THE ATARI 1040ST

A *megabyte* of *memory for* $999

Editor's note: The following is a BYTE *product preview. It is not a review. We provide an advance look at this product because we feel that it is significant. A complete review will follow in a subsequent issue.*

Atari's new $999 1-megabyte 1040ST (see photo 1) establishes a price break reminiscent of the Commodore 64's. And, as table 1 shows, the 1040ST will be the first computer to begin its retail life at a price that represents less than one dollar per kilobyte. The 1040ST is clearly a bargain, with over 1 megabyte of RAM (random-access read/write memory), its operating system in ROM (read-only memory), an internal 720K-byte double-sided drive, an internal power supply, and the same features and functionality that already make the Atari 520ST an attractive purchase. [*Editor's note: See "The Atari 520ST" by Jon R. Edwards, Phillip Robinson, and Brenda McLaughlin, January* BYTE, *page* 84.]

SYSTEM DESCRIPTION

Our coverage of the 520ST adequately describes most of the features of the 1040ST (see also the "In Brief" box on page 86). The new computer has the same keyboard, the same ports (although these are now in new locations, see photo 2), and the same architecture. We remain uncomfortable with the keyboard, but the keytops are removable. We suspect that some speedy entrepreneur will provide alternative tapered keys for the ST machines.

The most obvious changes are cosmetic: The keyboard/computer unit is 2 inches deeper and 4½ pounds heavier than the 520ST, and the keyboard provides a much more substantial feel. The mouse/joystick ports are now located under the bottom right front of the unit, a significant improvement for left-handed users.

A number of changes are more than cosmetic. The internal power supply eliminates two of the external power supplies needed by the 520ST (wire haters rejoice). We left the unit on for five days and experienced no difficulties with overheating. There is no internal fan, but the unit appears to adequately dissipate heat. The internal disk drive supports both single- and double-sided disks. An RF (radio frequency) modulator will allow you to hook up the 1040ST to a television set; you might, therefore, obtain the high-resolution monochrome system for word processing and programming without sacrificing the use of low- and medium-resolution color. However, we received a preproduction unit lacking the RF modulator that will accompany the final product; therefore, we were unable to test the television quality of the computer's output.

The megabyte of RAM in the 1040ST isn't crammed into the case. The 520ST uses a custom Memory Controller chip to handle its sixteen 256K-byte dynamic RAM chips. The 1040ST uses the same Memory Controller. Because the controller can handle 32 RAM chips at a time, the Atari engineers simply had to find room for 16 more 256K-byte dynamic RAMs on the 1040ST circuit board to pump RAM capacity to a full megabyte (see photo 3). In fact, the Memory Controller can also govern 1-megabit dynamic RAM chips. Atari should have little difficulty designing an ST with 4 megabytes of memory.

Undoubtedly, the most interesting addition to this computer, apart from the extra memory, will be an empty socket for a graphics coprocessor. Our preproduction unit also did not include the socket, and it may not be offered with the first releases of the 1040ST. Phil Robinson discussed this and Atari's future plans with Shiraz Shivji, vice president of research and development for the company (see the text box "An Interview with Shiraz Shivji" on page 90).

TOS IN ROM

With TOS (the operating system for both the 520ST and the 1040ST) in ROM, the 1040ST boots more quickly than the 520ST. [*Editor's note: Atari is currently supplying the* ROM *chips to* 520ST *developers and will be making the chips available through users groups.*] Booting with a nonsystem disk takes less than 6 seconds, down from 37

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BY PHILLIP ROBINSON AND JON R. EDWARDS

Photo 1: *The Atari 1040ST.*

IN BRIEF

Name
Atari 1040ST

Company
Atari Corp.
1196 Borregas Ave.
Sunnyvale, CA 94086
(408) 745-2000

Price
With monochrome monitor, $999
With color monitor, $1199

Microprocessor
Motorola 68000, a 32-/16-bit microprocessor (32-bit internal architecture with 24-bit, nonsegmented, external data bus) running at 8 MHz

Main Memory
1024K bytes of dynamic RAM

ROM
192K-byte TOS in ROM, not including the desktop accessories

Graphics
Three modes: 640- by 400-pixel monochrome, 320 by 200 with 16 colors, and 640 by 200 with 4 colors

Sound
Three independent sound channels from 30 Hz to 125 kHz

Floppy-Disk Drive
Internal 3½-inch double-sided double-density drive with capacity of 720K bytes. System supports maximum of two floppy-disk drives.

Keyboard
94-key Selectric-style QWERTY keyboard with numeric keypad, cursor controls, and rhomboid function keys

Interfaces
MIDI in and MIDI out ports
Monitor port (supports RGB analog, high-resolution monochrome)
RF modulator
Centronics parallel printer port (supports Epson-compatible printers)
RS-232C serial port
Floppy-disk port
Hard-disk port (10-megabit-per-second DMA transfer rate)
128K-byte ROM cartridge port
Ports for mouse or two joysticks

Bundled Software
Atari Logo
ST BASIC

Optional Peripherals
SF354 single-sided drive
SF314 double-sided drive

Planned Expansion
Graphics coprocessor, SMM801 dot-matrix printer, SDM121 daisy-wheel printer, 10-megabyte fixed disk, 8-slot expansion interface, CD-ROM, local-area network for MIDI port

seconds on the 520ST. After booting, the color system displays blue and yellow crossbars instead of the multicolor display shown on the 520ST. The desktop icon also appears in much brighter green on the 1040ST, which Neil Harris of Atari explains is more effective on color television screens for those who will make use of the RF modulator.

