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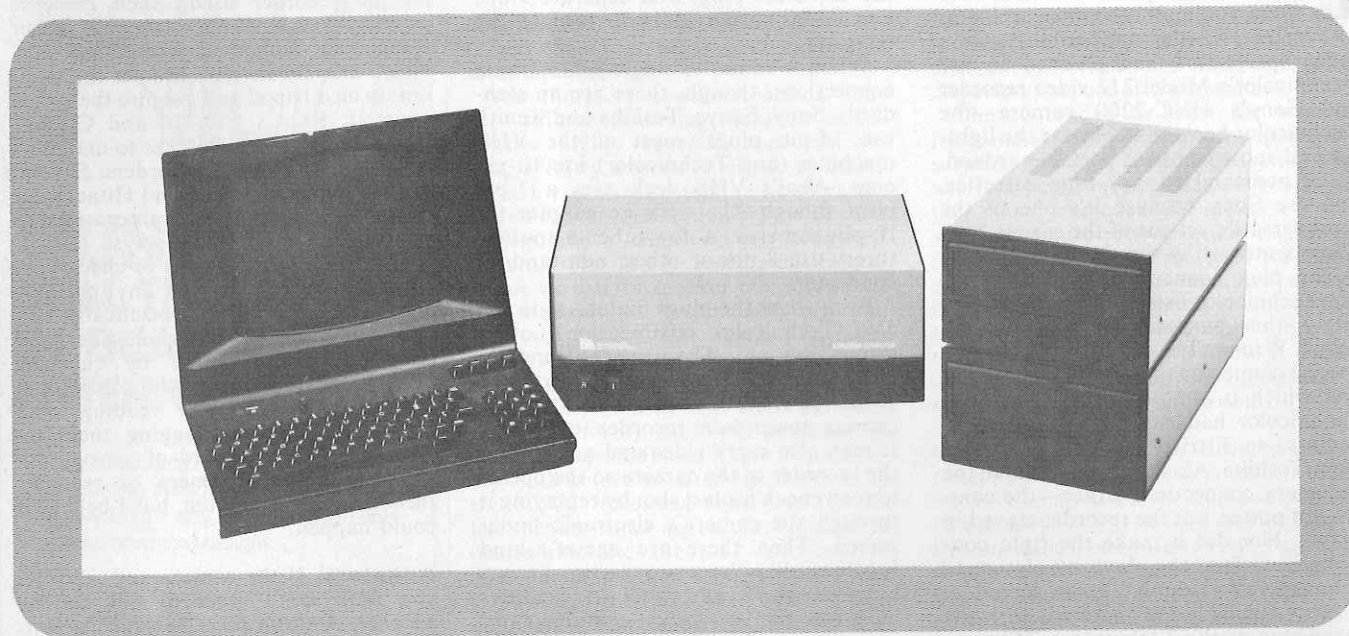
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The Netronics Explorer 85 Computer

The Explorer/85 computer from Netronics Research and Development is one of a rare breed—a simple, low-cost, yet exceedingly well-designed computer that starts as a basic kit, and can easily be expanded as the builder/user requires. Through the addition of other low-cost kits, the Explorer/85 can be expanded into an excellent and useful general-purpose computing system whose final price undercuts comparable systems.

The basic one-board system called Level-A ($129.95) contains an 8085 CPU (a "grandson" of the famous 8080) that is 100% compatible with 8080 software. It includes eight RST vector interrupts and four hardware interrupts that are automatically channeled to the monitor with a register save routine, and RAM area addresses that redirect the processor to the desired interrupt routine. The 13¼″ x 10¾″ glass epoxy board features plated-through holes with solder mask, and has provisions for serial I/O and another 25-pin socket for a hex keypad, a cassette recorder circuit with motor control, a speaker output, a LED indicator on the 8085 serial output line, a printer interface (less drivers), and four 6-bit plus one 6-bit I/O ports. The 8085 operates at 6.144 MHz. Other hardware includes a programmable 14-bit binary counter/

timer, 256 bytes of RAM at F800 that can be expanded to 4K on the mother board or to 64K via the S-100 bus.

