—it's more like a way of life. **MWC** came (in my review copy) on two double-sided disks (a single-sided version is available, according to an enclosed note). Installation takes the better part of an hour on a floppy-disk-based ST, just to build the system's directory structure and copy the necessary files. The paperback manual contains over 600 pages, every one of which comes in handy. The result is a system that has a lot of the feel of a mainframe UNIX, but which requires a hard disk for optimum performance.

The compiler is larger than Megamax's; the programs that make up its multiple passes total over 200K bytes, as opposed to 73K for the one-pass **Megamax C**. This means that **MWC** is slower than **Megamax C**. But you get a lot in return: a rich set of compiler and linker options, extended error checking (if desired) and the ability to link to object modules in standard DRI format.

The compiler is only one of many commands and utilities available to the UNIX-like command processor. Others include `egrep`, `sort`, `diff`, `history`, `wc` and `make`. I/O redirection, pipes and scripts (batch files) are supported. This system (called `msh` for micro-shell) is nicer than any of the other ST command shells I've seen.

You must have about 128K bytes of free memory to use `make`. In the command shell, you can type `mf` to find out how much memory is available.

On a floppy system, you obviously can't have access to all of **MWC**'s features at the same time. Instead, you put `msh` and the utilities on one disk and the compiler on the other. There's a full-screen (non-GEM) editor, **MicroEMACS**, with source code (which is definitely not "micro"). It's similar to **Mince** and the other **EMACS**-like editors. I used **1st Word** instead, and had no trouble doing so.

Also included is a symbolic debugger that allows you to monitor the execution of a compiled program. The debugger does not require a special compilation of the file to be debugged, but the file must be com-

piled under **MWC**. You can set breakpoints, patch values into memory and disassemble code. You can display the current contents of machine registers, but I couldn't find a way to change register values (none is mentioned in the manual). The debugger works only with TOS-type applications, not with GEM programs.

I found it very easy to port my Alcyon and Megamax source code over to **MWC**. The modifications involved header files only.

The advertising for **MWC** mentions "Lint-like error checking." Lint is a program included with some C packages to check for a lot of the little things that normal C compilers don't: variables that aren't used, data type mixups, etc. **MWC** certainly does much more than the usual checking. For example, it caught a redefined macro that slipped through Megamax and Alcyon. It will also notify you of variables that have been declared but never used, violations of standard C rules concerning structures and unions, constant conditionals and data type confusions.

There's a switch that allows warnings of deviations from Kernighan and Ritchie. This is a simple warning with no further elaboration—it's up to you to look at the source code and figure out just what the violation is. As far as I could tell from testing, **MWC** does not check for the following: use of uninitialized variables; use of a value returned from a function that has no return statement (and which is not declared void—this situation is detected); statements which are unreachable for various reasons; statements with possibly confused operator precedences; and cases where too many or too few arguments are passed to a function.

Unless you specify otherwise, a source file is compiled and linked with one command. The linker can be run separately. Various compiler switches allow you to (among other things) define or undefine symbols on the command line, specify include files and libraries, generate assembly source code as output (instead of an object file), substitute other programs for various passes of the compiler(!), and allow nested comments in the source code. The preprocessor can be run separately (for example, to generate macros in assembly source code), and so can the assembler.

However, the letter combinations denoting compiler and linker switches are case-dependent. When you run the compiler as a .TTP application from the desktop, everything is translated into uppercase by the system, so that many of the options become inaccessible. Since one of these is the library (-l) option, this made the .TTP form effectively useless for me. However, there is enough room on a double-sided floppy to hold the command-shell program and the compiler, so you can run the latter in the normal way.

An easy-to-use archiver will create libraries from object files. A very useful utility called `drtomw` converts object files in DRI (i.e., Atari) format to **MWC** format. You can then link to these modules, as well. I have tested all these features, and they all work.

MWC provides bindings for all VDI and AES functions. However, the manual does not include GEM documentation.