Although it increases the time to 17 seconds, you may prefer to boot with a nonsystem disk that includes the desktop accessories. By so doing, you can maintain access to the Control Panel (to change the background color, for example), the RS-232 Port Configuration, and the Install Printer facilities. You also have the option of placing the operating system (38 seconds), and presumably any alternative operating system, into RAM.

The ROM TOS appears to be functionally identical to the first release of TOS in RAM, but there have been some additions. In the interest of supporting business applications, the ROM TOS raises the limit on open files from 30 to 100. A new dialog box informs you if you have insufficient memory to run an application. The earlier versions of TOS simply return you to the desktop. Two new GEM functions, form_button and form_keyboard, will allow developers to bring up dialog boxes without freezing the current application. You could, for example, postpone your response until you finish a task.

Most of the other changes involved crunching the code from over 200K bytes to 192K bytes (Landon Dyer, software design engineer for Atari, reports that the production ROMs are a mere 14 bytes short of 192K bytes), but there have also been a number of modifications and corrections, many in response to the experiences of ST developers. Early versions of TOS did not allow you to print from the desktop if you set your printer to the serial port. Now you can. Full type-ahead buffers will no longer eat characters. And icon grabbers can take comfort in the fact that rapid movements of icons into the menu bar can no longer crash the system.

A Sample Session

We obtained similar results on BYTE's standard benchmark tests for both the 520ST and the 1040ST. Using ST BASIC (see photo 4), both machines ran the Sieve of Eratosthenes in 85 seconds and the Calculations benchmark of 10,000 multiplication and 10,000 division operations in 32 seconds. Both formatted single-sided disks (357,376 available bytes) in 54 seconds. The 1040ST took 102 seconds to format a double-sided disk (726,016 available bytes). It took 16 seconds with the 520ST to transfer a 40K-byte file from one single-sided drive to another. It took 17 seconds to transfer the same file from the 1040ST's internal drive to an external single-sided drive.

In conducting the tests, we had two small problems. First, when we connected an external single-sided drive and took a directory of the internal drive, the 1040ST appeared to poll both drives. We got the directory we requested, but the fact that the internal drive is so quiet made it seem that we had inadvertently addressed the external drive. The whirring of the external drive was a continual annoyance.

Second, Atari's ST BASIC reserves approximately 160K bytes to buffer graphics, store arrays, and so on. On the 1040ST, with TOS in ROM and when booting with the desk accessories, you still obtain a workspace in excess of 700K bytes. On the 520ST, with TOS in RAM, we obtained a workspace of only 5K bytes. To run the Sieve, which dimensions an array to 7000 elements, we had to boot without the desk accessories (a savings of about 30K bytes), eliminate graphics buffering (an additional savings of 32K bytes), and dimension the array as an integer array. Using a real array, the 1040ST ran the Sieve in 90 seconds.