A very useful monitor contained in a 8355 2K ROM (located at F000) includes tape LOAD/DUMP with label, EXAMINE/CHANGE MEMORY contents, INSERT data, provisions for a warm start (register save input) that is useful for breakpoint debugging, EXAMINE/CHANGE registers, single-step with register display at each break point, and GOTO execution address. Monitor routines in the terminal version (not available in the hex keypad version) can move data blocks from one location to another, fill memory blocks with a selected value, display memory blocks, select baud-rate automatically, and control variable line length (1 to 255 characters/line). Also included is a channelized I/O routine with 8-bit parallel output for a high-speed printer, and a serial console I/O so that the monitor can communicate with serial I/O ports. The monitor source listing is available. The system can be used with a conventional terminal or hex keypad. Level-A detects the baud rate of a terminal and readjusts itself accordingly.

The Level-B Expansion Kit ($49.95) provides the signals plus buffer drivers to support up to six S-100 boards. Included in this portion are the address

decoding for on-board 4K RAM expansion selectable in 4K blocks, address decoding for on-board 8K EPROM expansion selectable in 8K blocks, address and data bus drivers, a jumper-selectable wait-state generator to allow use of slow me ory, and two separate 5-volt regulators to provide stability and reduce bus noise. Besides installation information, the manual for this kit also contains a description of the S-100 bus used in this computer.

The Level-C Expansion Kit ($39.95) is mainly metalwork (card cage) that increases the number of S-100 board connectors (not supplied) to five, and also provides a trouble-shooting socket for vertically mounting an S-100 board. The metal structure mounts directly on the motherboard.

Level-D ($49.95) provides an additional 4K of on-board static RAM to the original 256 bytes in the basic system. It also has a power-supply regulator and decoupling, and requires the installation of Level-B. The additional memory can be located at any 4K block from 0000 to EFFF.

Level-E ($5.95) provides the sockets, power-supply regulation, filtering and decoupling components, and allows the use of up to 8K of 2716 or 2516 EPROMs. Jumpers are provided to allow these sockets to be used with RAM.

(MEMR and MEMW signals are available for this purpose.) This add-on requires the installation of Level-B, as well as an external +8 volts at 700 mA, unregulated.

Power for the system is provided by the AP-1 Power Supply ($39.95) that provides +8 and −8 volts dc, and 20 volts peak-to-peak ac. The output current is 5 amperes and switches accommodate both line and load conditions.

Memory expansion is via the "Jaws" S-100 dynamic RAM board with the 16K version at $149.95, expandable in 16K increments (at $50 per 16K), to a full 64K. This board takes so little power, even with 64K installed, that heat sinks are not required for the regulators. It uses the Intel D8202 arbitrator IC to keep the chip count to a minimum.

The 8″ CDC (Control Data Corp.) disk drive has a single-density capacity of 401,016 bytes or double-density capacity of 802,032 bytes unformatted, LSI controller, write protection, and an access time of 25 ms (one track).

The Disk Controller-I/O Board can handle up to four 8″ drives, uses a 1771A controller, and has an IBM-compatible data separator, two serial I/O ports with independent rates to 19,200 baud, autoboot-to-disk on system reset (allowing a full 64K byte RAM for actual program use), and operating software in a 2716 EPROM.

Software is Microsoft BASIC ($64.95) which requires Level-B and 12K of RAM, or the BASIC comes in ROM ($99.95) which requires Levels B and E and at least 4K of RAM. There is a disk version at $325 that requires Level-B, 32K of RAM, a floppy disk controller ($199.95), and an 8″ disk drive ($499.95). The disk can be housed in a metal cabinet with the disk power supply ($69.95) with the required cables at $25. CP/M 2.2 is available for $150.

The system we built consisted of Levels A and B, the disk controller, two double-density, single-sided CDC 8″ drives, the necessary cables, power supplies, and metal enclosures.

The system was constructed in accordance with the information in the manuals—which was just about equal to the task. A couple of phone calls to the plant were necessary to clarify a couple of points.

Since the disk controller contains the start-up (from RESET) utility in ROM (and also contains the ports for the printer and terminal), we elected to use the full 64K Jaws board ($299.95). Although Netronics has a terminal kit, we used a Heath H-19 terminal and a Teletype Model 43 printer.