Creating a desk accessory requires the following steps (not given in the manual): save a copy of `crtsg.o` (the normal GEM startup code) in a safe directory. Then assemble the following code, name it `crtsg.o`, and put it in the `lib` directory (see Figure 2).

After you've done this, compile with the `-VGEM` switch. The output should be a properly functioning desk accessory. The next release of the compiler will have a simple switch for creating accessories.

As I mentioned, the assembler can be used alone, but has its quirks. The assembler directives, data declaration and definition keywords are all nonstandard. The symbol for immediate data (\$, the dollar sign) is not only nonstandard but an alias of the symbol Motorola uses to denote hexadecimal values. Register lists for the move instruction aren't supported, so you'll either have to hand assemble your own mask values, or push and pull registers separately (making sure you preserve the right order). Within its limits, the assembler works fine. You can easily link to the object modules it generates, and you can

also compile/assemble a C source and assembly source file at the same time, link it, and get a runnable program—all with one command. There is no in-line assembly feature.

MWC includes many extensions and extra features. It's sometimes difficult to find them, though. Most of the manual (close to 400 pages) consists of the Lexicon, an alphabetical listing of every term, keyword, command or utility in the **MWC** system. There's an enormous amount of useful information in the Lexicon, much more than in most compiler manuals, and, for the most part, it is well organized. But there are, inevitably, omissions. Worse, nowhere in the manual can you find in one place a set of specifications for this implementation of C. Usually, you can look up the relevant topic, but in the case of identifier length and allowable characters, for example, I searched in vain. The section on the assembler gives this information (I assume it holds true for the compiler and external labels), but it isn't indexed. (It seems that all alphanumeric characters plus period (.) and baseline characters (__) are allowed in identifiers, and only the first sixteen are significant.)

The following seem to be the most significant extensions included in **MWC**: peek and poke statements (in byte, word and longword sizes); void as function and enum as data type; structure assignment, passing and returning structures (as opposed to pointers to structures) to and from functions; assert and #assert macro and

directive, to check the values of variables and constants at compile and runtime (used in debugging); two sort routines (shellsort and quicksort), included in the function library; initialization of auto arrays; a Bessel library function; and some other miscellaneous math functions. Three address registers and five data registers are available for register variables in any function. If you let it, the compiler will warn you when it is reducing "register" storage class variables to "auto."

The license agreement at the back of the **MWC** manual states that no royalties or license fees are required for commercial programs developed with the package.

It's difficult to make a hard-and-fast choice between **MWC** and **Megamax C** as the C compiler to buy. For single users, especially those without a hard disk, **Megamax C** is probably best. It's much faster than anything else, and its elegant in-line assembler is a joy to use. Those for whom such issues as object-module compatibility with DRI code are important, and who have a hard disk, may well prefer **MWC**'s many extras. From that standpoint, Mark Williams' command shell with its many UNIX-like utilities and wide range of compiler and linker options make it, in my opinion, the all-round best choice for serious software development on the ST. **A**

Figure 1.

```

/* subroutine to save/restore MMC base register */
/* DB == 0 => save A4, else restore A4 */
reg_a4: bsr      fix_a4      ;figure out what to do
save_a4: nop
        nop
fix_a4:  movea.l  (A7)+,A0    ;get address of 'save_a4'
        tst.l    store_a4    ;save or restore?
        beq     store_a4    ;if save
get_a4:  movea.l  (A0),A6     ;else restore A4
        rts
store_a4: movea.l  A4,(A0)   ;save A4
        rts

```

Figure 2.

```

/The MMC version of "accstart.s"--
.shri    .globl    main_     /shared instructions
start:   .globl    main_     /label of C program start
        lea      estack,sp   /set top of stack
        jsr      main_      /begin program
        clr.w    -(sp)       /code == terminate process
        trap     $1          /GEMDOS call
        bssd
ustack:  .blkw 1024          /space for stack == 1K
estack:  .bikl 1            /top of stack

```

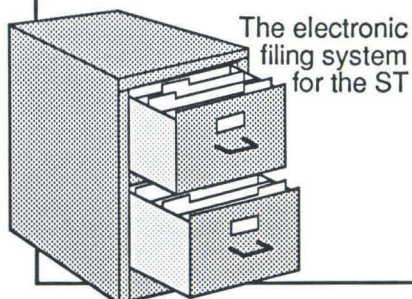
Table 1.