Software

The earliest critics of the 520ST bemoaned the lack of software, but the

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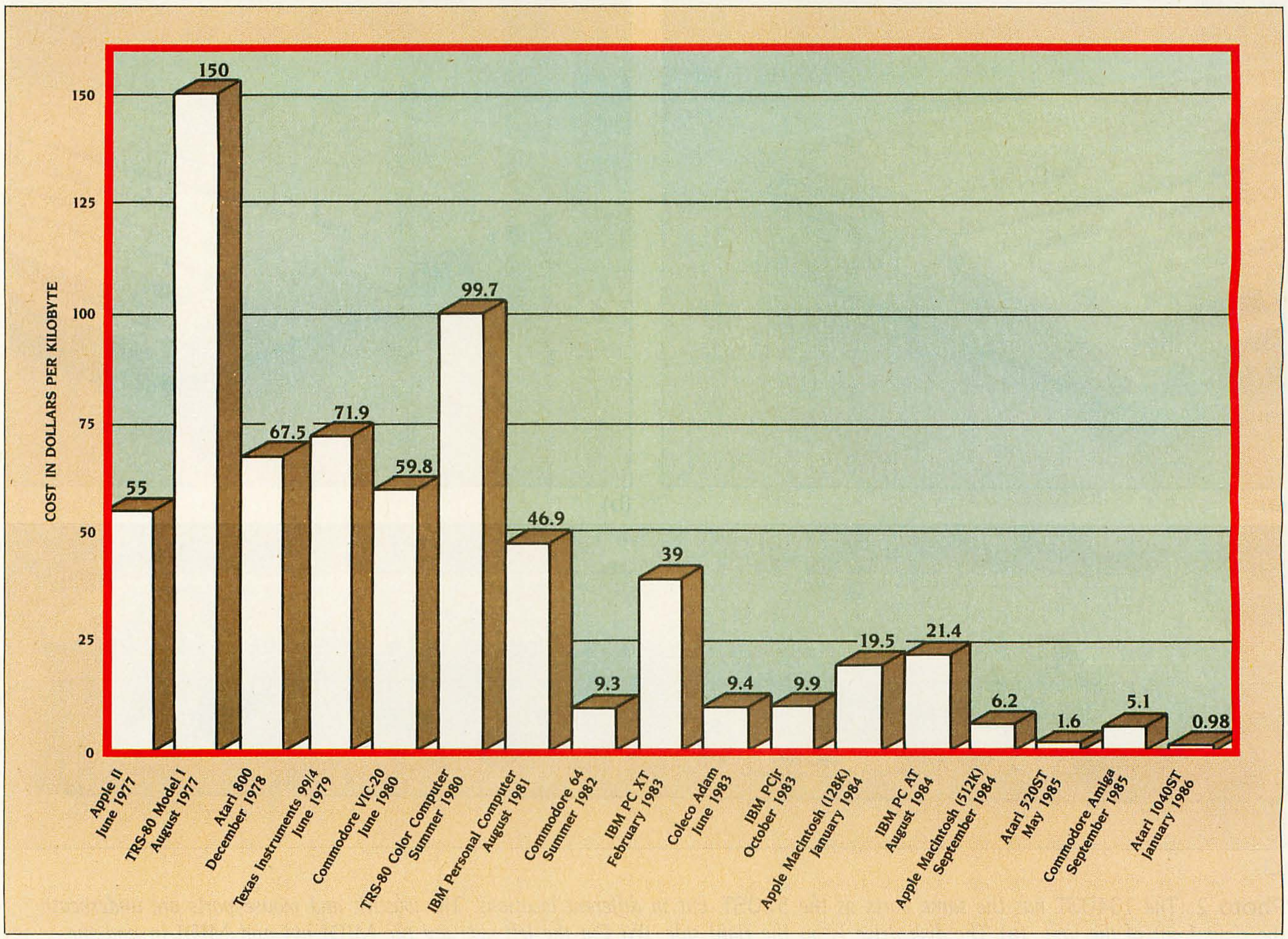

Table 1: *The Atari 1040ST is the first computer with an original list price that represents less than a dollar per kilobyte. The price-per-kilobyte figures were determined by using the original list price for each system on the chart. Prices reflect those for the original system configurations; many but not all of the systems were originally bundled with disk drives and monitors.*

list of available packages has grown and is still growing. The major criticism left is that most of the early products are ports that don't take advantage of the ST's full capabilities. A significant exception is DEGAS from Batteries Included, a full-featured paint package that makes the color monitor worth having (see photo 5).

For those of you who are anxious for information about available software: Michtron has a variety of utilities for the ST machines, including a printer spooler, a RAM disk, and terminal software. SST Systems has Chat, version 1.2, a terminal program with support for XMODEM. A variety of word processors are available, including Mince and Final Word from Mark of the Unicorn, Express from Mirage Concepts, Haba Writer from Haba Systems, Regent Word from Regent Software, and both 1st Word and ST Writer from Atari. The last of these is in the public domain. DB-Master One from Atari, Hippo Simple from Hippopotamus Software, and Zoomracks from Quickview Systems are database managers. Regent Software also offers a spelling checker with full GEM features. VIP Systems offers The Professional, a Lotus-like spreadsheet. And XLENT software offers Typesetter ST, which supports DEGAS and Neo formats and Prowriter, NEC, and Epson printers.

For some time, the Atari 1040ST will be the clear leader in price/performance.

CONCLUSION

The 1040ST has a remarkable price, and for some time it will be the clear leader in price/performance. Moreover, the graphics coprocessor chip may convince skeptics to take a second look at the ST. Some of our criticisms of the Atari 520ST remain: The desktop is less effective than the