Once the system was interconnected, power was turned on. We installed the CP/M diskette, hit the RESET pushbutton on the front panel of the Explorer,
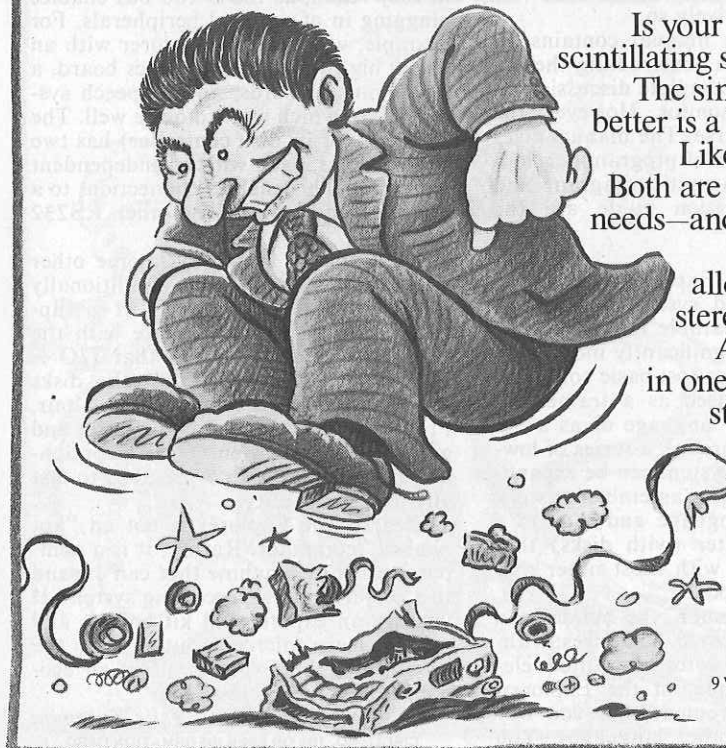
and the CP/M signed on immediately.

The computer enclosure houses the mother board, the S-100 bus expander, the small power supply, and a ventilating fan. Since, after many hours of use, the computer barely got warm, we disconnected the fan to quiet the tiny noise it made.

Evaluation. Since, in this configuration, the Explorer is a dedicated CP/M machine, we elected to challenge it with WordStar/MailMerge that contained a large number of files that we use at our computer club. As users of this word-processing software know, it really exercises the disk drives. The Explorer performed well, with typical Z-80 execution speed, and the CP/M, a disk operating system, behaved as it should.

Since, in our experience, the limiting factor in using a computer of this type in extreme environments is operator comfort, we decided to limit temperature stresses to those that would make a typical human surrender. To check high-temperature operation, we used hair dryers, one aimed into the computer housing and the other at the disk-drive housings. With the internal temperature of the housings at 105-110° F, the system went about its business free from problems, churning out form letters and spinning both disk drives merrily. Then we positioned the Explorer and its disk

drives in the direct blast of an air conditioner, where the temperature was 55°F. Once again, the system ran without a hitch. Using a variable transformer, we varied the power-line voltage between 105 and 123 volts, still causing no problems.

Like many other disk-drive manufacturers, CDC feels that too many programs have been "bombed" by the operator's pounding on keys before the drive had finished its job, so these disk drives do not have a LED indicator to show

buy what you need. While construction of the Explorer/85 is not particularly arduous, it does require some previous kit-building experience.

Looking into the computer enclosure can be quite a shock, as there seems to be almost nothing there. The large mother board contains a small handful of chips, and there are only two plug-in boards on the S-100 bus—the 64K Jaws board and the disk controller board, as compared to a typical computer's seven boards. Such sparseness of components
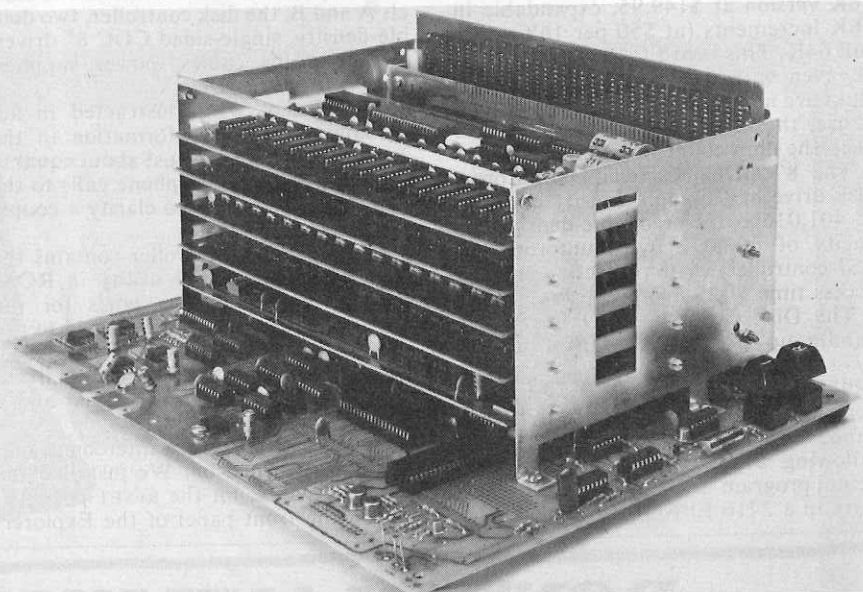
Fully expanded Explorer with levels A, B, C, D, and E.

disk activity. The user is expected to wait until the cursor (or other screen action) shows up as a positive indication that disk activity has ceased. The CDC drives are a little noisier than some others but not excessively so.