Compiler/Linker Timings and File Sizes						
Filename and sizes			Floppy times		Hard times	
	.c	.prg				
DRI: apskel	(7259)	10774	C=3:58, L=3:43		C=2:12, L=1:55	
sx	(6347)	14407	C=3:45, L=3:40		C=1:55, L=1:48	
wwx	(42695)	21069	C=11:00, L=5:17		C=3:25, L=2:13	
MMC: apskel	(8840)	5604	C=0:30, L=0:55		C=0:12, L=0:25	
sx	(6330)	10153	C=0:23, L=1:05		C=0:09, L=0:30	
wwx	(42664)	14397	C=1:01, L=1:28		C=0:27, L=0:35	
MWC: apskel	(9126)	8219	C+L=3:45		C+L=1:05	
sx	(6347)	14198	C+L=3:20		C+L=1:00	
wwx	(42764)	20134	C+L=6:35		C+L=1:50	

sx is a TOS file utility; wwx is a GEM windowing demo (see last month's **ST-Log**).
 C=compile time, L=link time. Times in minutes:seconds.
 File sizes in K bytes.
 Hard disk used was 60MB Supra in 4 15MB partitions.
MWC floppy version was double-sided, DRI and **MMC** single-sided.

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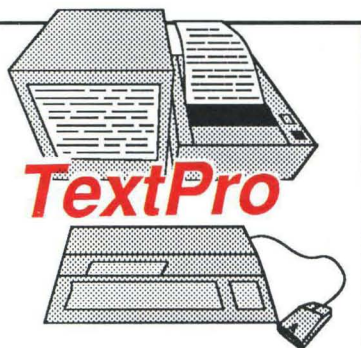


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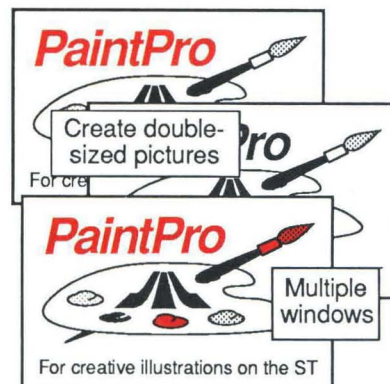


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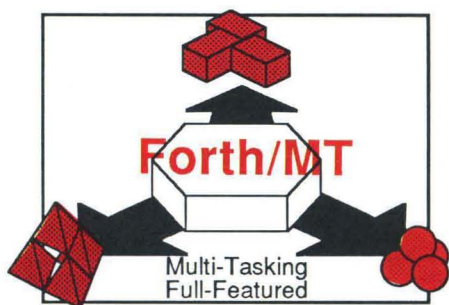
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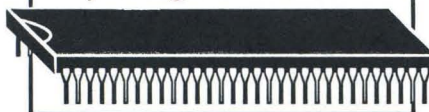
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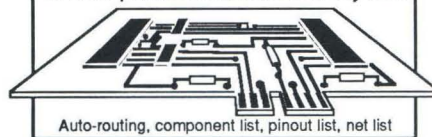


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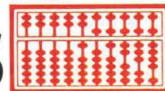
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by David Plotkin

While the ST is certainly more than just "another game machine," its capabilities and price make it outstanding in that category—when you finish all your word processing, spreadsheeting, etc. Software companies are starting to realize this, and games are becoming widely available. I admit to being an unabashed arcade-game lover (I've only solved two graphics/text adventures in my life), so the games reviewed here are for ST owners who still love a fast shoot-'em-up.