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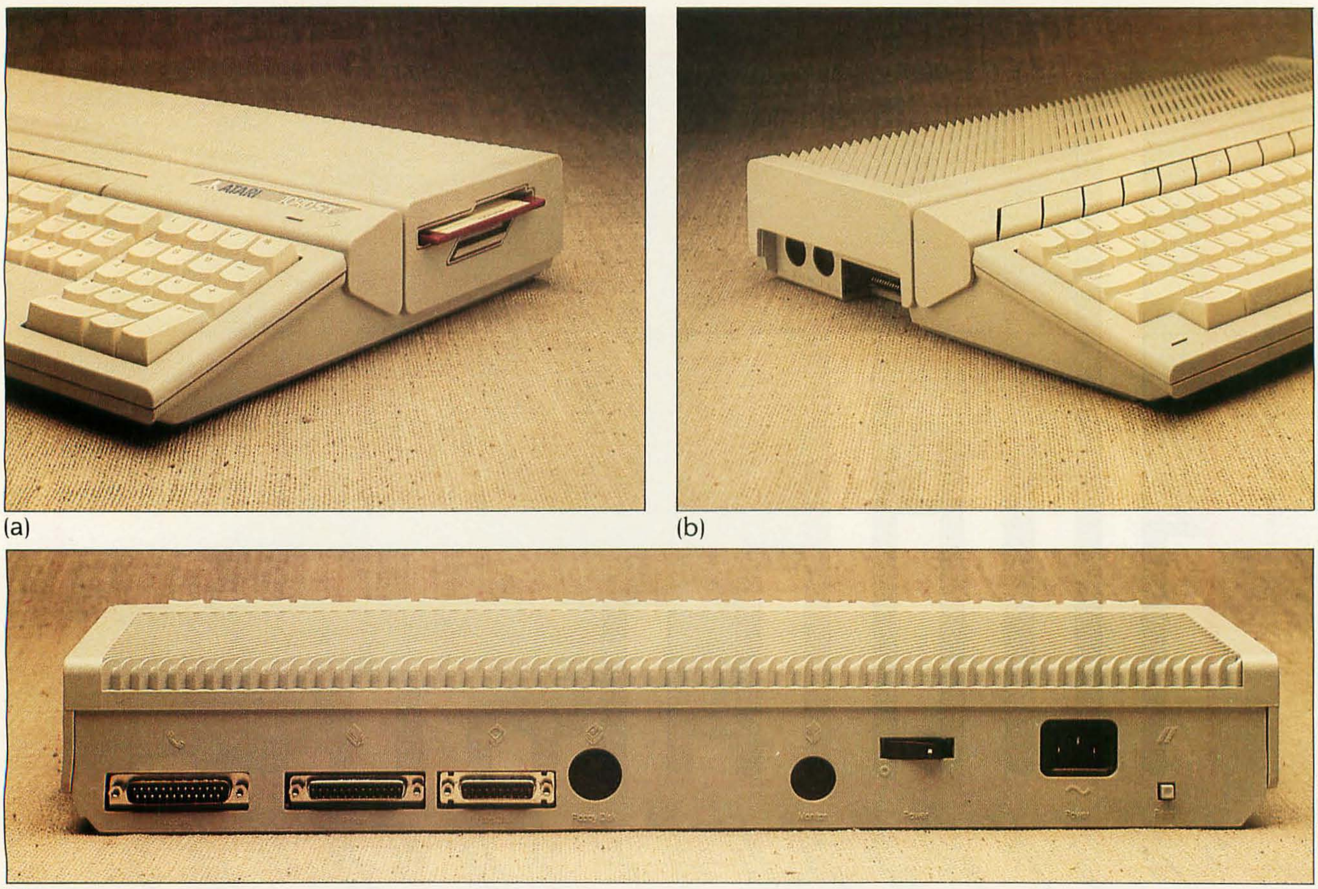


(a) (b) (c)

Photo 2: *The* 1040ST *has the same ports as the* 520ST, *but in different locations. The joystick and mouse ports are underneath the right front of the unit.* (a) *The disk drive is on the right side.* (b) *On the left side are the* MIDI *out and* MIDI *in and the* 128K-*byte* ROM *cartridge port.* (c) *From left to right on the back panel are the* RS-232C *serial port, the* 25-*pin Centronics parallel printer port, the* DMA *(hard-disk) port, the floppy-disk port, the monitor port, the on/off switch, the* AC *power connector, and the reset button.*