The instruction manual contains all the information on constructing the basic system and a complete discussion on the use of the monitor. However, the information is sparse. The manual gives but one illustration of program development, and a schematic diagram and component-installation guide are the only illustrations.

Comments. The Explorer is an excellent, well-designed system whose performance is comparable to that of machines that cost significantly more. You can start with a low-cost basic computer kit that can be used as a trainer for learning machine language or as a device controller. Through a series of low-cost add-ons, the system can be expanded to a resident editor-assembler to work with assembly language and then to a full-blown computer (with disks) that can hold its own with most other machines on the market.

Using this approach, the builder can configure the system as he desires, without having to pay for unwanted elements. For example, in the Explorer, there is no requirement that you buy BASIC (or any other language). You

should contribute to reliability. An old engineering maxim has it: "that which you ain't got, ain't going to hurt you."

A wide variety of applications is within easy reach, as the S-100 bus enables plugging in of optional peripherals. For example, we used the Explorer with an S-100 high-resolution graphics board, a set of music boards, and a speech system, all of which worked quite well. The Explorer (or its disk controller) has two RS232 ports, each with an independent baud rate. This enables connections to a terminal and printer (or other RS232 device).

The Explorer system has some other appealing niceties not traditionally available. For example, CP/M is supplied with patches to operate with the CDC drive's controller so that I/O is automatic. This means that the disks can be simply plugged into an old Altair, Processor Tech, or similar computer and give turnkey operation. Also, the optional CP/M comes with a program to test any disk for quality.

Clearly, the Explorer is not an "appliance" computer. Rather, it is a computer learning machine that can expand to a powerful data-processing system. If you are an experienced kit builder and want to learn microcomputing from the ground up, the Explorer offers an economical way to do just that.

—_Leslie Solomon_

CIRCLE NO. 102 ON FREE INFORMATION CARD

COMPUTER BITS

By Carl Warren

Sweeten Your Apple

IF YOU have an Apple II Plus and are anxious to sweeten it up a bit, here are some items to consider.
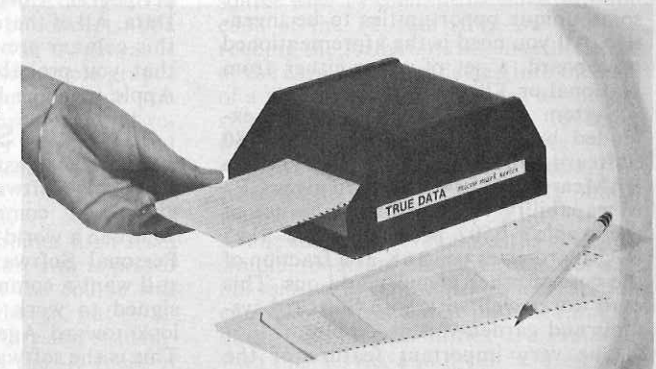
I. Hardware

From **Epson**, comes the **MX-100 full carriage dot-matrix printer.** This $945 unit sports a print rate of 80 cps bidirectionally and can handle bit-image graphics with a density as high as 120 dots per inch on the horizontal axis. It also permits double-emphasized characters (8x18 matrix) and can support as many as 233 characters per line in the compressed-character mode.