Monkey Business is a very thinly disguised clone of **Donkey Kong**. It's written by Ron Fortier, whose name you may recognize from such titles as **Bruce Lee** (Data-Soft) on the 8-bit machines. It's not bad for a first effort, although it doesn't utilize many of the ST's features.

In **Monkey Business**, you play an IRS agent attempting to collect back taxes from "Mr. Big." I'll refrain from commenting on this story line; most of them are pretty dumb, anyway. You must negotiate your way from the bottom to the top on each of three screens, leaping over or avoiding obstacles to accomplish your objective. If you complete all the screens you start over, faster and with more obstacles.

The three screens are remarkably similar to those in **Donkey Kong**. The barrels are there, as are the girders and the "springs and elevators." The fourth screen is missing, however. Also missing is the sequence where the barrels catch fire and chase you. This makes the barrel screen very easy.

Monkey Business isn't a "polished" program. It suffers from jerky animation and sound quality similar to that of the Apple II. The animation is jerky due to the lack of enough intermediate figures. For example, the ape has only three positions—left, center and right. Also, the supposedly fierce hounds on the girder screen resemble innocent beagles! Despite all this, the game is playable. The skill required rises just enough on each level to keep it interesting. If you're a **Donkey Kong** fan, this is the only game in town.



Don't kill the bystanders
in *Major Motion*.

Delta Patrol, also from The Other Valley Software, is a game wherein you pilot a helicopter across a scrolling landscape, shooting the descending aliens to prevent the destruction of your refueling dumps. There's a marked similarity to both **Defender** and **Choplifter**.

Your joystick controls the chopper, which carries an unlimited supply of ammunition. You shoot at the aliens descending from the top of the screen, dropping

bombs on your many refueling dumps. These dumps are periodically rebuilt by a little dune buggy, so running out of fuel isn't as big a problem as avoiding collisions with a screenful of aliens—who come at you in ever-increasing numbers. As the levels increase progress, more and faster aliens appear, along with new types, which even shoot back! A radar screen at the bottom of the display informs you of the attacking aliens' whereabouts.

Delta Patrol has some cute touches. The fuel dumps are little gas stations, complete with signs for donuts. The aliens themselves are amusingly designed, using bright colors. All screen motion is smooth. Finally, your chopper kicks up clouds of dust when it gets close to the ground.

Delta Patrol is a simple game with few variations. As such, it may lose its appeal after a short while. Like **Monkey Business**, this game leaves virtually untapped the graphics and sound capabilities of the ST, as well as its huge programming space. **Delta Patrol** will leave the adult arcader looking for other challenges.

A worthwhile challenge to turn to is MichTron's **Major Motion**. Based on the arcade classic **Spy-hunter**, it has you using your mouse to guide a car down a vertically-scrolling road, doing battle with all manner of enemy vehicles—while attempting not to injure innocent bystanders or run off the road. Kill too many innocent civilians, and you'll be demolished—by a fighter plane.

Your car is initially armed with just machine guns. You may use the guns to obliterate your enemies, or attempt to run them off the road by ramming them. Since many

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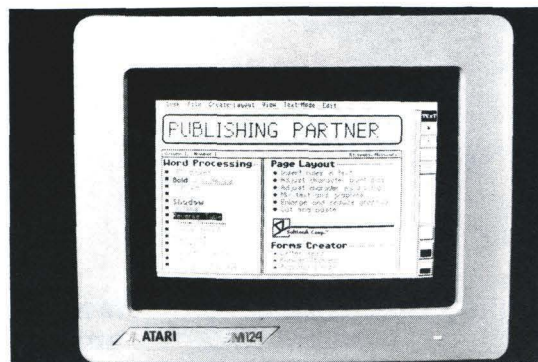
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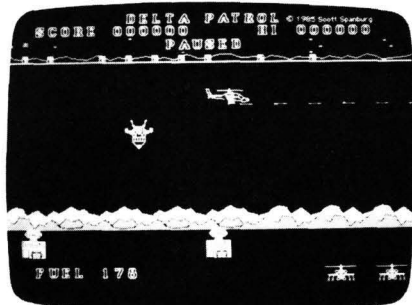


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of the enemy vehicles are armored against your guns—and are also bigger than you are—outrunning them is often the best strategy. Periodically, a weapons van appears which can arm your car with additional defenses. These include a smoke screen, oil (to cause skids), a super impulse device (for knocking other cars off the road), and a missile launcher to use against the chopper. The added weapons are activated via the keyboard.