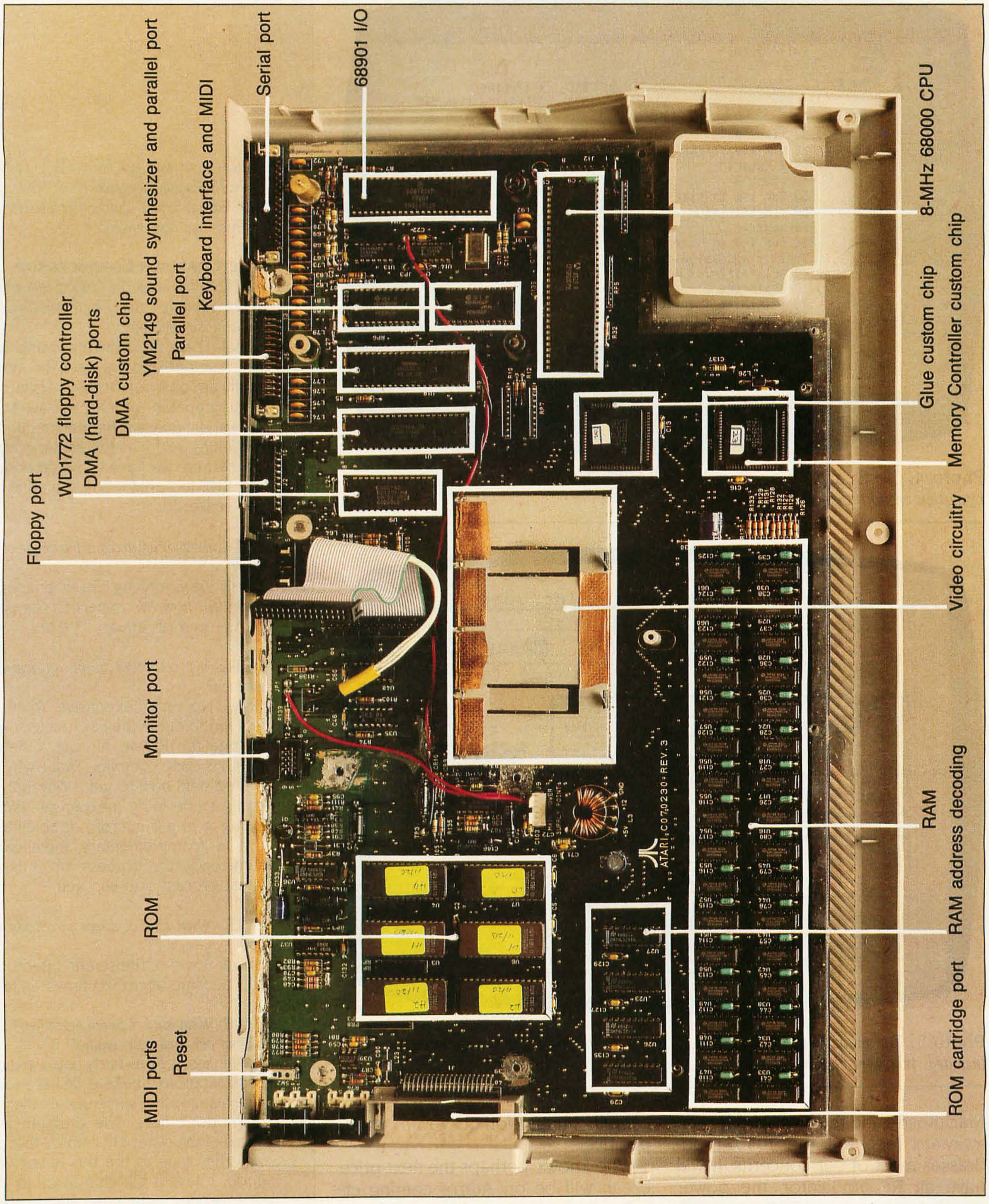


Photo 3: *The* 1040ST *motherboard.*

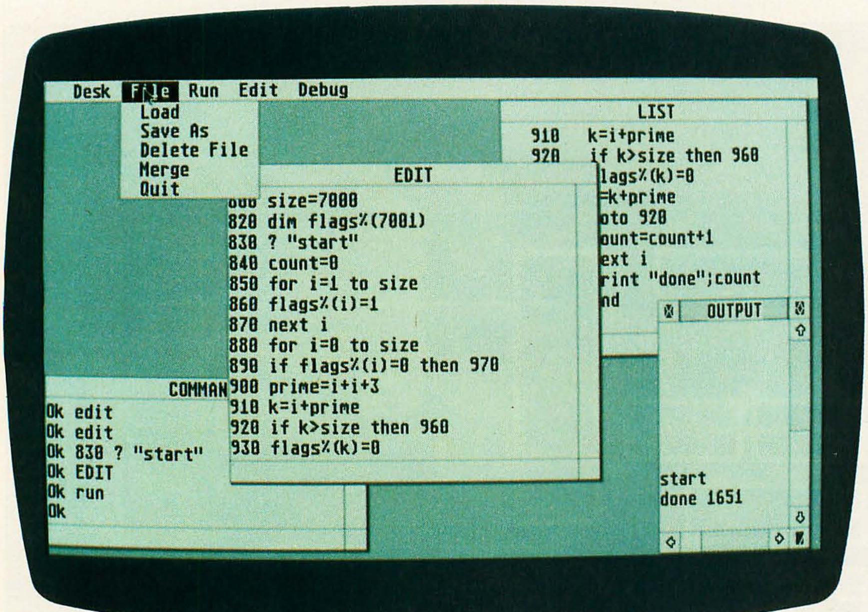


Photo 4: *The Sieve of Eratosthenes in* ST BASIC. *The screen shows the high-resolution monochrome display.*

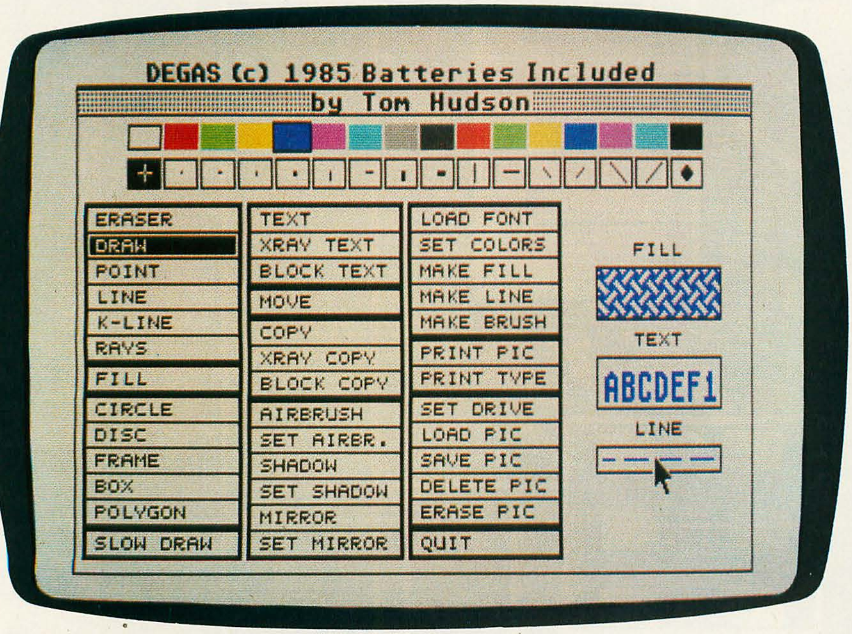


Photo 5: *The main menu of* DEGAS, *a deluxe paint package from* Batteries Included, *in low-resolution color graphics.*

Macintosh's and the keyboard has an awkward feel. But the 1040ST addresses most of our concerns. It will have an RF modulator, the power supply is internal, and TOS is in ROM. And given the outstanding price, our overall impression is even more positive.