The standard MX-100 has a Centronics-style, 8-bit parallel interface with RS-232 and IEEE-488 optional. The normal 1K buffer is expandable to 2K, and the print head is disposable—one of the key features of Epson printers.
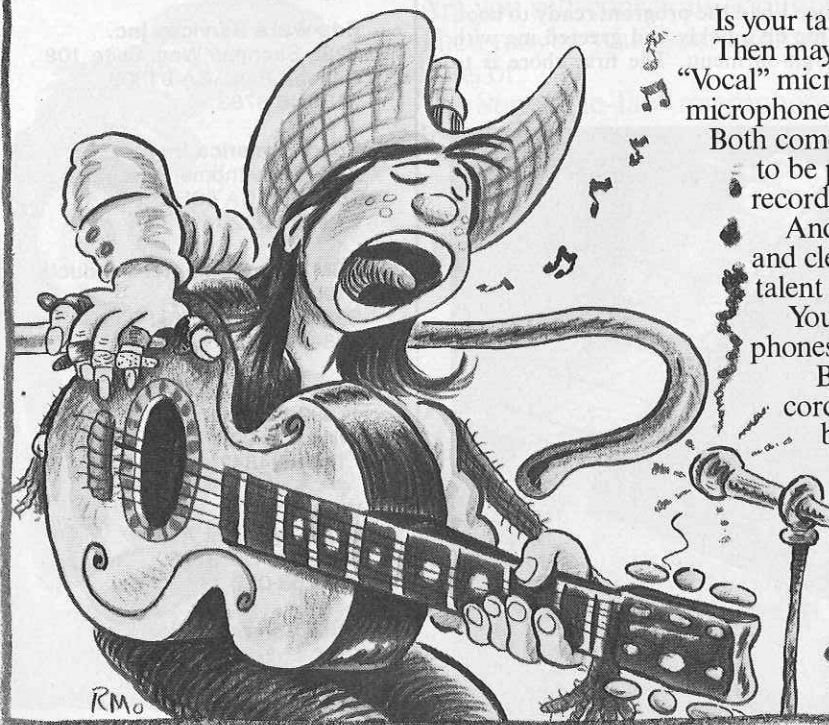
To improve throughput, consider adding **Vista's Model 150 type-ahead buffer.** This $49.95 module is compatible with all Apple II computers and software and is attached simply by plugging

it in between the keyboard and the system. Model 150 provides a 40-character buffer for entering commands. This add-on is almost critical if you're planning to use an Apple for data input.

For developing innovative applications, think about adding a _prototyping/hobby card._ This handy $24 item from Apple is available at most Apple dealers and can be used to build up any circuit you might need.

Vista also offers the **Vision 80**, an 80x24 video card, for $350. This plug-in has both upper and lower case and, when working in tandem with some of Vista's PROMware, can even produce impressive script displays. With the proper drivers, the card can be used in

The Micro Mark I card reader from True Data Corp. is a low-cost ($900) alternative to volume data collection.

concert with either a plotter or graphics printer for making hardcopy of the scriptset.

The **Videx Videoterm** 80x24 video board at $345 supports inverse video, alternate character sets, and graphics symbols. Apparently, you can contact Videx and they will provide a unique character set off the shelf or, for a price, create one to your specification.

To give voice to the Apple, the **Vista Vocalizer** should be available soon for about $250. It is based on National Semiconductor's DT-1050 speech processor.

I think it might be interesting to develop software that talks to you—especially if it's asking for data input. And, in general, the speech area offers some unique opportunities to be inventive. All you need is the aforementioned protoboard, a set of chips either from National or TI, and time to play.

System capability can be easily extended by attaching **Microsoft's Z-80 Softcard** and adding memory with **RAMcard.** The $349 Softcard gives CP/M capability without losing the use of the Apple's 6502 processor. The $195 RAMcard gives you 16K at a fraction of the cost of other memory add-ons. This card works well with both Softcard systems and garden-variety Apples.

One very important feature of the Microsoft cards is that you have the ability to upload and download CP/M compatible software from other systems. In addition, you can use a number of the sophisticated communications packages written for CP/M.

To connect your Apple with the world, you need either a serial or parallel interface—preferably both. **SSM's AIO serial and parallel Apple interface** is a likely candidate. This $195 Apple bus card supports switch-selectable serial rates from 110 to 4800 baud. Rates as high as 19.2K baud can be achieved by changing hardware jumpers. This serial port is

ideal for setting up communication with a modem.

To make the board flexible, an 8-bit parallel port is included to support a variety of printers including the Epson MX-100. To use the parallel interface, you'll have to part with another $25 for the ROM that supports the printer of your choice.

Although you can get a communication board designed just for the Apple bus—the **Hayes Microcomputer Micromodem,** for example—you may want to consider either the board from SSM or the Apple serial board, and use either an acoustic-coupled modem such as that available from **Tek-Com** or a direct-connect modem like those from the **Microperipheral Corporation** or **Universal Data.** All of these have been discussed in this column previously. We have found that you probably should consider the Apple with the Hayes board wired in.