Protect the refueling stations in *Delta Patrol*, from your 'copter.

This is a tough game! The weapons van appears at the most inopportune times, and can get in the way. Unlike the arcade version, you can't destroy it to get it out of the way. Docking with the van can be tricky if you're surrounded by enemy vehicles. Often the van will drop you back on the road alongside a tire-slashing enemy car. The van blocks your way so you can't run, giving the enemy a chance to destroy your car. This can be exceedingly frustrating.

The fact that **Major Motion** can only be played with a mouse also detracts, since I find myself running out of desk space at the worst times. A joystick mode would improve this game quite a bit. On the positive side, **Major Motion** allows you to redefine the weapons keys if the default keys aren't convenient, and maintains a high score on disk.



Time Bandit.

Overall, **Major Motion** is a good game, provided you don't have a low frustration factor. It features good graphics and sound, and nonstop excitement. The limitations of your car force you to plan carefully before running the next gauntlet of enemy cars. And look out for that chopper!

I've saved the best for last. **MichTron's Time Bandit** is billed on the box as "the ultimate arcade game." Of course, software packaging will never win a prize for truth in advertising—except this time. **Time Bandit** represents a truly outstanding feat—an arcade game with action, variety, attention to detail and fantastic graphics. Harry Lafnear and Bill Dunlevy (the authors) can be proud of this one.

Time Bandit opens on a scrolling landscape dotted with small structures. Castles, houses, a spaceship and a pyramid are just some of the items you'll find. Guiding your alter-ego into any of these icons opens up a new world. While these microworlds are similar in many ways, they present a new and different challenge to the arcader. Each of the microworlds is split into sixteen levels, from 1A to 4D. The object is to enter the microworld, battle your way to a variety of treasures, recover keys and, finally, unlock the way out. Each time you re-enter a microworld, the level goes up (from 1A to 1B, etc.), with a major jump in difficulty between numbered levels.

And what a battle you'll fight! Use your joystick to move and shoot your guns, while hounded by multitudes of evil creatures which inhabit the mazelike microworlds. The beings spring from special points located throughout the maze (don't stand on these points). Their touch costs you one life, and they'll follow you—even shoot at you—in the higher levels.

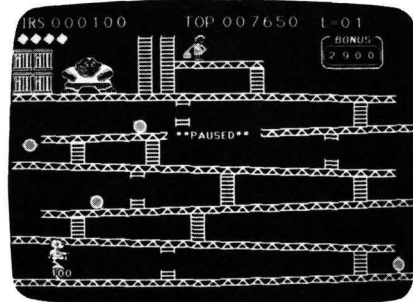
The maze in each microworld is different, and even shifts between levels, increasing the need for memory skills. The points you receive for each creature you destroy depend on how much you move. If you stand in one place, just blowing away attacking enemies, your points-per-creature count will drop to zero.

Time Bandit is full of surprises, which I won't spoil for you. But try the **Pac-Man** maze, and enter the subterranean chamber below the arena. The starship features a difficult text adventure (sit down at the computer consoles), and there's even a quest to recover the lost crown of a king—in return for a king's ransom in gold. Watch out for the wandering spaceships on the main screen, which will throw you into a microworld chosen at random. And read the signs scattered throughout this game; they can be very helpful.