Who knows, perhaps the next price break will be on Atari's coming efforts: 2- and 4-megabyte machines and 640- by 592-pixel graphics.

Editor's note: This text box contains portions of Phil Robinson's December 1985 interview with Shiraz Shivji, Atari's vice president of research and development.

THE GRAPHICS COPROCESSOR

BYTE: *Tell us about the graphics coprocessor. When will there actually be a socket waiting for it in the machine?*

Shivji: That's up to the marketing people, but perhaps by April or May. I really am pushing for the machines to be upgradable—at least to have sockets—and it may not happen in the first machines. As far as the engineering is concerned, we have some artwork in the 1040 footprint ready to go that has the socket for it.

BYTE: *How far advanced is the design of the chip?*

Shivji: We're running checks on the layout right now. We expect to see parts by the end of January [1986].

BYTE: *It's not going to be an expensive addition?*

Shivji: No, very inexpensive. You'll only need to put in the coprocessor and change the ROMs. It's not a simple part, it's quite complex. That's why we waited until now to get it out. But it's going to be fairly inexpensive. We're doing it in a 2-micron, double-metal CMOS [complementary metal-oxide semiconductor] process, which is the latest process you can get.

BYTE: *What kind of power will it add and how?*

Shivji: Some of the screen operations will become about 20 times as fast.

BYTE: *What kind of screen operations? Like blitting one area over another?*

Shivji: Yes, it does fairly sophisticated blit operations. I believe we have some nice features that some of the other blit chips don't have. The problem with some of the other blit chips is that the way they glue to the bus is not very good. I have a blit chip from an outside vendor right now that has just

AN INTERVIEW WITH SHIRAZ SHIVJI

CONDUCTED BY PHILLIP ROBINSON

come out, but the chip needs a lot of glue around it; in fact, it needs external counters and so on. I would say we do as much as what's in the Amiga chip, and we have some things in it that make it nice in the way it fits on the bus. The cleanliness of the architecture is very important to us. It's a 68-pin PLCC [plastic leaded chip carrier] part. It sits on the bus. It's benign unless it's activated, and then it comes over and takes the bus. But again, a lot of the things like the DMAs [direct memory accesses] are not affected because the DMA will preempt the chip; it has the same priority as the processor.

BYTE: *How does it share time with the processor?*
Shivji: It takes over stuff from the processor, but it doesn't hog it completely. We allow the processor to have a few cycles.

BYTE: *How many gates? Is it a gate array or will it be a fully custom-designed chip?*
Shivji: It will be a fully custom chip. As far as complexity is concerned, I would say it's around 20,000 transistors, so it's medium complexity. One of the things that is important in any design is how you partition things. I feel we have the best partitioning, as good as you can get. And again, it's like the early days of computers where things were hardwired and the concept of having subroutines came along. That was a tremendous breakthrough—to be able to modularize stuff. This is what I feel we've done on the ST. We are modular. For example, the blit is completely coordinate-free. We will use the same part in the new version of the ST, which is high-resolution. So, it's nice the way we can do those kinds of things and not have it tied to the machine.

EMULATING THE IBM PC

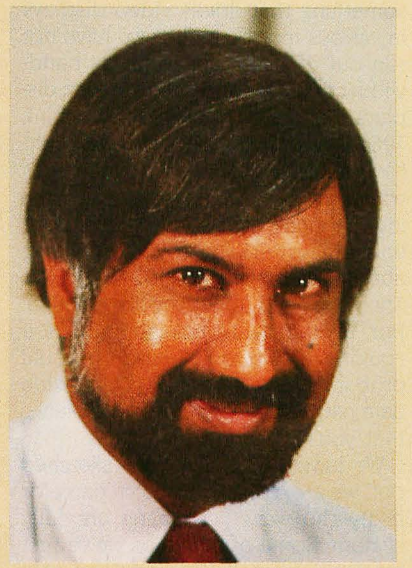
BYTE: *The V20 board that's in the lab for emulating the IBM Personal Computer—is that experimental?*
Shivji: No. We will actually show it at an upcoming CES [Consumer Electronics Show]. In fact, we can either run an 8088 or a V20. We're running it at 8 MHz, and we're going through the DMA channel to get the speed for the display.