II. Software

In the August column, I mentioned **Personal Software's Visiterm,** which gives you communication ability—if you're in a world that is compatible with Personal Software. If you're not, and still want a communication package designed to work with the SSM board, look toward **Agent Computer Services.** This is the software house I wrote about last year that does all that neat graphics ware for the OKI printers. It has come up with a humanized communication package called **The Buffered Modem.** This program, written in Apple BASIC, is priced at $85, is delivered on a 13-sector Apple disk (conversion to 16-sector takes about 3 minutes), and permits configuring the system to whatever you have on the bus including the Hayes board, a wide range of video display boards, and several printer interfaces.

Once I had the program ready to boot, it came up quickly and greeted me with the sign-on menu. The first chore is to

configure the package to your system, and everything in the screen display and manual directs you toward this end. You must, however, know what slots contain the various cards.

A really nice feature of Agent's software is that when you choose a menu item, the program doesn't just take off, but asks again if you're sure. The same philosophy is used on the control codes that turn various functions such as the printer on and off. You must precede that function with a control-A to signal the software that the next command is a valid control command.

A potential problem you should be aware of is that if you are using an **Apple Silentype printer,** you'll be unable to download files directly to the printer without losing characters. The reason is that printers like this (or software intensive cards) make use of the system's 6502 processor. As a result, the data stream gets ahead of the output and everything gets dumped. The solution is to download the file and save it on disk (the program is very clear on how to do this), then dump it to the printer.

With a full-size (15.5-in.) carriage, the Epson Mx-100 dot-matrix printer comes standard with raster graphics and almost letter-quality printing.
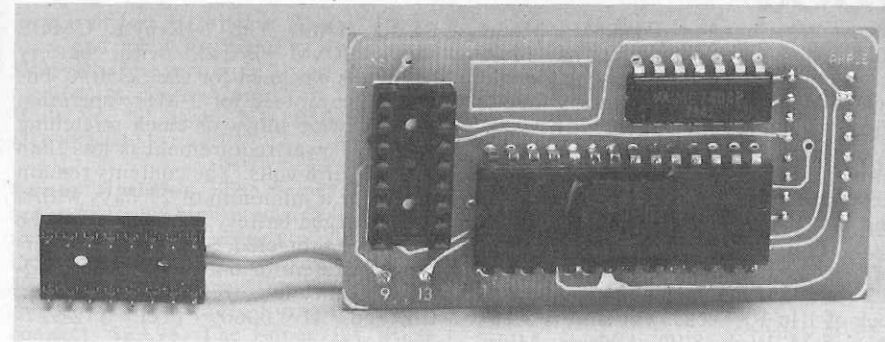
Vista's Model 150 provides a 40-character buffer for the Apple.

Currently, the Buffered Modem only permits the up- and downloading of text files without checking or referencing. In a later version, the ability to send packets of information, either sequential or random files, with error checking, will be available. Moreover, this updated version will be able to handle track-by-track or sector-by-sector transfers. Since this is still in the works, you'll need to contact Agent Computer Services directly for more information.

One of the mainstays of this machine has been courseware for Computer Aided Instruction (CAI). One company that has been harvesting the fruit of this growing market is **Edu-Ware.** It is dedi-cated to developing software designed to teach skills, techniques, or concepts. The program supplied us was Algebra 1. This unique program uses Apple graphics and numerous menus to guide you through the algebraic problems and solutions. Set theory is covered, and chances to check your skills are provided with the program.

To maintain interest, if not excitement, the program combines high-resolution graphics and color, and is priced at $39.95. I found that the course was interesting in its basic design, but problematic for even the interested student. The main annoyance is the slowness of the program. Moreover, to avoid at least

one notable omission, the authors could have used graphics to represent sets and demonstrate an intersection. Since Apple tells you the machine's secrets, such as the location of the disk drivers, they could have been turned on early to speed things up, and more frames could have been loaded at a time. Nonetheless, Edu-Ware's effort is laudable.

Further enhancing the Apple as a teaching machine is **True Data Corporation's Micro Mark I** hand-fed card reader. This unit, priced at $900 with a serial interface, is designed to read cards for collecting data on test scores, and the like. The unit reads marks that are made with a pencil and relates them to specific spaces. The read head contains a light source and 14 phototransistors (one for each of the 12 data rows and one for reading the format marks on either edge of the card). Light reflected into the lens of a phototransistor is defined as the no-signal condition. When the reflected light level drops due to a data block (pencil mark, preprinted mark, or punched hole) the corresponding phototransistor yields a signal output.

The software development is basically simple, requiring only the transistor signal relative to position. This information can then be translated into meaningful data. Lots of possibilities are available with this device, and it can be used with almost any system. ◇