Time Bandit is an example of the ST's capabilities in the game-playing department. The screen abounds with color, and small details are animated to good effect. Such things as flags waving on the castle ramparts and blinking lights on the starship *Excalibur* add a lot to the game. But this game especially shines in its animation. Each microworld features different sets of creatures, from the lions and trolls of the arena, to the roving snakes and eye balls of the pyramid. These creatures move

smoothly and are convincingly animated. Even the manner in which they disintegrate when hit is well done. For example, shooting a ghost causes it to appear in a "No Ghosts" symbol (from *Ghostbusters*) for a brief instant before disappearing. The variety of demises is another example of the imagination that went into this game.

Time Bandit is different; it's unlikely that you could ever finish every microworld



You're an IRS agent in *Monkey Business*.

through all sixteen levels. The authors don't believe it can be done, either. I play to see how far I can get in each structure before running out of lives. This way, each microworld becomes a separate arcade game, making this a good value for your software dollar.

High scores are saved to disk. I'd like to meet Krazy Kev, the fiend who put the high score on my disk—over 500,000 points (I've gotten about 50,000). If you plan to buy just one arcade game for your ST, this has to be it. **Time Bandit** is superb—there's no other word for it. **A**

David Plotkin owns an 130XE and a 520ST, and is currently a heavy Pascal user on the ST. His computer interests lie in programming, games and tutorials.

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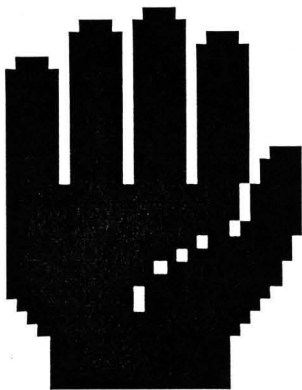
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Alert boxes from ST BASIC

**A subroutine and tutorial
to get you the help you need,
when you need it.**

by Matheu Spolin

One of the most useful features of the ST's GEM system is the ability to call alert boxes—forms that appear in the middle of the screen, displaying a question, with several buttons for input. But, if you've read through the *ST BASIC Sourcebook* in an effort to find a `Form_Alert_Box` command, your search has been in vain. To the casual user, there seems to be no way to call up alert boxes in ST BASIC.

Not so. Now, with `BOXFORM`, the subroutine presented here, calling alert boxes—of all sizes—is only a matter of defining a string, setting some parameters and calling the subroutine.

`BOXFORM` uses the powerful basic command `GEMSYS` to call AES routine 52, known as `FORM_ALERT`. This routine not only creates the alert box and gets input from it, but also closes the box and restores the former screen display.

Using `BOXFORM`.

To see `BOXFORM` in action, type in Listing 1 (in ST BASIC). If you're using TOS from disk, you may have to disable buffered graphics to employ the program. Lines 10 through 400 are part of the demo. They aren't needed to use `BOXFORM` in your own programs. The actual subroutine begins at Line 63000.

To put `BOXFORM` into your own programs, you must define `BOX$` with the text you would like to appear in the box. To separate lines of text within the string, use the logical OR character (`|`). This character is produced by striking the backslash character (`\`) while holding down `SHIFT`.

Next, the buttons you'd like to have appear in the box

must be assigned to the variable `BUTTON$`. Separate the button labels as you would lines of text, with the logical OR character (`|`).

After that, you must store the icon number in the variable `ICON`. The exclamation point, question mark and stop sign icons are numbered 1, 2 and 3, respectively. If no icon is desired, store a 0 in the variable.

Defining the variable `PRIORITY` is optional. It contains the number of the button to thicken, indicating that option may be selected by pressing `RETURN`. If you don't assign a number to `PRIORITY`, no button is highlighted.

After defining these variables, simply `GOSUB BOXFORM`. The subroutine will create an alert box, display it on the screen, read the input, then return to the main program's control. The button number which the user selected will be stored in the variable `KEYCHOICE`, upon return to the main program.