BYTE: *You're going through the DMA channel, so this is going to be an external board in a little box?*
Shivji: It's a self-contained box with its own power supply. It will have quite a bit of its own memory. It has the 8088. It also has an 8253 because a lot of people go directly to the timers in the IBM PC. But the problem in any kind of an emulation is the speed of scrolling things on the screen because you have to effectively reproduce what is being done in the PC environment into something else, and it's very slow. We don't think it will be that slow in the case of the ST. Our graphics modes are a superset of the IBM PC's anyway.

BYTE: *Are you using some BIOS [basic input/output system] from an outside source?*
Shivji: Actually, we have the work done on a machine that provides IBM PC compatibility with the 800XL. Initially there was an Atari project that was compatible with the IBM PC, the Apple II, and the 800XL. They eventually abandoned the Apple II compatibility, but they made it compatible with the 800XL. We're essentially following from that effort; we're using a lot of software from that era.

FUTURE MACHINES

BYTE: *Will the next machine be 2 or 4 megabytes?*
Shivji: We are using the base architecture for future machines. We will have a 2-megabyte version out fairly soon, perhaps in the same case. As you know, the chip is designed to handle 1-megabit parts. If 1-megabit parts are in sufficient quantities, then today we can use sixteen 1-megabit parts; that's a 2-megabyte machine. And if you use 32 parts, which the chip is designed to handle. . . .



BYTE: *You'd just need to have a new board layout, drill new holes.*
Shivji: Yes. And as a matter of fact, it would be easy to upgrade a 1040. . . . 1-megabit parts are 18-pin parts. It would not be that difficult to upgrade your 1040 to make it a 4-megabyte machine by using 1- megabit parts.

BYTE: *How would you do that?*
Shivji: You have two banks, you'd have to remove the chips, but you could do it because it's not that difficult. In fact, we have built a prototype with 1-megabit parts.

CHOICE OF THE 68000

BYTE: *About the 68010 and the 68020. You were saying that the 68010 didn't improve ST performance that much.*
Shivji: Not as much. We designed the ST in part as a front end for a compute engine through the DMA channel. That's where we're going to put our compute engine, whatever it is. The people that have bought STs and are buying STs in the future will have the capability of expanding painlessly and using their existing peripherals and everything and get on to a full 32-bit machine such as a 68020.

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BYTE: *So you're thinking more in terms of a box out back with a 68020 in it and not of an internal 68020.*
Shivji: Yes. We now know how to do a good job in putting a 68000 as part of something that drives video displays in various modes. In fact, we have not run out of steam yet as far as bandwidth of data is concerned for even displays that are 1024 by 1024. We think 1987 is approximately when we might have another generation of machines where the base I/O [input/output] driving the video, and so on, may not be enough, especially if you're talking about 4 to 8 planes of 1024 by 1024. Then you need something like a 68020. But even that is not enough. You couldn't run just raw 32-bits. You would probably have 64- and 128-bit-wide data paths to take care of all the planes that you're talking about.

We have the architecture sketched out; we are doing the custom parts for it. By the way, these parts are fully custom. Some of the chips we've met are really huge. You wouldn't be able to do it even with semicustom. You certainly could not use gate arrays; there's no gate array built at the moment that can handle one of the chips we're talking about. It would be the equivalent of about 25,000 gates. It's also very high speed. We're looking, in some cases, to run things at about 100 MHz.

BYTE: *Do you have to go to bipolar then in the custom chips?*
Shivji: We will actually have custom chips at 2-micron, double-metal CMOS. But then there's going to be an interface chip to drive external things. The reason we can go to high speeds is because the structures we're using are very regular. There's no loading. Supposing you run a shift register. There's no loading in between cells. All you're doing with a flip-flop cell is driving another cell, and so on. You can get quite a bit of performance if you use such a structure, and we're using a similar structure.

BYTE: *And when you're at 2-micron, too.*
Shivji: Yeah, 2-micron double-metal is quite fast. So we can run close to 100 MHz, but only on a small section of the chip. Everything is not running at that speed.

CD-ROMs and Floppies

BYTE: *What about the disk memories? the CD-ROM?*
Shivji: We're waiting for audio. The first version of the CD-ROM players was a small unit; the power supply was a separate box. The second batch has a built-in power supply. Now Sony has a third batch, starting around April, which has audio as well as digital. That's the one that we're waiting for. We feel that if a customer spends $600, he might as well have audio, too.

BYTE: *What about the floppies? Is there going to be a change at some point, going to higher densities, 1.2 megabytes?*
Shivji: Two megs is almost here. The thing that's going to be important is the media, because it is special media that can handle 2 megs. Some of our Japanese friends who are drive manufacturers are working on a 10-megabyte floppy in the 3.5 format. They think that sometime around mid to late 1986 there will be 10-megabyte drives.

Multitasking

BYTE: *What about multitasking? When will that be coming as an option, or do you see that as necessary at all?*
Shivji: To get useful multitasking you have to have things like protection, which is not the case in many existing machines. Although we have protected space, as you've noticed, it's not very much. The architecture is there to provide more protection, and in future versions of the machine we may provide a lot more protection.

BYTE: *That's why you're looking at the memory-management chips and such?*
Shivji: Yes, we're looking at memory-management chips, but doing logical-to physical-address translation is perhaps not as important as the protection feature for multitasking. So we're looking closely into protection. Again, the future versions of the ST architecture could have more; we have only 2K bytes at the moment, and we could probably protect about half a megabyte. And then that would make it a lot easier to run a protected kernel and then multitask.

BYTE: *What about UNIX System V?*
Shivji: We're looking at System V now. We're constantly looking at multitasking, and we're constantly getting proposals for a multitasking environment. As a matter of fact, I think it has become a bit of a buzzword. But it is something that people now are looking forward to having in their machines. So with the amount of memory the 1040 has, it will not be out of place to have a multitasking operating system that could run, coexist with TOS perhaps, by at least the third quarter of 1986.

BYTE: *What about peripherals? Is Atari going to get in the business of printers and modems and the like?*
Shivji: Yes, we have printers. We are working on a modem. We feel that a 1200-baud modem should be inexpensive. There have been a lot of advances in technology (such as the modem chips from Sierra Semiconductor). We hope that around the middle of 1986 we will have something to show.

BYTE: *What about higher-end printers? With Atari leading this price/performance curve now, what about laser printers?*
Shivji: We started talking to the people, around the time that the laser printers came out from Apple and Hewlett Packard. We have talked to a lot of the manufacturers. We're looking at something that costs about $1200 retail, but we don't feel that it's really a mass item. Although imagine an ST in an engineering environment where you can get prints.

Yes, we were looking at it. As a matter of fact, the interesting thing is that the cost of building the ST board is so low that we were thinking of using the ST board as a driver for the printer. At 300 dots per inch, if you want to have a full page in the unit, you've got to have about one and a half meg of RAM. And we actually can support more than that. It's something that's in the pipeline. We unfortunately don't have control over the manufacturers. We actually looked at the LCS technology—the liquid-crystal shutter—which is similar to that. Casio uses that. It wasn't quite as good. Nowadays people are also pushing the LEDs [light-emitting diodes]. The company that is farthest along the line of good printers in LEDs is NEC. They have a really nice one. We've been talking to them about getting their engine for quite a while. But right now it's too expensive. We could probably get it down to about $1500 right now. We're looking more toward $1200 and then under $1000.

BYTE: *What about sound capabilities?*
Shivji: We had a project here started during Alan Kay's tenure—a chip called Amy. And the ST was designed to have the Amy. But the Amy did not happen. We had silicon, the first pass, in October or November, and we had severe problems with it. It was kind of an orphan project. There were a lot of people who had worked on it. And if you have a chip that has six or eight people who have worked on it at different times, chances of the chip working are slim. But it's a good design.

BYTE: *What does it do? What's so special about it?*
Shivji: The approach of others is that during horizontal-refresh time you go out to some place and put some memory out automatically, and that goes through a DAC [digital-to-analog converter] and you have sound. Essentially you're sampling at 15.75 kHz, which is the typical frequency. So it's like a digital tape recorder. You have a digitized sound and you're just putting it out. And it needs enormous amounts of memory. The key is: How do you encode sound? From an information-theoretic point of view, there are two problems with this approach. One is it's an enormous waste of memory. Because you could encode whatever sound you're going to play, as far as data is concerned in a sound piece, the data rate is extremely low. And doing it in the digital tape recorder way, you're wasting an awful lot of bandwidth and a lot of memory. The second problem with other implementations is that you only have 8 bits and it's not really that good. Especially with CDs coming out.

Amy was a chip that had 16 bits of information coming out. So you could have 96 decibels of range. What you could hear! Amy was a complete digital sound chip. It's called an additive-digital synthesizer. It had an adder and 64 independent oscillators. It has a model for sound and you feed it the parameters. But if you do that you have to do an awful lot of preprocessing. We had hired a lot of people. We had a VAX 780 devoted to it. We had equipment, fast floating-point array processors, and so on, to analyze notes. We would get a tape of piano playing and then the VAX would analyze it and would take the Amy model and give the parameters. To play anything you only needed to have parameter tables and feed it to the chip.

BYTE: *Is it still a possibility then?*
Shivji: It is still a possibility. We were going to have the Amy, and then it didn't happen. Then we said, look, we want to have a base machine that's a good machine. Everybody doesn't really care about great sound, right? So let's not penalize people that don't care. Let's put something that will allow people who really care about sound to be able to play things. That's how the MIDI came in. And so if you get Amy, we could even have it out as a MIDI device. It's a great chip. Essentially all you do is you load it up. Off line you're doing an analysis of all the different things, and then you have it in table form. And you can play it any time you want. And you're not using up the bus that much.

BYTE: *If it has that kind of processing capability, it could probably build models for voice, too.*
Shivji: Exactly. We actually could reproduce opera sound. As a matter of fact, we had a sound lab. The type of sound that you could hear from that chip was just incredible. Again, 16-bit. Actually, the chip could even give you 17 bits if you wanted it to. The two problems are it needs too much memory and it hogs the bandwidth. The bandwidth you could probably get around. However, that's not the whole thing. You still have to move all that data around. Of course you don't get the data at the right place for free. For example, you have to move it somehow from a disk drive.

BYTE: *So the Yamaha chip is in there just to give it the basic sound?*
Shivji: Yes, just the basic sounds you need. Though, of course, the ports are very useful. ■