`BOXFORM` is an easy to use subroutine for creating alert boxes in any ST BASIC program. However, as with any call to GEM, passing the wrong parameters will cause ST BASIC to crash. So check your parameters carefully. Don't use any square bracket characters in your strings, and don't make any text line in `BOX$` over twenty characters.

Also, please remember that alert boxes can hold no more than three buttons. Defining a fourth will send your ST into never-never land. ■

Matheu Spolin has been writing computer programs for six years and works in BASIC, Action!, C and 6502 assembly language. He currently enjoys writing programs on his 520ST, while his 130XE runs his bulletin board system, the Towers of Darkness BBS, at (301) 656-3401.

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//Alert boxes *continued*

Listing 1. ST BASIC listing.

```

10 ' BOXFORM.BAS By Mathew Spolin
20 '
30 '
40 ' *** DEMO PROGRAM DRIVER ***
50 CLEARW 2:FULLW 2
60 COLOR 1,3:FILL 0,0
70 BOX$="Welcome to BOXFORM|By Mathew
  Spolin"
80 BUTTON$="OK|Not OK"
90 ICON=2:PRIORITY=1
100 GOSUB BOXFORM
110 ON KEYCHOICE GOTO 120,170
120 BOX$="IM glad it's OK.|Aren't you?
  "
130 BUTTON$="You Bet|No Way"
140 ICON=3:PRIORITY=0
150 GOSUB BOXFORM
160 ON KEYCHOICE GOTO 220,240
170 BOX$="Oh. That's too bad."
180 BUTTON$="Continue"
190 ICON=0:PRIORITY=1
200 GOSUB BOXFORM
210 GOTO 280
220 BOX$="That's great."
230 GOTO 250
240 BOX$="Oh well..."
250 BUTTON$="Continue"
260 ICON=1:PRIORITY=1
270 GOSUB BOXFORM
280 BOX$="Choose next operation"
290 BUTTON$="BASIC|DESKTOP|RUN THIS"
300 ICON=3:PRIORITY=3
310 GOSUB BOXFORM
320 IF KEYCHOICE=1 THEN END
330 IF KEYCHOICE=2 THEN 350
340 IF KEYCHOICE=3 THEN 30
350 BOX$="Please type QUIT at|the OK p
  rompt"
360 BUTTON$="I'll do that"
370 ICON=1:PRIORITY=1
380 GOSUB BOXFORM
390 END
63000 BOXFORM:' Subroutine to make ale
  rt box
63010 BOX2$=STR$(ICON)+"|["+BOX$+"|["
  "+BUTTON$+""]"
63015 BOX$=BOX2$
63020 A#:=GB:GINTIN=PEEK(A#+8):GINTOUT=
  PEEK(A#+12)
63030 N#:=PEEK(A#+16):POKE GINTIN,PRIOR
  ITY
63040 POKE N#,VARPTR(BOX2$)
63050 GEMSYS(52):KEYCHOICE=PEEK(GINTOUT)
63060 RETURN

```

ST CHECKSUM DATA.
(see page 56ST)

```

10 data 340, 450, 356, 735, 464, 535
, 288, 87, 764, 334, 4353
110 data 511, 820, 161, 799, 349, 52
4, 251, 278, 809, 336, 4838
210 data 404, 450, 401, 771, 271, 80
4, 357, 261, 105, 794, 4618
310 data 341, 508, 381, 322, 130, 92
1, 809, 362, 806, 962, 5542
63010 data 433, 920, 43, 273, 277, 3
01, 542, 2789

```

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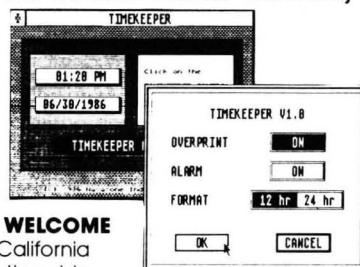
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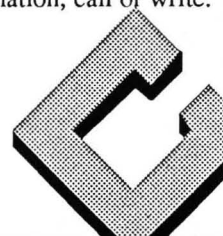
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